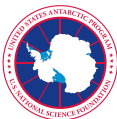


UNITED STATES ANTARCTIC PROGRAM

Field Manual



Continental Version 2027



This manual was prepared for the U.S. National Science Foundation (NSF) Office of Polar Programs by Antarctic Support Contract (ASC) field area and other personnel. It brings together decades of first-hand field experience in Antarctica with the United States Antarctic Program.

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Please send suggestions and corrections to DEN-FieldSafety@usap.gov.

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Emperor penguins,
McMurdo Sound

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PROGRAM INFORMATION

U.S. National Science Foundation Introduction

The “United States Antarctic Program Field Manual” provides an overview of field logistics, operations and safety within the U.S. Antarctic Program (USAP). It contains information relevant to living and working in an Antarctic field camp and is intended to enhance your success in the field. This reference manual provides valuable knowledge. Read it before deploying, and take it into the field with you. It is your responsibility to be familiar with the skills and techniques covered in this manual.

The harsh conditions encountered in the field setting, coupled with the need to conduct important scientific objectives in short periods, require effective leadership and constant risk management from all team members. Safety, environmental stewardship and your health are of paramount importance. Continued vigilance and action in these areas are essential.

This manual is designed to be used with the “U.S. Antarctic Program Participant Guide” available at <https://www.usap.gov/travelanddeployment/541/>. The participant guide provides general programmatic information that complements the field manual. Using these materials and adhering to their guidelines will enhance your safety and productivity while working in Antarctica.

We wish you a safe and successful field season.

Jean Cottam Allen, Acting Director, Office of Polar Programs

Sarah Ruth, Section Head, Antarctic Sciences

Stephanie Short, Section Head, Antarctic Infrastructure and Logistics

Emergency Management

An essential part of field planning is anticipating emergencies. The Emergency Operations Center (EOC) is on call 24/7. The EOC is initiated by the U.S. National Science Foundation (NSF) station manager after receiving initial information from U.S. National Science Foundation McMurdo Station Central

Communications (Central Comms). Central Comms staff 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 information 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 search and rescue team (JSART) comprising USAP and Antarctica New Zealand personnel.

Who to Contact

If an emergency occurs, contact Central Comms.

Central Comms Emergency Numbers

Type	Number
Phone	x42586
VHF Radio	Channel 3
HF Radio	7.995 MHz 11.553 MHz
Iridium	00-8816-763-12464
HF = high frequency. MHz = megahertz. VHF = very high frequency.	

For non-emergency numbers, see the Communications section. For a medical emergency, call McMurdo Medical.

When an emergency call is made, the person answering the phone 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. No emergency looks the same, so this manual cannot pinpoint specific courses of action. But the following information provides field party members with resources to help manage incidents in the field.

Emergency Response Guidelines

When responding to an emergency, first survey the scene. Is it safe for you as a responder? What happened? How many

people are involved? Assess the situation, and determine if the emergency is mechanical/logistical or medical. Gather as much information as you can before jumping in. Emergencies by nature can be confusing and complex. As we like to say in the mountains, go slow to go fast!

Mechanical or Logistical

Problem-solve to the best of your ability.

Medical

1. Conduct a primary assessment using the ABCDEs:
 - A**irway
 - B**reathing
 - C**irculation
 - D**isability
 - E**xposure
2. Provide necessary first aid to stabilize the patient.
3. Radio for help if needed. Alert other field team members of the situation.
4. Call Central Comms to give an initial report of the following:
 - A. Patient's condition (if applicable)
 - B. Plan of action
 - C. Resources or support needed
5. Establish a callback time with Central Comms.
6. Perform a secondary assessment.
 - A. Interview the patient.
 - B. Take vitals.
 - C. Conduct a head-to-toe physical assessment.
 - D. Continue monitoring.
7. Provide care and comfort.

- A. Keep the patient warm, dry and sheltered if possible.
 - B. Reassure them and offer food or warm liquids, if appropriate.
 - C. Improvise toilet equipment if needed.
8. Prepare documentation.
- A. Take detailed notes throughout the incident.
 - B. Complete a subjective, objective, assessment, and plan (SOAP) note. (A SOAP note is an organized way to take notes about a patient. See the References section for a template.)
9. Conduct an inventory of available resources.
- A. Other people
 - i. Define roles and responsibilities. Check in with team members to determine who will do what while the situation develops.
 - B. Standard operating procedures
 - C. Wilderness Medical Guidebook
 - D. Deep Field Camp Medical Manual
 - E. NSF McMurdo Station medical team
 - F. Equipment (e.g., first aid, medical, mechanical)
10. Decide and plan.
- A. With the EOC's assistance, a decision will need to be made.
 - i. You are on the ground and best able to determine how outside parties can help.
 - ii. Have a list of questions and requests ready for the EOC.
 - iii. Determined what you need to immediately stabilize the situation.
 - B. Continue monitoring the situation by documenting, clearly communicating to your team and establishing regular check-in times.

11. Reporting

- A. Notify the appropriate manager and other involved parties about the incident.
- B. Complete and submit the required incident report as soon as possible. (See the References section for a sample of the Emergency Incident Worksheet).

PRO TIPS

- Be prepared before making a call to Central Comms. Phone calls from Iridium or Starlink can drop or cut out momentarily. Have a concise message ready when first establishing a call.
- Prepare focused questions.
- Be ready to take notes, or have someone available to do so.
- Have your documentation ready. Use the Emergency Incident Worksheet as a guide to help organize thoughts.
- If possible, have a plan ready to share.
- Understand the urgency of the situation.
- Know your location.
- Understand and communicate weather and terrain factors.
- Understand the timetable for evacuation.
- State requests for any additional needed resources (e.g., gear, food, support).
- Be prepared with a backup plan.
- Determine timelines for continued communication with Central Comms.

Response Timeline

Emergency response times will vary by location. See the next flowchart for details by location.

Three groups monitor the below types of travel when there is a missed check-in or distress call.

Central Comms		Firehouse	Scott Base
Foot Travel	Fixed Wing	Foot Travel	Assist Requests
Local Vehicle	Field Camp	Local Vehicle	
Vehicle Traverse	Other Stations	Vehicle Traverse	
Helicopter	SAR Satellite Beacon	Other Stations	

▼ Missed Check-in or Distress Call

▼ Uncertainty Phase

05 min	Foot Travel or Local Vehicle
15 min	Helicopter
30 min	Fixed Wing
60 min	Field Camp or Vehicle Traverse

EOC team notified
Pager 365
EOC established
SAR team notified

▼ Alert Phase

30 min	Foot Travel, Local Vehicle or Helicopter
60 min	Fixed Wing
2 hr	Vehicle Traverse
6 hr	Field Camp

EOC activated
SAR team
USAP SAR pager 568
JSART pager 567
SAR members report to designated areas
Briefing sheet completed

▼ Deployment Phase

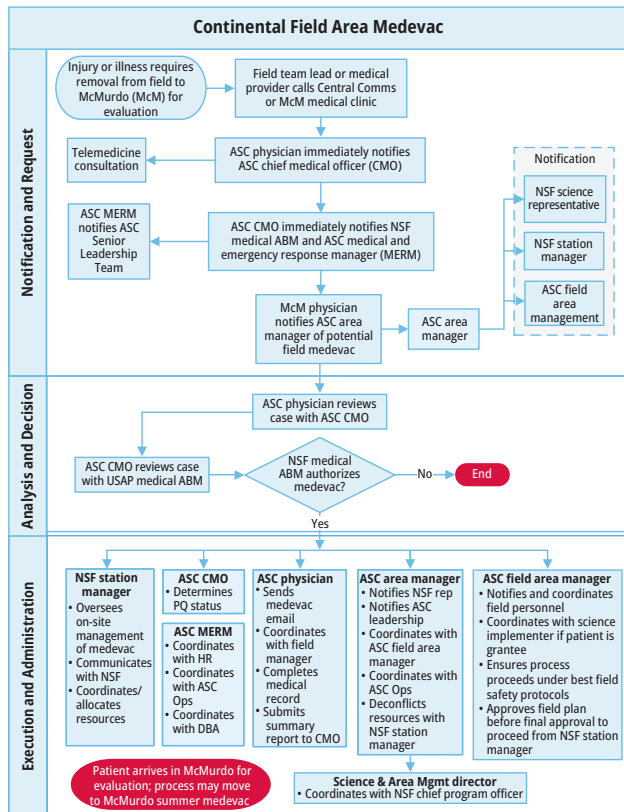
60 min	Foot Travel, Local Vehicle or Helicopter
90 min	Fixed Wing
2 hr	Vehicle Traverse
24 hr	Field Camp

SAR team deploys

■ Recovery and Debrief

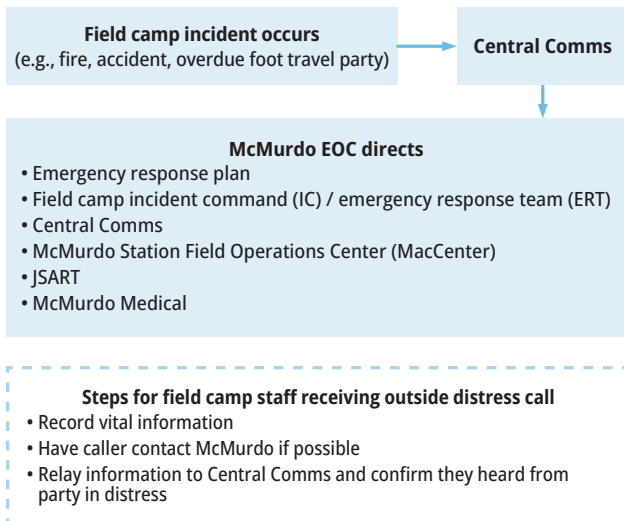
Medevacs

A decision about the need for a medical evacuation (medevac) will be reached with guidance from McMurdo Medical. Medevacs require considerable resources and involve many stakeholders to successfully execute.



Field Emergency Planning

Response to an emergency in the field could take from an hour to several days, depending on a variety of factors. While multiple resources are available to provide support via communication devices (e.g., Central Comms, SAR, Medical, Field Safety), field teams must be prepared to manage people and the situation until help arrives.



USAP Operational Risk Management

The following risk matrix is used across USAP to help determine the probability of an incident and the consequence level. During planning, this matrix can be utilized to reduce the overall risk of a project while balancing goals, priorities and logistics. In the field, this tool can be used daily to discuss hazards as they are encountered.

Risk Matrix

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

Note: None = No degree of possible harm. Trivial = Incident may take place, but injury or illness is unlikely or will be extremely minor. Minor = Mild cuts/scrapes, mild contusion, minor burns, minor sprain/strain, etc. Major = Amputation, shock, broken bones, torn ligaments/tendons, severe burns, head trauma, etc. Death = Injuries that can/do result in death if untreated in a reasonable time.

USAP also uses the six-step risk assessment as a way to help define what the team is doing, whether for a day trip, activity or entire field season.

USAP Six-Step Risk Assessment

No.	Step	Task
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?

It also helps teams understand the emergencies that may arise given the field work and location and plan for them accordingly. The risk assessment is highly useful in early

season discussions to ensure the team has a shared understanding of goals, objectives, hazards and how handle them in real time, all of which is essential to effective RM.

Emergency Response Planning

Before deploying, it is important that all team members understand what to do in emergencies. While this manual offers useful guidelines, teams must discuss likely scenarios, available resources and what managing emergencies would look like for them, so each person can make wise decisions in such situations.

Questions to Consider

- What are the roles and responsibilities of each person? Consider medical, technical and communication skills.
- When will you be furthest away from additional resources (e.g., other camps, groups)?
- Where do you anticipate your highest level of hazards?
- Is there anything unusual you can anticipate?
- How will extreme weather affect your plans, and what are your thresholds for weather?
- Where does emergency gear live (e.g., first aid, communication resources, paperwork that could be helpful in talking you through steps to responding to an incident, mechanical backups)?
- Establish relationships with people you would rely on in an emergency. Before going into the field, introduce yourself and your team to emergency contacts and make time to meet face-to-face with Central Comms, McMurdo Medical and SAR.

Scenarios to Discuss

- High likelihood / low consequence
- High likelihood / high consequence (entirely avoid or actively mitigate these, which hopefully are few)

- Low likelihood / high consequence
- Low likelihood / low consequence

Survival Bags

All field parties traveling off established roadways beyond McMurdo town limits or away from any camp in the deep field, as well as passengers who disembark a helicopter at any location other than an established field camp, are required to bring survival bags. The survival bag is designed for use in emergencies where parties may be stranded away from McMurdo Station or a field camp for longer than planned.



While the bag is designed for survival purposes, it could be used in medical emergencies. The bag contains emergency shelter, a sleeping bag, a stove and minimal food and water. The bag does not negate the need for each participant to pack their own day pack with extra clothes and warm layers, water, food, personal medications, lip balm and sunscreen.

A survival bag is for backup. Do not rely on it for gear you plan to use during the day. Keep the bag sealed unless you need it for an emergency or survival situation. A tag on the inside of each bag lists its contents. If a survival bag is used, it should be returned to the Berg Field Center (BFC) and tagged with the missing and used items.

Survival Bags

Bag Type	Local	
Appearance	Shiny red dry bag	
Not Required	Within McMurdo town limits or on established roadways (e.g., Phoenix Road, Williams Field Road)	
Required	For travel off established roads past McMurdo town limits (e.g., Cape Evans, Cape Royds, Windless Bight)	
Supports	2 people for 3 days	
Contents	2 sleeping bags 2 bivvy bags 2 Ensolite pads, 24" × 48" 1 mountain tent (w/ instructions and repair kit) 1 collapsible snow shovel 1 snow saw 1 first-aid kit 2 white gas bottles (20 or 30 oz in Ziploc bag and polyvinyl chloride [PVC]) Tent Stake Bag 10 assorted stakes 2 ice screws 0 or 1 snow fluke 1 hammer Cook and Stove Set Bag 1 cook set 1 or 2 pots w/lid	1 signal mirror 1 MSR WhisperLite stove (w/instructions, repair kit, and 4 35-match boxes) wrapped in foil Toilet Paper Bag 1 toilet paper roll Food Bag 6 dehydrated meals 3 large or 6 small chocolate bars 12 assorted tea bags 12 hot chocolate packets 2 packs of 9 Mainstay food bars (2 bars/person/day) or 10 Bumper Bars Utensil Set 1 pot handle 2 hard-plastic mugs 2 spoons

Bag Type	Local	
Contents (continued)	1 tube/bottle burning paste wrapped in foil 1 pocketknife Clothing Bag 1 bag of miscellaneous clothing (e.g., hat, mittens, gaiter)	Ziploc Bag 0 or 1 book or game 1 survival manual 50' of paracord 1 contents list
Notes	Bag contains all components. Open only in emergency.	

Bag Type	Deep Field	Helicopter
Appearance	Shiny blue dry bag	Orange bag
Not Required	For travel via LC-130, Twin Otter, or Basler to fixed camp (aircraft carries bags for all passengers)	If disembarking helicopter at fixed camp, location with survival cache, or tent camp with all survival bag components
Required	When traversing away from any fixed camp (usually daily)	If disembarking helicopter at any other location
Supports	2 people for 3 days	2 people for 3 days
Contents	Same as local survival bag EXCLUDING white gas bottles and book/game	Same as local survival bag
Notes	Bag excludes fuel bottles, which cannot be flown on LC-130s. Obtain bottles from the BFC, then have Science Cargo hazardous-certified them. Add fuel from camp stock to bag.	Bag contains all components. Open only in an emergency.

Survival caches provide emergency supplies and are staged at fixed camps. Like survival bags, each cache contains emergency shelter,

a sleeping bag, a stove, minimal food and other pertinent items for camp. When setting up a tent camp, survival bags will substitute for the survival cache.

Survival Cache

Appearance	Orange locker (typically)	
Not Required	N/A	
Required	As needed in emergency	
Supports	Varies by camp	
Contents	Sleeping bags Ensolite pads, 24" × 48" Mountain tents (except in caches at large camps, which have Jamesways or Rac-Tents) Collapsible snow shovel Snow saw / ice ax Sledgehammer First-aid kit First-aid books (e.g., Medicine for Mountaineering, Cold Injuries) Coleman fuel Matches Assorted stakes Ice screws Snow flukes Pots w/lid (10-/5-/3-quart) Frying pan Plates Signal mirror Coleman 2-burner stove MSR WhisperLite stove Human waste buckets Pee bottles Toilet paper rolls Dehydrated meals Meals, Ready-to-Eat (MREs) Oatmeal Hot chocolate packets Bars (granola, chocolate) Pot grips Hard-plastic mugs Utensils (fork, knife, serrated knife, spoon) Pocketknife Cleaning pads/scrubbies 100' of paracord	
Notes	Caches are staged at fixed camps. Exact quantities and supplies vary by cache, based on average camp population and camp criteria.	

A stylized map of Indonesia is shown in dark blue against a white background. The island of Sumatra is visible in the upper left, and the main island of Java is in the center. A yellow triangle with a red dot is positioned above Java. Another yellow triangle is located on the eastern coast of Java. A dashed white line curves across the bottom of the map.

ENVIRONMENTAL POLICIES

Policy and Designations

Environmental stewardship and protection in Antarctica are essential. The U.S. is a signatory to the Antarctic Treaty (1959) and the Protocol on Environmental Protection to the Antarctic Treaty (Antarctic-Environmental Protocol; 1991). These agreements are implemented under the “Antarctic Conservation Act” (ACA; 16 U.S.C. 2401 et seq.).

The Antarctic Treaty sets Antarctica aside for peaceful purposes, primarily scientific research, cooperation and the exchange of information. The Antarctic-Environmental Protocol commits to comprehensive protection of the Antarctic environment, including a ban on commercial mineral exploration. Through its six annexes, it requires an environmental impact assessment of all proposed actions and the conservation of native fauna and flora, including management activities to limit introduction of non-native species. The Antarctic-Environmental Protocol also establishes procedures for waste disposal and waste management, prohibits marine pollution and establishes a process for area protection and management. USAP participants’ adherence to it relies on educational programs in each of these areas.

U.S. federal regulations implementing the ACA can be found in 45 C.F.R. §§ 641, 670–674. For more information, contact Antarctic Support Contract (ASC) Environmental at Environmental@usap.gov.

Antarctic Specially Managed Areas

Antarctic Specially Managed Areas (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.

There are two ASMAs that are typically visited on the continental side: McMurdo Dry Valleys (ASMA 2) and Amundsen-Scott South Pole Station (ASMA 5). Ensure you understand the management objectives and requirements for working there by reviewing the ASMA management plans on

the Antarctic Treaty website at <https://www.ats.aq/devph/en/apa-database>.

Antarctic Specially Protected Areas

Antarctic Specially Protected Areas (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. As with ASMAs, it is your team's responsibility to ensure you know and abide by the rules of each ASPA, whose management plans are available on the Antarctic Treaty website at <https://www.ats.aq/devph/en/apa-database>.

Historic Sites and Monuments

In addition to ASPAs and ASMAs are Historic Sites and Monuments (HSMs) designated by the Antarctic Treaty. Information on HSMs can be found on the Antarctic Treaty website at <https://www.ats.aq/devph/en/apa-database>. **You are responsible for knowing the latest restrictions and guidelines for all locations you plan to visit.**

Visitor Site Guidelines

Visitor site guidelines provide specific instructions for conducting activities at frequently visited Antarctic sites. This includes practical guidance on visiting the sites, considering their environmental values and sensitivities. Permission to conduct recreational visits to sites with visitor site guidelines must be requested from NSF, and if approved, reported in your environmental end-of-season (EOS) report. For more information and a list of sites, visit <https://www.ats.aq/devAS/Ats/VisitorSiteGuidelines>. For more information on ASMAs, ASPAs or HSMs, visit the Antarctic Treaty website at <https://www.ats.aq> or contact the ASC Environmental team at Environmental@usap.gov.

ACA Permits

Without an ACA permit, it is illegal to (1) take native mammals, birds or terrestrial plants, (2) engage in harmful interference of native mammals, birds or terrestrial plants, (3) enter ASPAs, (4) introduce non-native species to Antarctica, (5) introduce substances to Antarctica designated as waste, (6) discharge designated waste or (7) import certain Antarctic items into the U.S. or export them to another country. It is important to know that the term “take” also applies to dead mammals or birds, including parts (e.g., teeth, feathers, bones) or eggs.

The processing time for an ACA permit averages three months. Violations of the ACA or conditions of a permit can result in fines. Research with marine invertebrates, marine plants or fish does not require an ACA permit if it does not occur within an ASPA.

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. If there are questions regarding ASMAs, ASPAs or ACA permits, refer to the permit language, consult with the field supervisor or commercial project coordinator or contact the NSF ACA permit officer at ACApemits@nsf.gov.

Specimen Collection and Permits

Teams should refer to the project’s permit regarding specific specimen collection. The following applies to all research conducted in the Antarctic:

- Collecting souvenirs is not allowed. Do not remove any specimens from Antarctica, including feathers, rocks or shells, without an ACA permit and/or permission from NSF. This includes historical evidence of humanity’s presence (e.g., whale bones from early whaling expeditions).
- Do not take, handle or remove items that could potentially be historic artifacts. The Antarctic Treaty

guidelines state “[i]f there is uncertainty as to the age of a newly discovered historic artifact/site it should be treated as a pre-1958 artifact/site until its age has been established.” If a USAP participant finds something that **may** have historical significance, they must note the location with global positioning system (GPS) coordinates, take a photo of the artifact and notify the ASC Environmental team of the artifact’s presence at Environmental@usap.gov.

- The “Marine Mammal Protection Act of 1972” prohibits U.S. citizens from taking or importing marine mammals or parts of marine mammals into the U.S. without a permit. The take or harmful interference of marine mammals requires permits from both the National Oceanic and Atmospheric Administration and NSF.

Environmental Training

All personnel deploying to the field or conducting field work are required to attend environmental trainings provided at McMurdo Station prior to field deployment to ensure they understand what is expected under the ACA and the Antarctic Treaty.

Wildlife

Personnel must not interfere with wildlife unless they have an ACA permit to do so and are specifically trained for the activity being conducted. In general, always maintain a distance of at least three meters (15 feet) from animals. If an animal’s behavior is altered or disturbed, increase that distance. Incidental disturbance of wildlife is not allowed unless specifically permitted. This means that if your project is not wildlife focused, you may not disturb wildlife while conducting your project, including on any routes to access your field sites.

Highly Pathogenic Avian Influenza

Highly pathogenic avian influenza (HPAI) H5N1 outbreaks were first detected in the Antarctic Peninsula region in December

2023 and have occurred in subsequent seasons. While most outbreaks have concentrated around the Peninsula, there continues to be a high risk that HPAI will spread within the continent. In response, USAP requires enhanced biosecurity protocols in Antarctica, including prelanding surveillance, decontamination of boots and gear between wildlife colony visits, use of appropriate personal protective equipment when in contact with potentially infected animals, reporting of suspected HPAI outbreaks to the NSF Office of Polar Programs (OPP) Environmental team at OPP-ENV@nsf.gov and enhanced management of areas impacted by HPAI. The status of HPAI outbreaks in Antarctica may change rapidly, and certain USAP field activities may be impacted by HPAI outbreak status.

Non-native Species

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

Sample Site Markings and Equipment Installation

If a research group needs to mark sample sites, it must use reusable, recoverable flags. If flags cannot be used, the only acceptable paint marker is chalk paint, which can be washed or worn away. Prior approval for using paint markings must be obtained from the OPP Environmental team. If a group needs to install equipment with the use of mechanical fasteners (e.g., bolts drilled into rock), prior approval from the OPP Environmental team is required and use of such fasteners must be minimized.

Spill Prevention, Cleanup and Reporting

All fuels, chemicals and hazardous liquid wastes must be stored with secondary containment (e.g., berms). Where secondary containment is not feasible, employ best management practices to protect the environment from a release. These practices include regular inspections of all liquid stores during transport, using absorbent materials, using two people for transfers, ensuring spill response capabilities are available and using any other means as necessary or prudent.

Primary storage containers must be of durable construction and sealed when not in use. Appropriate secondary containment and spill kits must be available for any fueling operation to reduce the occurrence of spills. All spills of designated pollutants (e.g., fuel, glycol, transmission fluid) must be immediately reported upon discovery, regardless of the volume spilled. At camps with a camp manager, report spills directly to the camp manager. At McMurdo-based camps without a camp manager, report spills to Central Comms. All spills must be cleaned to the greatest extent practicable and disposed of through the hazardous waste system.

Waste Management

Releases of human waste or gray water are permitted only in accumulation zones (i.e., areas where snow and ice are thickening relative to the surrounding area). Releases onto sea ice, onto blue ice, into crevasses or on ice-free land are forbidden. Any release to the environment in the McMurdo Dry Valley ASMA or within ASPAs is also forbidden. All hazardous waste (e.g., fuel-contaminated material, lab waste, chemical containers, aerosols, radioactive material) requires special handling and labeling. Direct questions about hazardous waste management to the applicable station's Waste department.

Protocols may vary by camp type and location (e.g., if the camp is in or near an ASPA). In general, everything taken into the field must be brought out. Waste generated at field camps is removed by camp staff, grantees and support staff. It is

transported back to McMurdo for disposal. To expedite the camp takeout process, consolidate or compress items to make packing easier. See the Field Camp Operations section for more details on separating waste.

Hazardous Waste

The ACA has strict guidelines on hazardous waste, which requires special handling and labeling. Remove all hazardous waste from the field at the end of each season. The following are examples of hazardous waste:

- Fuel and fuel-contaminated material
- Lab waste
- Chemical containers
- Aerosols
- Radioactive material
- Batteries
- Biohazardous waste

Human Waste

Human waste must not be discharged onto ice-free land, onto sea ice or in blue ice areas. Discharge can occur only in snow accumulation areas and only if permission has been obtained first.

Discharging urine on land is not allowed anywhere in Antarctica. If urine discharge is specifically approved, it may be discharged only to the subsurface (e.g., into a pit or hole). Personnel must carry and use a pee bottle when bathrooms or outhouses are unavailable. **Used pee bottles must be emptied and cleaned by the user upon return and before they leave the station.** McMurdo Station has dedicated pee-bottle cleaning stations at the Science Support Center (SSC) and BFC.

Human waste and gray water must be returned to McMurdo Station. For planning purposes, the table below provides estimates of volumes generated. Typically, human waste

is collected in five-gallon buckets lined with plastic and sometimes biodegradable bags. The bags are then placed into a five-gallon drum, and the plastic buckets continue to be used throughout the season.

Bucket Use Rates

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

Environmental EOS Report

At the conclusion of field activities, all field-going USAP-supported science groups must submit an environmental EOS report to Environmental@usap.gov. ASC Environmental will contact groups that must complete an environmental EOS report. Groups can also email the department at Environmental@usap.gov to receive a copy of the Microsoft Excel template for the report. To ease the process and increase accuracy, populate the report with information throughout the season.

The following information must be tracked and quantified in the EOS report: camp site location and information, fuel use, hazardous materials used, waste disposition, scientific equipment installed, materials remaining and any spills. See the template for specifics. If desired, ASC Environmental will also provide one-on-one training before field deployment on how to complete the EOS report.



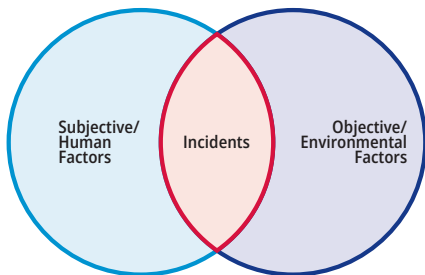
RISK MANAGEMENT

Risk management (RM) is essential to all we do in the field, from the daily hazards inherent to field work, to the bigger risks analyzed weeks or months before a project. Understanding what the hazards are and how to manage them as a team can ensure a successful field season.

Hazards and Risks

Hazard and risk assessments are the foundation of RM, informing the decisions and plans we make in the field. “Hazard” and “risk” are often used interchangeably but are distinct terms in the field. Hazards are sources of danger, while risks constitute the possibility of loss or injury due to exposure to a hazard. Typically, we identify hazards and manage their related risks. We cannot change the hazard but can manage our interactions with it.

RM often concerns “accident potential,” the interaction of subjective/human factors and objective/environmental factors. Objective hazards are aspects of the natural environments and forces that present risks (e.g., weather, terrain, ice, snow, rockfall, moving water, wildlife). Subjective factors are the characteristics and behaviors of people (e.g., communication style, fatigue, complacency, personality, risk perception and tolerance, overconfidence, experience level). Incidents occur where the subjective and objective factors intersect.

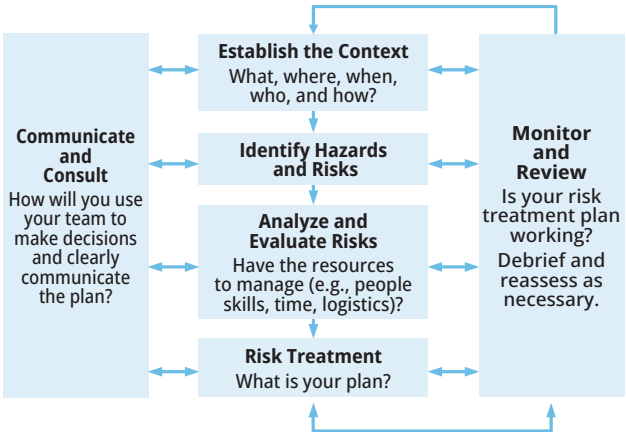


For example, crevasses may be present while traveling on a glacier (objective factor, i.e., out of our control), yet how we

communicate and plan to manage them is key to not falling into a crevasse and getting injured (subjective factor, i.e., within our control).

RM Process

The RM process involves systematically applying management policies, procedures and practices to communicating, consulting and establishing context, as well as to identifying, analyzing, evaluating, treating, monitoring and reviewing risk. From the proposal stage to implementation, RM is accounted for at all levels, from big picture oversight to daily decisions.



Daily RM leads to successful projects. Teams need tools to recognize hazards, mitigate risks and communicate effectively. Questions like the following have proven successful and can serve as the starting point of the risk assessment process:

- What can happen?
- How likely is it to happen?
- If it does happen, what are the consequences?

Asking these questions helps identify one or more scenarios in which someone or something is at risk to a hazard and how. These hypothetical sequences of events go through the initiating conditions to a final state (e.g., reduction of hazard, loss to the entity at risk), leading to this next set of questions that will inform the mitigation measure you choose:

- What is tolerable?
- How safe is safe enough (i.e., what is acceptable)?
- What needs to be done?

The RM process involves continuous iteration as shown in the previous figure. Communication, consultation, monitoring and reviewing occur at each step as you cycle through the process.

Practical RM in the Field

Each day, we are making decisions, assessing hazards and communicating with our team. RM does not stop once the field plan is complete and you have arrived in the field. There are many ways to approach practical, everyday RM.

Conduct Daily Briefings and Debriefings

Morning Brief

- Conduct a rundown of activities for the day and associated hazards.
- Ensure there is an estimated time of return (ETR), as well as a communication plan if the ETR needs adjustment.
- Cover the mitigation plan for hazards.
- Do a physical and mental check-in for all team members.
- Plan for self-care throughout the day (e.g., food, water, personal needs).
- Ensure all gear is accounted for.

Afternoon Debrief

- Did we make good decisions, or did we get away with it?
- What happened? So what? What next?

- What do people need to be at their best?
- Do we need to change anything for tomorrow?

Assess Likelihood Versus Consequence

We often assess this unconsciously. Do a quick check-in: What is the likelihood of injury or incident, and what would that consequence be for myself and my team?

Use Common Language

Come up with common language and terms to identify risks (e.g., red means stop, yellow means caution, green means go). This can be applied to a variety of terrain and hazards.

Practice Situational Awareness

- Observe, orient, decide and act.
- Be observant of changing conditions — with individuals, the team and the environment.
- Effectively make decisions based on your observations.
- Reflect (in real time) on your decisions to refine courses of action.

Positive Work Environment

Successful field work is a result of a high-functioning team. Expeditions with extended time in the field tend to have their own culture characterized by team member's shared values and practices. USAP supports creating an inclusive, respectful and welcoming work environment, on the belief it leads to teams who successfully manage and plan for risks. To help make this happen, make time to discuss and practice the following together:

- Actively invest in a work culture that promotes proactive RM and support for all team members.
- Plan a positive work environment that is pertinent to team makeup, location, work, schedules, etc.

- Have AM/PM meetings that include dialog about subjective and objective hazards.
- Interrupt behaviors that erode the work environment, and actively solicit feedback about impact on others.
- Determine how the group plans to hold one another accountable to this?
- Facilitate foundational conversations around respectful team dynamics.
- Be inclusive by being curious and appreciating other's differences and identities. Exclusion is not tolerated.
- Build in time that is not centered on work. Ensure there is space for fostering relationships, morale and respite.
- Be mindful of humor, jokes and references that could alienate team members.

Sexual misconduct is a serious offense. Online and in-person meetings before and during deployment are required. Some institutions may require their own training, but the NSF Sexual Assault and Harassment Prevention and Response (SAHPR) trainings are essential for all deploying participants. These trainings are designed to set expectations around behavior and to review USAP sexual misconduct policies. As a team, it is important to consider the logistical impact that Antarctic field camp life has on implementing such policies.

Early discussions about expectations, norms and values are chances to build trust and rapport in the group, work through scenarios and formulate agreements on how the team will process conflict and promote accountability in the field. These discussions also help teams understand and address their group dynamics. Teams are encouraged to memorialize their discussions in a field safety agreement and ensure all members are aware of and have access to the material.

Self-awareness

Effective RM starts with **you**! Having a good understanding of your skills, attitudes, comfort level and risk tolerance and

perceptions allows you to be a solid team member. Working in the cold, harsh environment of Antarctica has its challenges. Learning to thrive and not just survive is the goal.

Strengthen your situational awareness with accurate self-awareness by being aware of both your mood and your thoughts about that mood. Self-awareness can be cognitive (e.g., thoughts, beliefs, biases, assumptions), emotional (e.g., feelings, moods) or behavioral (e.g., language, actions), all of which helps us understand how we will respond in various situations.

Self-awareness also benefits from others' feedback. Strong teams make a habit of giving and receiving objective performance feedback in a way that minimizes defensive responses. Self-awareness flourishes within groups and environments in which people can freely share how they feel, voice their needs and actively grow as individuals. This takes work and benefits from attending to all the RM factors covered herein.

Stress Management

Stress and fatigue are normal components of field work. Working in the outdoors demands a strong work ethic. Team members work hard, both physically and emotionally, regularly putting in long days throughout the field season. Planning for this can improve your experience and performance in the field.

PRO TIPS

- Before deploying to the field, consider talking with your team about what you need to be successful (e.g., I like to have my hot drink in the morning before talking to anyone; it is important to me to laugh and have fun; I like to find time to connect with loved ones at home).
- As part of field planning, discuss some scenarios and ask team members to be realistic about how they would react.
- As a team, determine how you will make space for each other to get needs met.

- What does leadership, communication and feedback look like?
- Think about intent versus impact when communicating.
- Prioritize curiosity over assumptions. We all come with a belief system that influences our behaviors. Ask questions before assuming ill intent.

Teams can be under enormous stress from the physical exertion of living outdoors in the cold, time pressures, aspects out of our control, living with strangers, or adapting to a new diet and routine. The effects of stress and fatigue on performance are well documented. Our strength, stamina, mental and emotional health and immune responsiveness decline if we are chronically tired, undernourished or stressed. We are also more susceptible to injury when tired and hungry.

PRO TIPS

- Make it normal to ask for help. Role-model this regularly.
- It is not a character flaw to be tired or need time to recharge. Before deployment, ask team members what they need to be successful in the field. Know how you will support one another beforehand.
- Have a plan for your team to get good, consistent sleep.
- Ensure mealtimes are consistent and meals are nutritious.
- Have regular team check-ins as a team or one-on-ones as needed.
- Carve out personal time so people can recharge the way that is best for them.
- Mix up camp responsibilities throughout the season.
- Use the following stress continuum so team members have common language to describe how they are feeling.

Using the Responder Alliance's stress continuum (<https://www.responderalliance.com/stress-continuum>), we can become attuned to our stress levels and communicate when they are green, yellow, orange or red. This helps teams approach situations that require heightened focus and risk mitigation.

No one should be in the field if they are in the red. Teams can utilize the continuum to help each other recognize stress-driven behaviors and provide support to their best ability. While it may be logistically difficult from certain locations, you can always leave the field if you are having an adverse experience. USAP also has support resources, including but not limited to the USAP counselor, the community phone (which has unlimited minutes to call anyone you wish) and Human Resources representatives.

Individual Stress Continuum

Green/Ready	Yellow/Reacting	Orange/Injured	Red/Critical
Healthy sleep	Sleep loss	Sleep issues/ nightmares	Insomnia
Healthy relationships	Distance from others	Disengaged relationships	Broken relationships
Spiritual/emotional health	Change in attitude	Feeling trapped	Intrusive thoughts
Physical health	Fatigue	Exhausted	Anxiety and panic
Emotionally available	Avoidance	Physical symptoms	Depression
Gratitude	Short fuse	Emotional numbness	Feeling lost or out of control
Vitality	Criticism	Suffering	Thoughts of suicide
Room for complexity	Lack of motivation	Isolation	Blame
Sense of mission	Cutting corners	Burnout	Hopelessness
	Loss of creativity/interest		

Fatigue Management

Antarctic field research opportunities are precious. It is tempting to burn the candle at both ends to accomplish project objectives. However, when people become extremely tired, their awareness level can drop and their stress level can rise. Exhaustion causes the following problems:

- Compromised work quality
- Worsening personal relations
- Judgment lapses
- Decreased situation or self-awareness of safety
- Behavioral changes that put self or others at risk

Create a work schedule that encompasses research duties, camp responsibilities and rest time. Divide camp responsibilities as equally or sensibly as possible. Prioritize work objectives and complete them accordingly. Encourage people to be responsible for their own well-being and take advantage of rest periods as necessary.

Know that field work is busy and you will be tired. Regularly check with your team to ensure your schedules are working. A plan made before deploying, when everyone was fresh and rested, may not work two months into a busy season, when people are more drained and may need more rest.

Rest and Duty Cycles

Setting up a field camp can be one of the busiest days of the field season. Getting basic needs met is the priority: shelter, warmth and water. It is important to determine roles and responsibilities before arriving at camp. It is also important to plan what to accomplish in the first 24, 48 and 72 hours on site. Making your task list is important. So is knowing when you will rest, which keeps motivation up. Consider keeping a rest and duty cycle throughout the field season.

Lifting and Carrying

Manual material-handling tasks performed repeatedly, or over long periods, can lead to fatigue and injury. Below are some of the main risk factors.

Risk Factors for Injury

Risk	Example
Awkward posture	Bending, twisting
Repetitive motion	Frequent reaching, lifting, carrying
Forceful exertion	Carrying/lifting heavy loads
Pressure point	Grasping loads, contact with parts/surfaces that are hard or have sharp edges
Static postures	Maintaining one position for an extended time

Before Lifting

- Always test the load for stability and weight.
- Assess whether more than one person may be needed to accomplish the lifting activity.
- Wear appropriate footwear to avoid slips, trips and falls.
- If you wear gloves, choose a size that fits properly. Depending on the glove material and number of pairs worn, more force may be needed to grasp and hold objects. Wearing a single pair of gloves can reduce grip strength up to 40%. Wearing two or more pairs can reduce grip strength up to 60%.
- Lift only as much as you can safely handle by yourself, and be realistic about how much you can lift.
- Keep the lifts in your power zone (i.e., above the knees, below the shoulders and close to the body) if possible.
- Use extra caution when lifting unstable loads.

While Lifting

- Get a secure grip.
- Use both hands whenever possible.
- Use smooth, even motions.
- Keep the load as close to your body as possible.
- To the extent possible, use your legs rather than your back to push up and lift the load.
- Do not twist your body. Step to the side to turn.
- Alternate heavy lifting or forceful exertion tasks with less physically demanding tasks.

Staying Warm

Our health and comfort in the field depends on staying warm and dry — we make better decisions, sleep better and are happier. It is far easier to stay warm than warm up once cold.

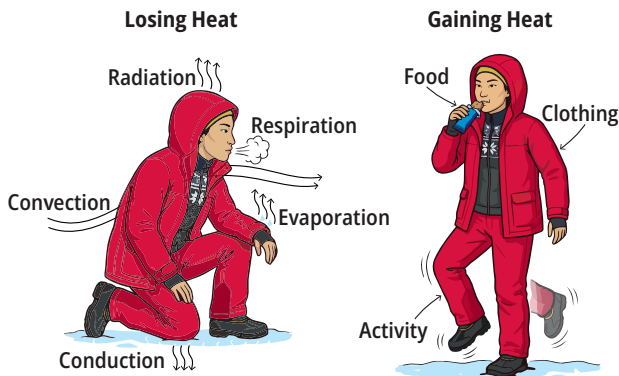
Ways We Lose and Generate Heat

Lose	Gain	Mode	Description
×	×	Conduction	Direct transfer of heat from one object to another (e.g., while sitting on ice/snow with no insulation, picking up cold objects with bare hands)
×	×	Convection	Movement of air between the body and air outside (e.g., via open collars, untucked shirts, unzipped jackets, no hat)
×	×	Radiation	Transfer of electromagnetic energy from a hot object to a cold object, primarily through exposed skin
×	×	Evaporation	Heat exchange when moisture evaporates from wet clothing or skin
×	×	Respiration	Heat exchange via breathing, which can occur rapidly when breathing is heavy in cold weather
	×	Activity	Bodily movement or exertion (e.g., shoveling snow)
	×	Food	Consuming food, especially simple sugars, which the body can break down quickly to produce heat
	×	Clothing	Wearing light/medium/heavy layers to trap "dead" air space around the body

PRO TIPS

- Take short, frequent breaks while doing strenuous work to avoid sweating, which can cause chills via evaporation and perspiration.
- Change out of wet clothes, or if clothes are only damp, layer up and do light activity. Synthetics and wool dry as your body creates heat.

- Eat throughout the day! Lunch starts as soon as breakfast is over and ends when dinner begins. This helps regulate body temperature during the day.
- Stay hydrated! Not only will the dry environment take its toll on your body, but also drinking fluids will keep you warm.
- Wear a warm hat and gloves most of the time.
- Always have layers available so you can fine-tune for the activity and location.



Clothing

In addition to the extreme cold weather (ECW) gear that USAP issues, you will need several layers to be comfortable and thrive in the field. Before leaving home, you should have received a gear list from your team or supervisor to help you acquire the proper gear.

A good rule for living in cold environments is to get lots of insulation between you and the environment and then remove that insulation, layer by layer, as you warm up. You need a clothing system that allows you to shed layers quickly and easily before you get damp from perspiration. Several thinner garments are better than one bulky layer.

Layering

Layers ensure you can be comfortable in a variety of temperatures and work conditions.

**Lightweight
Base Layer**



**Wicks
moisture**

**Midweight
Base Layer**



**Adds warmth
and wicks**

**Insulation
Layer**



**Traps
heat**

**Shell
Layer**



**Sheds wind
and water**

Base Layers

Your first base layer should fit snugly against your skin and be lighter weight. This layer works by wicking away water and keeping your skin dry. Merino wool or synthetic fabrics (e.g., polypropylene aka polypro) work great. Cotton is a poor choice and should be reserved for hanging out around camp and sleeping in warmer temperatures. Depending on location, you may wear two to three base layers of varying weights. This will help trap air and prevent heat loss.

Insulation Layers

An insulation layer can be thicker long underwear (e.g., light fleece, wool), whose role is to absorb and maintain heat.

Thickness is warmth! Insulation layers are often worn while working, but avoid wearing your thickest layers for high output. Have an outer garment with several inches of loft during sedentary activities or extreme cold. Down is best for dryer conditions. Synthetic insulation is best for wetter climates.

Shell Layers

Shell layers are often the most important layer in your system and the most used after your base layers. Wind shells over any garment can add up to nearly 4°C (25°F) of warmth and 10°C (50°F) in very windy conditions. In places like Antarctica, we need constant protection from wind. Ensure your wind shell can fit over all layers before going into the field.

PRO TIPS

- Bring comfortable, synthetic fabric underwear, which is easy to wash and fast drying. (If allergic, try merino wool.) Also, bring cotton underwear for sleeping.
- Sports bras are popular and comfortable but often thick and slow to dry. (You will sweat in the cold.) Test before deploying.
- It is tempting to go to sleep with all your layers on but best to remove wind-resistant clothing and sleep in breathable layers to avoid sweating.
- Bring lots of good-quality socks. Our feet can be some of the hardest working parts of our body. Change into sleep socks at night (affectionately called “sacred sleeping socks,” which live in your sleeping bag only).
- Wear materials that wick moisture from the skin (e.g., synthetic materials, wool).
- Wear clothing that retains its warming properties even when wet (e.g., wool, fleece, synthetic insulation like Primaloft).
- Try on all layers together and test a variety of layering strategies before going into the field, to ensure your clothing is not constricting and lets circulation take place.
- Avoid excess clothes while active, so they do not saturate with sweat and cause you to lose heat through evaporation.

Damp or Wet Clothes

More often than not in Antarctica, clothes will not dry on their own or when hung outside while you work. Keeping clothes dry takes effort.

PRO TIPS

- Your body is often the best “dryer” for damp clothes. Sandwich them between your layers as you work around camp to dry them.
- Putting clothes in your sleeping bag is usually not enough to dry them. Hot water bottles in the bag will help with drying.
- Socks are the most likely clothing to become damp, as you wear them all day while working. To dry them overnight, you can put socks between your clothing layers so your body heat dries them while you sleep.
- Beware of hanging clothing too close to heaters. Synthetic fibers can melt!
- Hanging clothes in your tent in hopes they will dry is usually futile. The ambient temperature in your tent will rarely be enough to dry anything.

Sleeping in the Field

Part of thriving in the field is getting a good night's rest. Insufficient sleep can affect your physical and psychological well-being. Everyone has different sleeping needs and metabolic rates, so you may need to experiment with sleep during the first few days in the field.

PRO TIPS

- Always use multiple pads for comfort and insulation from the ground. Foam and inflated air mattresses are standard issue.
- Eat well before going to bed, ensuring you have both fats and carbohydrates. Fats take longer to digest, keeping your furnace stoked throughout the night.

- Do not wear all your clothes to bed. Start with base layers and add if needed. The goal is not to sweat.
- Urinate before getting into your sleeping bag, and do not ignore the call to urinate in the middle of the night. Use your pee bottle.
- Do some light calisthenics as you get into your bag to heat up your body.
- Consider wearing a warm hat as significant heat is lost from the head.
- Take a hot water bottle (or two) or hand warmers to bed with you. Place them under your arm pits, in between your legs or at your feet. You will not regret it.
- Have a pair (or two) of sacred sleeping socks that are solely for the bag.
- If your sleeping bag is somewhat big for you, consider filling the voids with other dry clothing to warm up the dead space.
- Keep sugary snacks nearby for midnight refueling.

Staying Found

While most fieldwork happens during the austral summer months, with 24-hour daylight, getting disoriented or lost can happen. As you set up camp, discuss a plan for this. It can be easy to become disoriented in the wind, fog and snow when moving between tents or huts at larger camps. In bad conditions, visibility can plummet in minutes. It is essential to have a plan if you are moving around camp in bad weather:

- Tell someone where you are going.
- Carry a radio.
- Have a check-in time.
- Set up rope lines in advance of bad weather.
- Determine how a person would signal distress if lost around camp (e.g., use of whistle, radio).
- Determine the minimum time-distance from camp in which a person must carry extra supplies (e.g., survival

bag, food, layers). Starting this requirement at ~15 minutes from camp is suggested, but it may need to change by location.

If you become disoriented or lost, do the following:

- Stay calm, positive and alert.
- Stop once you know you are disoriented. Make a plan and take a deep breath.
- Do not wander around aimlessly. You are better off staying where you are.
- Make contact or noise.
- Minimize heat loss by putting on additional layers if you have them.
- Stop and think. Try to remember your movements and figure out a way back.

Hygiene

Preventing illness within camp is crucial to ensuring the team's success and eliminating the risk of a serious illness that requires a medevac. Multiple people in a camp often get sick at the same time because they live and work so closely. Practice proper hygiene to minimize pathogen transmission and keep drinking water clean.

Camp

- Designate a handwashing area in camp.
- Wash hands after using the bathroom, before cooking and eating, before cleaning up after meals and at other times during the day. Have hand sanitizer easily accessible in the toilet tent and at other locations around camp.
- Protect drinking water from motor exhaust and microbial contamination.
- Use filters, chlorine, iodine or boiling to disinfect water as needed.

- Designate certain equipment for water collection (e.g., containers, shovels, ice axes) and do not use it for anything else. Alternatively, sterilize equipment before using it to collect snow or ice for water.
- If collecting glacial ice or large chunks of snow for water, designate a pair of gloves as “snow gloves” that are worn only for this purpose. Store them in a communal area so everyone can access and use them accordingly.
- Clean and disinfect drinking water storage containers regularly.
- Use bleach to sterilize dishwater and dishes.

Personal

A big part of self-care is personal hygiene. You will be better focused and able to make good decisions if you are comfortable. If you have any anxiety about hygiene during your prolonged time in the wilderness, this information can help. While in McMurdo, do not hesitate to ask field staff for tips and tricks!

Shower

Most, if not all camps, have little opportunity for a proper shower. Occasionally, some camps set up a berm in a private space where people can have a bucket shower. More often, no one showers in the field. For this reason, it is essential to set up some good daily habits for keeping clean.

Bathroom

You will learn how to “pee and poo” in the field in a way that is environmentally responsible and sanitary. Depending on the field location, there will be different parameters on human waste containment. Many camps require all gray water (pee) and human waste (poop) to be contained in buckets and barrels. Toilet paper is provided for all camps.

You will be issued at least one pee bottle along with your sleep kit. If you have a vagina, you can ask for a urinary adjunct (e.g., Lady J, “shenis”) from the BFC. It is best to practice before

leaving for camp, in the comfort and warmth of an indoor bathroom stall.

Handwashing is an important aspect of maintaining backcountry hygiene and health. Alcohol-based hand sanitizer is readily available, but traditional handwashing is best when possible. All camps should plan on having a handwashing system with soap and water.

If you have a vagina, you are encouraged to wash your pubic area with mild soap and water daily and bring an extra bandanna to clean yourself after urinating. Baby wipes are also a good alternative to soap and water. Bandannas can be hung outside of your tent in the sunlight to dry. Consider sleeping in cotton underwear instead of synthetic fibers.

Menstrual

If you menstruate, your cycle may change while living in the outdoors, so plan to bring extra menstrual supplies. You can use a reusable menstrual cup in lieu of tampons or pads. If you are using a new method, practice it before deploying and ensure you have a way to effectively clean any reusable devices.

All camp outhouses should have both a human-waste bucket and a sani-waste bin. Dispose of menstrual products in sani waste. When away from camp, it is also helpful to carry a stuff sack containing menstrual products and a zip-top bag for their disposal and carryout. Placing one or two aspirin tablets (not acetaminophen aka Tylenol) in the disposal bag will help keep odors down.

If you experience menstrual cycle changes or genitourinary symptoms (e.g., itchiness, soreness, excess or smelly discharge, painful or more frequent urination), do not hesitate to contact the field medical lead or whomever you feel most comfortable talking to. USAP field medical kits have medication to treat common infections (e.g., urinary tract infections, yeast infections).



COMMUNICATIONS

Regional Travel

Persons traveling off established roadways in areas around McMurdo Station must maintain communication with Central Comms. Established roadways include snow roads to the Long Duration Balloon Facility (LDBF), Williams Airfield, and Phoenix Airfield, as well as dirt roads between McMurdo Station, Scott Base, T-site and Arrival Heights. (Note that field camps and U.S. National Science Foundation Amundsen-Scott South Pole Station have their own rules for regional travel.)

Solo travel away from McMurdo Station — whether one person or multiple people on one snowmobile — must obtain NSF authorization first. If the solo travel is authorized, NSF and Field Safety coordinate a well-managed plan for the travel that accounts for the location and type of work involved.

When traveling off established roads, do the following:

- Check out by radio with Central Comms. (This also ensures the radio works.)
- Check in before your ETR, as failure to do so will initiate an emergency response.
- Maintain awareness of and abide by the following weather conditions.

Weather Conditions

Weather	Description	Travel Requirement
Condition 1	When visibility is < 100 feet, wind speed is > 55 knots (60 miles per hour [mph]) or wind chill is > -100°F (-73°C)	No travel of any kind
Condition 2	When visibility is > 100 feet but < 0.25 miles, wind speed is 48 to 55 knots (about 55 to 60 mph) or wind chill is -75°F to -100°F (-24°C to -38°C)	No solo/snowmobile travel
Condition 3	Any weather conditions with better visibility, wind speed or wind chill than Condition 2	Follow standard travel procedures

Radio and Phone Best Practices

For Checkout

Using your VHF radio, follow these best practices:

1. Listen before transmitting to ensure the channel is not in use.
2. Hail the party you are calling (e.g., "Central Comms, Central Comms. This is <vehicle number or call sign> calling on <channel name>.").
3. Pause for a moment after pressing to transmit, to ensure the entire transmission gets through.
4. Wait for acknowledgment.
5. Transmit the following information:
 - A. Vehicle number(s)
 - B. Event number (or department)
 - C. Destination
 - D. Number of people on board
 - E. Driver name (one name per group)
 - F. Point of contact (POC) in McMurdo Station and phone/pager number
 - G. ETR to McMurdo Station or estimated time of arrival (ETA) at destination
6. Keep the radio batteries warm, and always carry a spare battery or spare radio.
7. To conserve power, do not overuse repeaters.
8. Use the following phonetic alphabet when letters or groups of letters must be pronounced separately (e.g., unusual words, call signs, during noisy conditions).

Phonetic Alphabet for Radio

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

For Overnight Stays

- Before departing McMurdo Station, provide the names of all persons in the traveling party.
- Provide a one-way checkout when leaving for the destination, a morning check-in from the destination and a one-way checkout before your return.

If You Are Late

Five minutes after a missed check-in, the EOC is activated, including the NSF station manager, ASC station manager, deputy field area manager, SAR supervisor, information technology (IT) manager and fire chief. The EOC meets in Building 165 (BL165) to gather relevant information and attempt to contact the group. **Call Central Comms beforehand if you need more time and want to change your check-in time. There is NO grace period for check-ins.**

Field Camp Communication

Field camps must have at least two unique types of communication devices that are approved and issued by USAP. Field camps may use any combination of the following: VHF radio (when repeaters are operational), HF radio, Iridium satellite phone or telephone (e.g., radiophone, Voice over Internet Protocol [VoIP]).

Before Leaving McMurdo

- Contact the communications coordinator at BL159 (x42378) to arrange pickup of communications equipment.
- Test the equipment by calling Central Comms.
- Ensure you have a copy of the “Radio Communications Equipment User Guide.”

At Put-in (Arrival at Field Site)

- Make the put-in call to Central Comms before the aircraft departs camp.
- Provide the following information:
 - Location name
 - Camp leader name
 - Number of people (by event number)
- Confirm the daily check-in time and coordinates of the site.

For Daily Check-in

- Check-in with Central Comms before your scheduled time.
- Provide the following information:
 - Location name
 - Number of people (by event number)
 - Confirmation all is well (or not)

At Takeout (Return From the Field)

- Notify Central Comms when leaving the camp vacant.

For Day Trips via Aircraft

- No communications with Central Comms is required because the flight is tracked by McMurdo Station Field Operations Center (MacCenter) and Aviation Operations (AvOps).
- Establish communications with the helicopter pilot on VHF Channel 7 “Helo Ops” (i.e., Helicopter Operations) before the helicopter departs.
- Central Comms is available for communications checks, message relays, or recording locations.

In Emergencies

- Call Central Comms and notify them of the emergency.
- Medical staff call the Central Comms transfer line and indicate if the emergency is URGENT.

If You Are Late

One hour after a missed check-in, the EOC will start activating a rescue. Based on the late team’s location, this could mean vehicles are in motion, helicopters are in the air, and many people are searching for the team. To avoid unneeded rescues, ensure you always check in or call Central Comms for an extension if you are running late.

Communication Devices

USAP uses five systems for field party communications, based on the field party location: telephones, HF radios, Iridium satellite phones, VHF radios and Garmin inReach devices.

Telephones

Field camps in the McMurdo region that are equipped with telephone service can call Central Comms by dialing x42000.

This number rolls over to four available lines, so callers are always able to get through.

HF Radios

All deep field camps (and early season camps without repeater coverage) are issued an HF radio as they are beyond the range of VHF. HF can provide long-distance communication via groundwave or skywave, surpassing VHF's line-of-sight limitations. HF radio can be adjusted to change how the signal is controlled. However, users should follow the standard setup instructions for the Barrett PRC-4090 (newer backpack HF transceiver) or Barrett PRC-2090 (older backpack HF transceiver) and verify that radio settings are correct before making adjustments. The handset and long-line dipole antenna must be attached to the radio before operation. Select channel/frequency using the up/down arrows for McMurdo Station individual frequency.

The long-line dipole must be elevated at least four feet off the ground. Ensure all shorting bars are connected, except for the desired frequency. **Remember when plugged into the radio, the long line is an active wire and electrical shock can occur.**

PRO TIPS

- Use the following HF radio frequencies for the McMurdo region:
 - Central Comms: 7.995 or 11.553 MHz
 - Air Traffic Control (for field party emergencies only): 9.032 MHz
- At South Pole Station, the US-17 circuit is used to pass information between outlying stations and McMurdo Station, as well as for daily camp check-ins. Use the following continuously monitored frequencies in the order listed:
 - Primary: 7.995 MHz
 - Secondary: 4.770 MHz
 - Tertiary: 11.553 MHz

- Speak loudly into the microphone, and follow the radio best practices described above.
- When conducting communications checks with Central Comms before departing McMurdo Station, point the antenna at Black Island.
- The loss of saved frequency programming in the available channels does not render the radio inoperable. Manually tune the radio to the desired frequency, and operate using radio best practices.
- Charge the battery (AC or DC power), and keep it warm for best battery life and performance.

Iridium Satellite Phones

Deep field camps are also issued at least two Iridium satellite phones. Field parties working away from McMurdo Station will be issued Iridium phones. Any team spending one or more nights in the field will be issued a second phone, known as the community Iridium phone. These phones operate in the ultra high frequency (UHF) range of the radio spectrum. Instead of directly connecting to other radios (i.e., via line of sight or via line of sight to repeaters), they connect to satellites orbiting Earth. To make calls, ensure you have a clear view of the sky and, if possible, move to an area free from obstructions to obtain the best reception. Iridium coverage is not guaranteed in and around McMurdo Sound.

Iridium phones are administered by the U.S. Department of Defense. Dialing sequences to and from other commercial Iridium phones may vary. If a field party has multiple Iridium phones, the one with the lowest phone number is designated as the “Alpha” (i.e., primary) line. The next ones are “Bravo,” “Charlie” and so on. All Iridium phones issued at McMurdo Station are preprogrammed with several important operational numbers (see next table) that are also printed and attached to the outside of the phone’s storage case. The phone’s number is printed and attached to the phone case and the outside of the phone.

Iridium Phone Numbers

Department	Type	Preprogrammed Position	Number
Automated Transfer	Automated Transfer	MR01	00-697-720-568-1000
Central Comms	Satellite Phone	MR02	00-8816-763-12464
	Operator Transfer	MR03	00-697-720-568-1042
This Phone	Satellite Phone	MR04	00-8816-763-XXXXX
Field Ops	Camps Office	MR05	00-697-720-568-1056
	Traverse Office	MR06	00-697-720-568-1183
Fixed Wing	Office	MR07	00-697-720-568-1043
Helo Ops	Office	MR08	00-697-720-568-1180
	Satellite Phone	MR09	00-8816-763-29073
Medical	Clinic	MR10	00-697-720-568-1181
	Satellite Phone	MR11	00-8816-763-15142
S&TPS Manager	Office	MR12	00-697-720-568-1175
SAHPR Advocate	Office	MR13	00-697-720-568-1083
SAR Field Training	Office	MR14	00-697-720-568-1182
	Satellite Phone	MR15	00-8816-763-15141
Weather Charleston	Satellite Phone	MR16	00-8816-763-15168
Weather McMurdo	Satellite Phone	MR17	00-8816-763-20030

Dialing Calls

Below are instructions for calling from or to Iridium phones. If you have any questions or need help, call the Central Comms transfer line, which is staffed 24 hours per day and connect you to anyone in USAP or the U.S.

Getting Started

1. Power up the phone.
2. Wait for the phone to register with the network and display a signal level. This may take several minutes.

Iridium to Iridium

1. Dial 00 to access the satellite network.
2. Dial 8816.
3. Dial the Iridium number using the XXX-XXXXX format.
4. Example: 00-8816-763-12464 for Central Comms Iridium.

Iridium to U.S. Phone or USAP Direct Inward Dialing (DID) Line

1. Dial 00 to access the satellite network .
2. Dial 697 to connect to the Federal Telephone System (FTS).
3. Dial the area code. (Do not dial 1 beforehand.)
4. Dial the seven-digit number.
5. Example: 00-697-720-568-1042 to call the Central Comms transfer line.

Iridium to Non-U.S. Phone

1. Dial 00 to access the satellite network.
2. Dial 698 (code for international calls).
3. Dial the country code.
4. Dial the area code.
5. Dial the number.
6. Example: 00-698-64-3-358-8139 to call USAP Christchurch.

Iridium to US Toll-free Line

1. Dial 00 to access the satellite network
2. Dial 699 (code for toll-free calls).
3. Dial the appropriate toll-free prefix (e.g., 1-800, 1-888 or 1-887)
4. Dial the seven-digit phone number.
5. Example: 00-699-1-800-XXX-XXXX.

Phone to Iridium

If calling from a regular phone, dial the U.S. phone number (using the Hawaii 808 area code) corresponding to the Iridium number.

Iridium to U.S. Phone Number Conversion

Iridium Number	Equivalent U.S. Phone Number
8816-763-0XXXX	1-808-786-XXXX
8816-763-1XXXX	1-808-659-XXXX
8816-763-2XXXX	1-808-434-XXXX
8816-763-3XXXX	1-808-684-XXXX
8816-763-4XXXX	1-808-851-XXXX

Getting Text Messages

Friends and family can send short text messages to an Iridium phone. People sending a text message should enter the initials of the intended recipient at the start of the message and their own initials at the end. Otherwise, camp members will not know the intended recipient of the message.

Generally, friends and family should have only the Bravo (i.e., secondary) Iridium number so the Alpha line is used for work purposes only. They should be informed that the Iridium phones are a shared resource. As a team, you can determine which phone can be used for texts.

Text messages can be sent from a computer to Iridium phone as follows:

Option 1: The message can be sent via <https://messaging.iridium.com>. The sender fills out the form on the webpage by entering the Iridium phone number (e.g., 8816763XXXXX) and composing a message that is no more than 160 characters.

Option 2: The message can be sent via email, using the 8816763XXXXX@inah.pac.disa.mil format, where the last five digits of the Iridium phone are inserted at the Xs. Your message will be sent in plain-text format (not rich text or HTML). Leave the subject line blank, type 160 characters maximum in the body of the email, starting with the recipient's initials and abbreviating when possible. Exclude hyperlinks, signatures, photos, documents and other attachments.

In the field, check for Iridium text messages as follows:

1. Turn on the phone, and let it connect.
2. Messages should automatically download, with an icon appearing on the phone screen.
3. Follow the prompts to check the inbox.
4. Delete messages from the inbox and outbox when finished, as the phone can store only a limited number of messages.
5. If messages are not downloading or you missed a message, call your own phone number (preprogrammed in the phone), which will push any messages stuck in queue.

Troubleshooting the Phone

If the Iridium phone is malfunctioning, first disconnect and reconnect all accessories (e.g., battery, antenna, adapters) to ensure there are solid contacts. If possible, move to an area clear of obstructions. Then try operating the phone again.

Also protect the antenna, as plastic will become brittle and crack in cold environments. Be gentle when swapping out Iridium components. Most of the adapters are made of thin plastic, especially the 9575s. Work from sheltered

environments when possible, and do not force any connections. Replacement phones are limited.

VHF Radios

VHF radio is the primary form of wireless communication at and around McMurdo Station. The radio is a shared resource monitored by multiple users. If you are not within line of sight or repeater coverage, you may not reach your audience. In this case, move to higher ground to acquire line of sight, or have a third party relay messages for you. If you are still unable to make contact, use the Iridium phone or HF radio.

Use the best practices described above during radio communications, which 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 during poor weather or heavy communications traffic. Always refer to the frequencies by the channel name, not the channel number.

Air-to-Ground VHF Frequency Assignments for 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	Use 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

Most users will receive VHF radios with preprogrammed frequencies. South Pole Station uses the same authorized VHF frequencies as McMurdo Station, but the channels are not permanently assigned to specific functional areas, so your McMurdo Station-issued VHF radios may not be usable at South Pole Station. Instead, VHF assignments for channel 1 through channel 7 are determined seasonally or on demand. The 129.7 MHz frequency is reserved for monitoring aircraft, same as McMurdo Station.

Preprogrammed VHF Radio Channels

McMurdo VHF Radio		Field Party VHF Radio	
Channel	Functional Area	Channel	Functional Area
1	i-Net	1	i-Net
2	Fire	2	Fire
3	MacOps*	3	MacOps*
4	Science	4	Science
5	MCC / Fleet Ops	5	MCC / Fleet Ops
6	Air / Tower	6	Air / Tower
7	Helo Ops	7	Helo Ops
8	Power and Water	8	Power and Water
9	Fuels	9	Fuels
10	Linepersons	10	FP Taylor Valley
11	AGE / ANG	11	FP Wright Valley
12	FP Hut Point Peninsula	12	FP Hut Point Peninsula
13	FP Mount Aurora	13	FP Mount Aurora
14	FP Mount Terror	14	FP Mount Terror
15	FP Mount Erebus	15	FP Mount Erebus
16	Marine 16	16	FP Beacon Valley

Note: Fleet Ops = Fleet Operations. FP = field party. MCC = Movement Control Center.

* Channel name is MacOps, i.e., McMurdo Station Operations, which is now Central Comms.

McMurdo Station deploys three types of VHF system: simplex, simplex with base station and semiduplex.

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 transmit one at a time. Aerospace Ground Equipment / Air National Guard (AGE/ANG), Marine 16, Science, Tower/Airfield, Utilities and all airband channels use simplex VHF.

Simplex With Base Station

A base station is utilized when buildings or hills block radio signals. An antenna is placed at the highest available point (e.g., hill, tall building, radio tower), and the radio at the tower (i.e., the 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 cannot communicate directly, the dispatcher relays the messages. Fire, Fuels, i-Net and Helo Ops use simplex VHF with the McMurdo Station base station. Note that the following ASC functional areas use simplex VHF that is not monitored by Central Comms:

- i-Net (for shuttle operations; antenna at T-site)
- Helo Ops (for communication between the helo hangar, helicopters and helo field parties)
- Science Net (for communications between field parties)

Semiduplex

For areas farther from McMurdo Station (e.g., camps in the Dry Valleys), semiduplex VHF repeaters are used. The repeater is installed on the highest available point, receives a signal on one frequency (F1) and automatically retransmits the signal on another frequency (F2). The control point at the dispatcher's desk transmits and receives just like a mobile radio. Central Comms, all field party repeaters, all flight-following repeaters and the MCC use the McMurdo Station semiduplex VHF.

Semiduplex VHF Channel Use

Name	Repeater Location	Coverage
MacOps*	Crater Hill (above McMurdo Station)	McMurdo Station area and sea ice areas south of Erebus tongue
Mount Aurora	Black Island	McMurdo Station area, sea ice area south of Erebus tongue and ice shelf
Hut Point Peninsula	Crater Hill	McMurdo Station area and sea ice, ice shelf, Windless Bight and Hut Point Peninsula
Wright Valley	Mount Newall	Wright Valley, New Harbor and sea ice areas
Taylor Valley	Mount Coates	Taylor Valley, including Lake Hoare, Lake Fryxell, Lake Bonney and F6
Mount Terror	Mount Terror	Cape Crozier, Windless Bight, areas south of Ross Island
Mount Brooke	Varies	Repeater location and use varies each season
Mount Erebus	Mount Erebus	Line of sight to west side of Mount Erebus
* Channel name is MacOps, now known as Central Comms.		

inReach Devices

USAP has a limited number of Garmin inReach devices for field teams to efficiently communicate short messages to McMurdo Station. Note that messages on USAP inReach devices transmit to an email account that many individuals can access. As such, do not rely on these to send private or sensitive messages.

While inReach is not considered a primary form of communication within USAP, it is becoming increasingly popular in the field. Many people bring their own inReach devices to Antarctica. When doing so, you must register your inReach with Central Comms before deploying the field.



FIELD CAMP OPERATIONS

Overview

USAP opens Support Information Packages (SIPs) between March and April for principal investigators (PIs) to fill out. The SIP covers science objectives, grantee participant team information, USAP equipment requested, cargo, lab consumables, camp equipment needs and personnel support requested. During the SIP process, the field team, implementer and PI discuss the project's scientific objectives and field gear.

Many field locations are well known and utilized each season. They have hard-sided, permanent structures. Locations that lack permanent structures, are less frequently used or are new for field work purposes must be identified using ArcGIS maps and/or satellite imagery and submitted to the ASC Environmental team for review, which may submit a report to NSF for approval based on the project's environmental impacts. Satellite imagery is required for all field work locations that are bound by ice (e.g., glacier, blue ice, sea ice). Any teams conducting work away from their camp site must also utilize satellite imagery to ensure a safe route is viable.

Once teams arrive at McMurdo Station, they determine their plan and field location and Field Area meets with them to fine-tune the plan. This will include meeting with the field risk manager to discuss the overall operational RM plan for the season. If the field season involves technical travel, meeting with and planning with Field Support & Training (FS&T) is also required.

Day Trips

Projects intending to remain in the field for a partial or full day must have at least two people, the correct number of survival bags, proper clothing and two distinct forms of communication with spare batteries. (See the Communications section.) All personnel must keep in mind that weather or other circumstances may cause them to remain in the field overnight.

Field Planning

Before going into the field, all teams are required to create an operational RM plan for the season. This is required for all groups conducting work either on day trips or camping at a field location for the entire season. The plan includes information about all team members, camp and worksite location, work to be completed, a comprehensive list of risks and their respective mitigations and a plan for collaborating as a team. It also details emergency planning, which includes emergency response plans, first-aid certifications, emergency caches and important medical, SAHPR and logistical contacts to call in an emergency. Teams must develop the plan together then meet with the field risk manager for up to 2 hours to discuss it. This occurs shortly after arriving in McMurdo and before departing for the field. The plans are stored on ASC's Emergency Management drive so they are accessible to the many pertinent parties in McMurdo (e.g., Central Comms, EOC, AvOps).

Besides the field teams (i.e., grantees conducting fieldwork or ASC teams assigned to field locations), many USAP participants travel to the field, for either day trips or multiple days based on their work. To track such travel away from the station, participants fill out a field plan on the McMurdo intranet to account for their team and work objectives and ensure they have emergency gear. Whether you are headed to the field for a day or season, take the following steps:

- Develop a general emergency plan.
- Discuss how it should be implemented in different situations the team may encounter.
- Discuss any job or camp hazards before initiating any work.
- Discuss methods of incident and injury prevention.
- Make risk mitigation a daily strategy and discussion topic.

- Emphasize the importance of practical RM given the remoteness of the location.
- Be certain everyone is familiar with the use of all communication equipment, and set up a schedule to check the equipment throughout the time at camp.
- Encourage field team members to be their own advocates and raise any work or camp safety issues they observe.
- Encourage team members to watch out for each other's safety and well-being.
- Revisit the plan as needed or throughout the season.

All field team members have the right to stop any operation if they observe something unsafe.

Field Planning Checklists

All Field Parties

The following checklists reflect the typical timeline for grantee field teams. ASC field parties have more time in town, so their tasks will be extended over several more days or weeks based on the project.

Day 1

- Arrive at McMurdo Station.
- Attend an arrival brief, and receive room keys and station information.
- Meet your POC.
- Find your dorm room and settle in.
- Retrieve bags from BL140.
- Check in with Crary Science and Engineering Center (Crary Lab) staff between 1000 and 1700 hours for building keys and lab or office space (if not provided by the POC and if you have office space).
- Check in with other team members.

Day 2

- Attend the science in-brief, where you will receive your binder outlining specifics for your project and getting to the field.
- Visit the BFC to get the lock combination to the cage holding field gear, and confirm that all your requested gear is in the cage. It is your responsibility to check all your gear (e.g., set up tents, test stoves, check zippers on sleeping bags).
- Meet with the Fixed Wing Office or Helicopter Office to get details on flight times and allowable cabin loads (ACLs).
- Contact the BFC to schedule the food pull and ensure allocated fuel quantities are correct.
- Contact the field risk manager to set up a time for the field plan meeting.
- Retrieve radios and other equipment from the field party communications office.
- Check with the Mechanical Equipment Center (MEC) for any requested mechanical equipment (e.g., snowmobiles, generators).
- Meet with Science Cargo to confirm deadlines for getting cargo to the field and find out where project cargo shipped from the U.S. has been staged.

Days 3–7

- Confirm that resupply items are clearly labeled and stored in the cage.
- Meet with Central Comms personnel to discuss the field communication plan and establish a daily call-in time.
- Prepare any resupplies, and stage them in your cage.
- Check and test all equipment destined for the field, and call Central Comms to test communication equipment.

- Bring all material and equipment collected from the BFC, MEC and other departments to Science Cargo for processing.
- Check that team members have been scheduled for their required training (e.g., Antarctic Field Safety [AFS], Crary Lab, radio and communication, fire extinguisher, environmental, cargo, snowmobile, small engine, light vehicle, tracked vehicle), and schedule any additional training needed.
- Pick up any required office supplies from Central Supply (BL140, upstairs), checking hours of operation before going.
- Consult with the environmental coordinator on proper procedures for handling hazardous material and human waste at the camp site, and procure necessary materials (e.g., spill kits) and correct forms for reporting spills and waste discharge.

Fixed Wing-supported

Week Leading up to Flight

- Make an appointment with McMurdo Medical to pick up a field medical box. (Your Research Support Plan [RSP] or supervisor will advise if you must do this.) Some supported camps will already have the field medical box staged.
- Meet with the field risk manager to discuss your field plan.

Five Business Days Before Flight

- This is the last day to deliver hazardous cargo to Science Cargo at BL073 so cargo handlers have sufficient time to build cargo on pallets and deliver it to the airfield.

Three Business Days Before Flight

- This is the last day to deliver all remaining non-hazardous cargo to Science Cargo at BL073 and help

cargo staff package cargo and assign shipment numbers if assistance is needed.

Two Business Days Before Flight

- Schedule a meeting to go over final cargo weights, cargo priorities and passenger names to the Fixed Wing Office.

One Day Before Flight

- Ensure that Central Comms has your put-in plan, including the camp name, camp leader and number of people in camp, and set a time for the daily check-in.
- Fixed Wing Office staff will confirm that all cargo is ready for flight.
- Check the intranet or televisions for departure times, as the fixed wing flight schedule will be published by 1800 hours.
- If dorm rooms are not being held for field team members, clear the rooms and properly store items not going into the field. Lodging personnel will perform a room inspection.
- Fully charge the batteries for satellite phones, radios, Kestrel weather meters, cameras and other electronic devices.
- Set up the “away” auto-reply on USAP and personal email accounts.

Day of Flight

- Check the flight schedule early in the morning.
- Stay near the phone identified as the team’s contact number, and monitor the pager if the team has one.
- If releasing a dorm room, pack the bedding and leave it in its blue bag outside the door.
- Be at BL140 or Derelict Junction, dressed in ECW gear, at the time indicated on the flight schedule.

- At the airfield, team members may be asked to assist with loading the plane.
- Visually confirm that sleep kits and all critical life safety items (e.g., all required shelters, stove fuel, ignition source, food, required communication devices, water for some locations) are loaded on the plane.
 - Do not allow the plane to take off until crucial safety gear has been confirmed aboard the aircraft.
 - Without critical life safety items, it may be necessary to return to McMurdo Station, delaying your field work.

Delayed/Canceled Flights

- For same-day departures, remain in the passenger area and wait for updates.
- If the flight is canceled, take the shuttle back to McMurdo Station.
- Check with Lodging staff to confirm room assignments.
- Check with the Fixed Wing Office for an updated flight schedule.

Helicopter-supported

Week Leading up to Flight

- Make an appointment with McMurdo Medical to pick up a field medical box. (Your RSP or supervisor will advise if you must do this.) Some supported camps will already have the field medical box staged.
- Meet with the field risk manager to discuss your field plan.

Three Business Days Before Flight

- Confirm the flight request (including estimated cargo weights, number of passengers and list of hazardous cargo) with the helicopter coordinator.

- This is the last day to request changes to the flight schedule.
- This is the last day to deliver hazardous material to Science Cargo.

One Day Before Flight

- Ensure all non-hazardous cargo has been delivered to the helicopter pad.
- Ensure that Central Comms has your put-in plan, including the camp name, camp leader and number of people in camp, and set a time for the daily check-in.
- If dorm rooms are not being held for field team members, clear the rooms and properly store items not going into the field. Lodging personnel will perform a room inspection.
- Fully charge the batteries for satellite phones, radios, Kestrel weather meters, cameras and other electronic devices.
- Set up the “away” auto-reply on USAP and personal email accounts.

Day of Flight

- Check the flight schedule early.
- Monitor the pager if the team has one.
- Stay near the phone identified as the team’s contact number.
- Be at the helicopter pad (helo pad), dressed in ECW gear, 45 minutes before the flight.

Delayed/Canceled Flights

- For same-day departures, remain in the passenger area and wait for updates.
- If the flight is canceled, check with Lodging staff to confirm room assignments.
- Check with Helo Ops staff for an updated flight schedule.

Camp Put-in

Camp put-in can feel chaotic. There is much to remember, so the following checklists (along with direction from ASC implementers, ASC field staff and other support staff) will help you get out the door and off to a successful season. Resources and personnel change with each season, so never hesitate to ask for clarification about put-in procedures and be proactive in your preparation. ASC Field Area is here to ensure you have a productive season.

Before Departing McMurdo Station

- Review environmental EOS report forms and instructions. Be prepared to record EOS data daily.
- Review your fixed wing- or helicopter-supported field planning checklist to ensure all items are complete.
- Turn in your room keys to Lodging staff and lab keys to Crary Lab personnel (unless authorized to keep the keys).
- Ensure all electronic devices are warm and their batteries are fully charged.
- Visually confirm that all sleep kits, communication equipment and required safety gear are loaded on the aircraft. Do not allow the aircraft to depart until this is complete.

At Camp Arrival and Before Aircraft Takeoff

- Assist the flight crew with unloading the aircraft as directed.
- If staying overnight, establish contact with Central Comms using an Iridium phone or radio, and verify the camp name, camp leader, and number of people in camp. Confirm the time of the daily check-in.
- Establish a shelter, setting up a tent away from the landing area.
- Light a camp stove.

- Inform the pilot when the above tasks are complete.
- Confirm with the pilot which is grid north by using a GPS or the sun, as this direction is used to establish directional flags in camp for weather observations.
- Stay well clear of the aircraft and any propeller wash as it departs.
- In fixed wing camps, test the VHF air-to-ground radio (if on hand) with the pilot once the aircraft is airborne.

After Aircraft Departure

- Identify the best location for the camp. Most likely, this was determined during the planning season using imagery.
 - Look for a spot that offers easy access to research sites, avoids hazards and provides protected areas for shelters.
 - Consider storm wind direction and the helo pad or skiway location to optimize the camp's orientation.
- For helicopter-supported camps, keep camp elements at least 25 meters (82 feet) away from the primary flight path. Be aware of rotor wash, and keep a secure landing zone at all times in case of unexpected helicopter landings.
- Set up all tents. Appropriate spacing may vary by location but generally starts at 3 meters (10 feet) between tents in areas with drifting potential.
- Set up the HF radio, solar panel and antenna, and test the radio by contacting Central Comms.
- Set up a camp bathroom area. This may be a tent with a human waste container or a hole in the snow (when allowed in accumulation zones).
- Do the following as soon as practical:
 - Place all fuel containers and equipment (e.g., generators) in containment berms.

- Establish a site for trash, ensuring trash is correctly packaged and labeled for return to McMurdo Station. Trash should be collected into its sorted categories. Once it is full, label it by type of trash, mark its weight, then place it in the trash triwall (i.e., triple-layered, corrugated paperboard box).
- Erect flag lines between tents or cargo lines in case of whiteout conditions, if your location warrants these measures.
- Set up a camp survival cache with spare fuel and food, often near or in the bathroom tent if it is a Scott tent. (Smaller tents [e.g., kiva tents] do not work as well.) Some teams also situate their personal locator beacon with the survival cache or a survival bag.
- Establish GPS coordinates for cargo lines, tents and the survival cache. Store your GPS device in an easily accessible location for a whiteout conditions.

Site Selection

Camp site selection is determined during the SIP process, following ACA protocols and any relevant regulations for ASMAs and ASPAs. The field team can assist in making recommendations. Details such as terrain, weather patterns, flora, fauna, distance to the worksite and logistics are considered when choosing the camp location. Once on site, the field lead is responsible for adjusting the camp site as necessary.

Wildlife, Vegetation and Sensitive Areas

Participants must not interfere with wildlife unless they have an ACA permit and a specific reason to do so. Avoid seabird nests and colonies, paths in which penguins walk to and from the ocean and seal haul-out areas. Consider any existing vegetative ground cover (e.g., mosses, grasses, lichens), and avoid trampling and disturbing it as much as possible. Also avoid camping in areas that drain into sensitive sites (e.g.,

streams, ponds, lakes, nesting areas). At the end of the field season, disassemble any rock cairns and leave the area in its original state.

Topography and Weather

Consider the lay of the land and how storms will impact the camp. Choosing areas with physical features that block wind can be ideal, but know that leeward sites will accumulate snow. Be aware of tide lines, glacier wall calving and rock fall hazards. In addition, select an area where topography does not interfere with VHF radio and Iridium satellite communications. This will be particularly important if you have an emergency.

When possible, position camp near the research study sites to decrease commute times. Conversely, it may be best to establish camp as close to the put-in area as possible to maximize the efficiency and safety of camp put-in and takeout.

McMurdo Dry Valleys

Field teams heading to the McMurdo Dry Valleys must adhere to the region's environmental regulations and consider helicopter restrictions for site selection and camp setup. Consult with ASC Environmental before going. The most commonly visited areas in the Dry Valleys have predetermined camp locations.

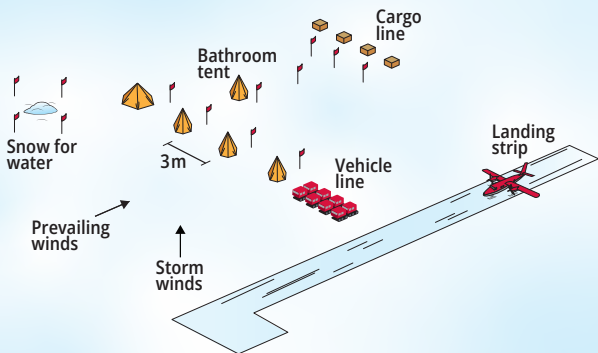
When erecting tents in the Dry Valleys, large boulders can provide a wind break, and large rocks or stacks of rocks can be tied off as anchors. If the field team is using metal stakes for anchors, it may take several minutes to hammer each one into the frozen soil. If the team intends to move camp, members should take extra anchors as it may be difficult to remove some from the frozen soil.

Camp Layout

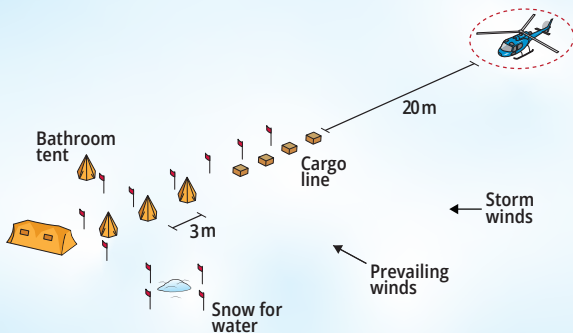
The layout of camp can be discussed ahead of time and adjusted once actual conditions are observed. Consider where to erect tents (e.g., for berthing, kitchen, meeting). Establish a

bathroom area with or without a tent. Store outside gear, and establish an emergency cache. Discuss camp layout regarding possible whiteout conditions, accounting for obstacles between tents and the feasibility of erecting rope lines between berthing, kitchen and bathroom tents. Below are examples of fixed wing- and helicopter-supported camp layouts.

Fixed Wing Camp Layout



Helicopter Camp Layout



Survival Cache and Emergency Shelter

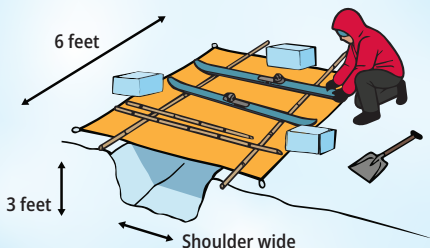
A survival cache should be set up a short distance from camp, about 200 to 300 meters (655 to 985 feet) upwind, in case the main tent with food and supplies is destroyed by fire or storm. The cache must contain a basic assortment of survival gear, with the minimum amount of each item determined by the number of people in camp and remoteness of the location. Critically, this cache must be securely anchored and its items kept dry.

The survival cache can consist of the issued survival bags, supplemented with a radio and batteries, water bottles and other crucial items specific to the field team. The bags can be stashed in a cave, anchored to the ground or buried in snow and flagged.

If the need arises for an emergency shelter, the first and most important order of business is to arrange for protection from wind. Spend some time looking around camp and investigate locations for physical features that provide a break from the prevailing wind and could be used in an emergency. Identifying those locations ahead of time can be crucial to an emergency response.

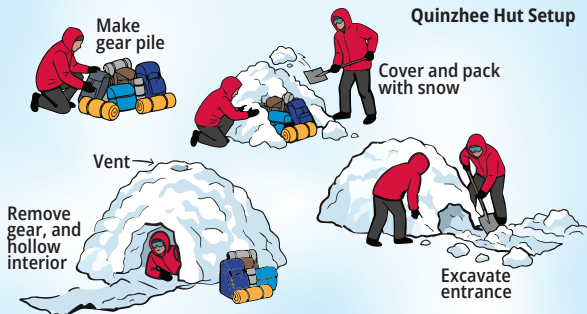
In snow, the quickest emergency shelter to construct is a trench. Dig a roughly three-foot-deep, six-foot-long, shoulder-width trench in the snow, making it long enough for a person to lie down with extra room for gear. Cover the trench with a tarp, and anchor the tarp with snow blocks, bamboo stakes, 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.

Snow Trench Setup

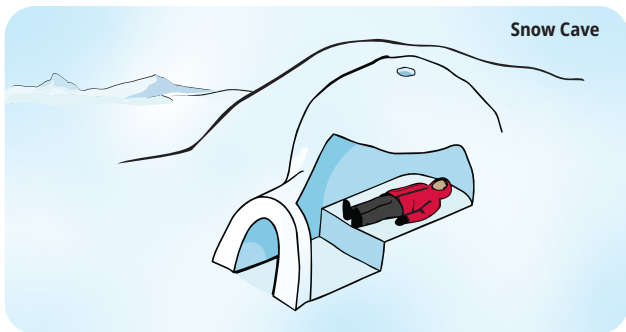


Other emergency snow shelters are quinzhee huts (i.e., snow mounds), snow caves (similar to quinzhee huts but dug directly into the snow) and igloos. Ventilation is critical if a stove will be operated in any snow shelter. On sea ice or a blue ice glacier, a wind break can be created by repositioning snowmobiles and sleds.

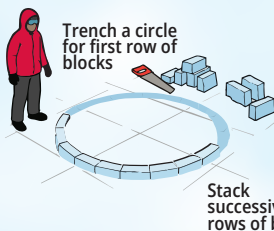
Quinzhee Hut Setup



Snow Cave



Igloo Setup



After last block, cap top then cut in vents and entrance

Shelters

Before teams deploy to the field, they should become experienced in erecting the tents they are issued. Set up tents at McMurdo Station and double-check their condition.

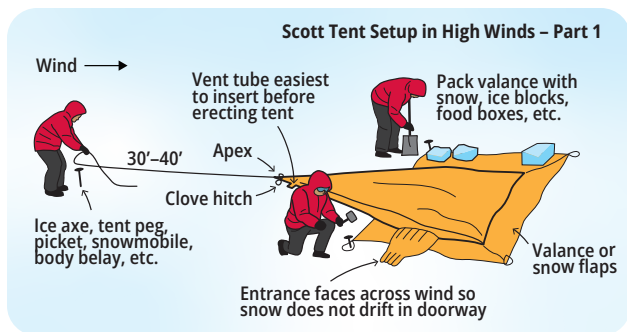
Tents must have a solid anchor for every guyline, and these should be checked daily to ensure they are tensioned. Loose guylines make the tent more prone to wind damage and make catastrophic failures in a storm more likely.

Avoid using “hard” knots (i.e., any knot that cannot be adjusted). Instead, use taut-line hitches or trucker’s hitches, as they are easy to tension and undo. Field team members should practice and become familiar with such knots before deploying. See the References section for steps on making a variety of knots.

Establishing Wind Direction

The most important factor in setting up a tent is securely anchoring it to withstand high winds. Field teams must first determine the prevailing wind direction by observing patterns in the snow or sand. Long rows of snow drifts (i.e., sastrugi) in, for example, a north-south orientation indicate the prevailing wind is either from the north or south. Next, 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. Sand can also form sastrugi-like drifts that help determine wind direction. Shorebirds often face into the wind, so wildlife can be an indicator too.

Orient the tent with the main door opening downwind, at a 45-degree angle to the prevailing wind. This helps prevent drifting that blocks the door and sheds the wind load.



Scott Tent Setup in High Winds – Parts 2 and 3

Wind →

If belay rope still connected, take in slack to secure tent

Tip into wind

Guyline still intact

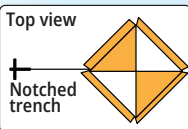
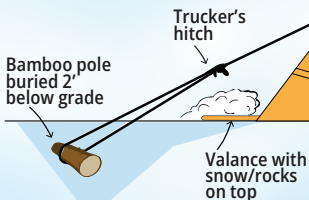


Anchoring the Tent

If tents have a valance (i.e., skirt) on the tent fly or body (see figure part 1 above), 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 and damaging the tent and helps keep it warmer. Do not pile rocks onto the tent wall, which could wear and tear the fabric in high winds.

Securing the Tent Valance

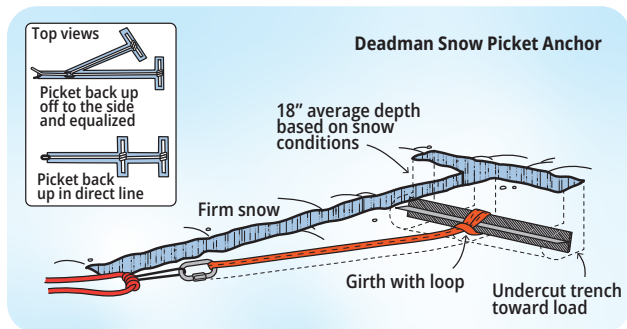
Wind →



Ground level

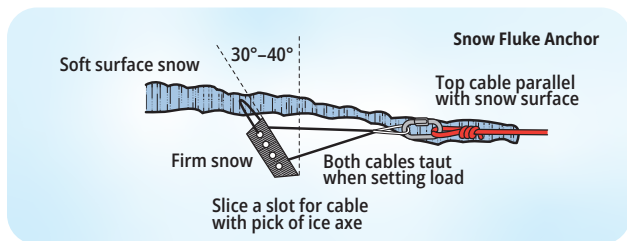
Substrate conditions inform how best to anchor a tent. If the snow or soil surface is **firm** (i.e., hardpacked), hammer in long stakes or sections of bamboo angled slightly away from

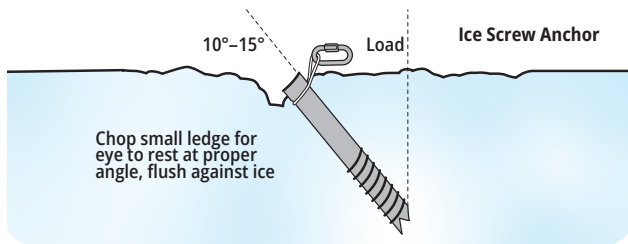
the tent and attach guylines to the stakes. If the snow is **soft**, bury a long stake or piece of bamboo (i.e., deadman) in a slot perpendicular to the angle of pull, with a guyline attached at the midpoint.



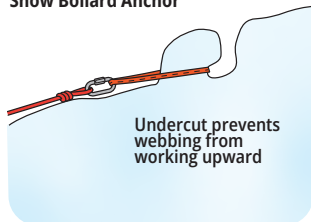
The guyline runs in a straight line from the deadman to the tent via a slot cut in the snow. Do not bury deadman too close to the tent, or it will be pulled upward when the line is tensioned. In very soft snow, the deadman anchor must be buried two feet deep or more. In soft sand and rocky terrain, rock bags can be the best way to anchor a tent. Fill rock bags with rocks, tie them up, then guy the tent to the bag.

Use a looped line or web sling around the deadman so the guylines can be easily tensioned or adjusted daily. Snow flukes and snow bollards are other ways to anchor tents or other objects in hard snow areas.

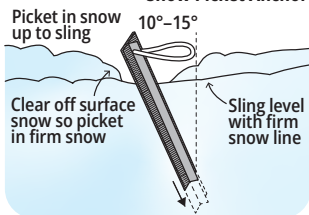




Snow Bollard Anchor



Snow Picket Anchor



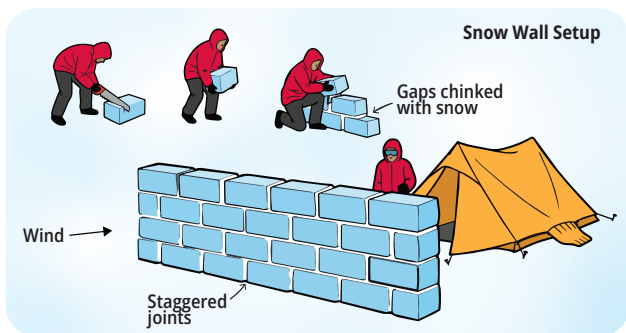
PRO TIPS

- If anchoring on rocky land, especially in a volcanic area with sharp rocks, be aware that the guyline exiting the ground from the deadman could wear down in windy conditions. Frequently monitor the line, and replace it if necessary.
- Alternatively, create a makeshift sheath around the line using rock sample bags or whatever may be on hand. Placing a length of bamboo between the guyline and ground may also help keep the line off sharp rocks.

Snow Walls

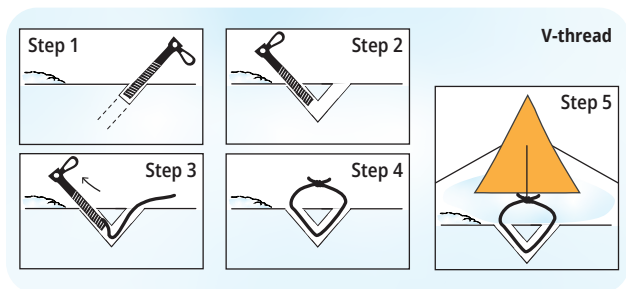
Snow walls (i.e., blocks cut from snow) can shelter tents from wind. If it is a windy day or the camp is at a windy location, field teams may need to construct snow walls before setting up a tent. Ideally, blocks are cut from hardpack with a saw, but a shovel or ice ax may work. Since snow conditions 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, try

packing down the snow with boots then check if it hardens (i.e., sinters) after an hour or more.



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 create the holes, and feed a guyline through the channel. Feed it to the bottom of the V on one side, then insert an ice screw on the other side. Twist the ice screw, and the teeth should grab the line and pull it out as the ice screw is withdrawn from the hole. The line can then be attached to the tent.



On sea ice, a glacier, rock or dirt, create a wind break by repositioning snowmobiles and sleds. In thick snow, you can opt to dig a trench.

Camp Medical

Before arriving at camp, it is best practice for team members to discuss relevant medical concerns with the designated field safety or medical lead. First-aid kits will be supplied and located in an agreed central location. The field lead (ASC camp manager, field coordinator, field safety coordinator or grantee) will most likely be in control of the prescription medical kit. Any medical interventions at camp involving more than basic first aid must be coordinated by the medical lead with the McMurdo Station physician. Ensure everyone is familiar with the location of medical supplies and knows what to do in case of a medical emergency. See the “United States Antarctic Program Field First-Aid” manual for more information.

Drinking Water

Most continental field camps set up a system to melt snow or glacial ice for their water supply. Some locations filter the meltwater, while others drink it as is. ASC Environmental can share information about when to filter water. For dry camp locations (i.e., many places in the Dry Valleys), water will be transported out in five-gallon jugs via helicopter.

Fire Prevention

Fire prevention is crucial in remote camps. Losing supplies or shelter to fire can immediately create an emergency situation. Before deploying to the field, ensure all field team members know how to properly operate stoves, lamps, heaters and generators. Once in the field and while you establish camp, keep these guidelines in mind:

- Minimize hazards in areas where combustible equipment is set up. Move stove and heater away from tent walls, and keep loose materials such as jackets or towels away.

- Ensure all equipment remains in proper working order during the field season.
- Place small propane heaters only on aluminum tables.
- Check propane cylinders for damage or leaks before using them.
- Store propane cylinders outside the tent whenever possible, with long propane hoses running from the tank to the inside of the tent where the stove or heater is located.
- Release pressure in any liquid fuel canisters outside the tent before packing or storing them.
- Operate and store generators at least 15 meters (~50 feet) away from any tent to prevent carbon monoxide (CO) poisoning.
- Do not dry clothes on a heater or stove. Use a clothespin to hang wet clothing on a string inside the tent.
- Line the inside of the tent behind the cooking stove with foil (duct tape and string can also be used) so the tent is not splattered with cooking grease and becomes a fire hazard. Change the foil frequently. Foil also helps protect the tent fabric from burning or melting.
- Fire extinguishers, CO detectors and smoke detectors are standard issue for field camps. Place them in appropriate and accessible areas, and ensure all field team members know their location and proper use.

Field Camp Daily Tasking

Communications

All Field Camps

- Complete the daily check-in call at or before the appointed time. Inform Central Comms of the number of people at camp and whether all is well.

- Make weather observations and call them into McMurdo Weather (MacWeather) at the prearranged times if this is required for the camp location.
- Call work centers as needed to request or confirm material for any impending resupply.

Fixed Wing-supported Camps

- Make weather observations and call them into MacWeather at the prearranged times.
- Call Central Comms after 1900 hours for the next day's flight schedule, or call the fixed wing supervisor.
- Follow the communications plan established with the Fixed Wing Office to arrange resupplies.
- Inform Fixed Wing Operations of the amount and nature of resupply items expected and the planned delivery date.
- Field teams may contact the Fixed Wing Office any day from 0730 to 1730 hours to transmit information or request a resupply, schedule change or camp takeout time.

Helicopter-supported Camps

- Monitor Channel 7 at all times, especially if a helicopter is in the vicinity, in case the pilot is trying to contact the camp.
- Call Helo Ops three business days in advance of a requested flight and provide all flight details (e.g., passengers, cargo, mission). If you are in Taylor Valley, route flight requests through the Taylor Valley camp manager.
- If expecting a flight that day, make weather observations and call them into Helo Ops between 0700 and 0730 hours.

Housekeeping, Health and Safety

- Inspect the camp area daily. Ensure everything is secure and all tent guylines are taut. Wind can increase at any time, and snow can drift quickly.
- Take daily weather observations, including temperature and wind speed. Maintain awareness of weather conditions.
- Inventory drinking water and cooking water. Haul, melt and boil or filter water as needed.
- As many items have long delivery times, check levels of commonly used items regularly (e.g., propane, food, paper towels, toilet paper, hand sanitizer). Make a list, and call for resupply once a week.
- Check waste levels (e.g., urine, solid human waste, gray water, food waste, biomedical waste), and bag or dispose of waste according to environmental guidelines.
- Check handwashing stations for adequate supplies, and replenish as necessary.
- Ensure the communal tent space is clean, tidy and stocked with essentials.
- Ensure waste and recyclables are properly sorted per McMurdo Station requirements.
- Ensure all Iridium phones, HF and VHF radios, other communications devices and the backup power pack are charged. Set up solar panels, or start up a generator to charge them.
- Refuel generators, stoves and other items that need fuel.
- Check for leaks, and clean up spills of any kind.
- Restock grab-and-go foods and snacks.
- Prepare and cook evening meals as assigned.

Recordkeeping

- Record any pollutant spills using the Field Spill Reporting Sheet.
- Record the required data in the environmental EOS reports (e.g., water and fuel usage, number of people in camp, estimates of human waste and gray water discharge, weather information).
- See the Environmental Policies section for details on the above.

Camp Takeout

Days Before Takeout

- Package equipment and cargo that are not being used. Record the weight, cube and type of retrograde (retro) cargo (i.e., cargo heading in opposite direction) for each box. This information will be passed to the fixed wing or helicopter supervisor for takeout flight planning.
- Package hazardous cargo in its original packaging and label it. Have the original hazardous cargo documentation readily available, as the pilot may request it.
- Identify a staging area next to the landing strip, and place cargo there when it is packaged and ready to go.
- Communicate with the fixed wing or helicopter supervisor to confirm takeout flights and relay cargo details.
- Notify Central Comms of the planned takeout date.
- Plan the takeout in stages.
- Cargo and passengers going on the last takeout flight must include essential gear and survival food for one week, plus a passenger responsible for weather observations, in case the takeout must be aborted.

- Communicate with ASC Lodging at least two days before arriving in McMurdo Station to arrange and confirm room assignments.
- Take GPS coordinates of all release sites for the EOS report.

Day of Takeout

- In fixed wing-supported camps, begin making hourly weather observations six hours before an LC-130 aircraft leaves McMurdo Station and three hours before a Twin Otter or Basler leaves its point of origin.
- Take down all tents.
- Place all remaining camp items in the staging area.
- Conduct a visual sweep of the camp to ensure all items are removed.
- Disassemble all radios and antennas.
- Before takeoff, conduct one last visual sweep to ensure everything and everyone is on the plane!

Hut Tasking

Complete the following tasks before leaving the hut so it is clean and tidy for the next field team:

- Sort and pack all trash and recyclables per waste guidelines, and take them back to McMurdo Station for proper disposal.
- Leave no trash or recyclables in the hut containers.
- Sweep the floor.
- Wipe all tabletops and chairs clean.
- Arrange chairs and tables neatly.
- Conduct a thorough visual sweep of the hut, and remove all personal and project-specific items.
- Wash and put away all dishes, utensils and cookware.

- Neatly package, label and store non-perishable food in its proper area.
- Take perishable food back to McMurdo Station.

On Return to McMurdo

Set aside sufficient time to clean and return all equipment to its proper storage area or department. Field teams are responsible for cleaning their gear, sorting it and ensuring it is checked in by BFC personnel. Gear return can take from one hour to two days based on the type of gear and its condition.

Initial Tasks

- Call the BFC in advance (x42348) 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, Therm-a-Rests) on the floor downstairs.
- Remove all flight tags, cargo stickers and duct tape from the gear.
- Report any damage to BFC staff, or tag it as such.
- BFC staff will inspect the gear, inventory it, check it in and print 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.

Tents

All communal cook tents must be set up, swept out and scrubbed. Make an appointment with BFC staff so they can assign a location and provide the proper cleaning tools. If there are holes in the tent or any other problems (e.g., cut guylines), affix a tag explaining the problem on the outside of the tent bag.

Kitchen Items

Dishes, Thermos bottles, food coolers, stoves, water coolers and five-gallon buckets must be cleaned. Wash and dry these items, using the sinks at the BFC. Repack the kitchen box, and inform BFC staff of any missing content.

Climbing Ropes and Equipment

Inform BFC staff of any issues with climbing ropes and equipment or of any falls on the rope. Check ropes before returning them. BFC staff will check all equipment during the winter, but field team knowledge and assistance is helpful.

Pee Bottles and Toilet Seats

Soak pee bottles with 10% bleach solution (1:10 bleach-to-water ratio) for 10 minutes. A system with directions is in place at the BFC, downstairs at the sink next to the washing machine, and on the first floor of the MEC.

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

Take human waste to the Waste Barn and place in the appropriate container.

Cage

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 BFC staff.

Fuel Cans aka Jerricans

Label any full or partially full fuel cans with the type of fuel, and place them under the appropriate sign outside the flammables van (across from the BFC). Consolidate like fuel,

and empty all unknown or unmarked jerricans in the waste barrel near 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 and become susceptible to decomposition during transport.

Stoves

Clean stoves with a degreaser, and dispose of grease in the designated sink onboard. Dry the stove before putting it away.

Backpacks

Empty all pockets and scrub backpacks with soap. Hang to dry.



FIELD GEAR

Predeployment

Most group and personal camping gear you take into the field will be issued to you upon arrival at McMurdo Station. All gear you receive will be tagged “RFI” (ready for issue). This means it has been serviced and checked and is ready to deploy into the field. Your team must inspect all its gear before going into the field. This ensures that participants are familiar with operation and setup in a controlled environment and helps catch any problems (e.g., malfunctioning equipment, broken parts) before deploying. The field team lead builds time into the deployment schedule to accomplish this, during gear issue at McMurdo Station. If your team requires specific guidance on equipment operation or maintenance, discuss this with your implementer or supervisor early so time and space can be dedicated to your field preparation.

This section of the manual covers safety, basic operation and troubleshooting of stoves, heaters, sleds, generators, snowmobiles and renewable-energy power systems. Most field gear will come from the BFC, MEC and Carp Shop. Contact the appropriate work center for assistance.

Stoves

The BFC issues propane and white-gas cooking stoves (liquid fuel stoves to field parties. This guide provides information on stove safety, basic operation and troubleshooting.

Safety

Liquid-fuel stoves are potentially hazardous due to the flammability of the fuels and the toxicity of the CO they produce. It is important for field personnel to follow these safety measures when using stoves or heaters:

- Test all stoves before field deployment.
- Do not use stoves without adequate ventilation.
- 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 the stove.
- Pack stoves and fuel away from food.
- Do not cook in mountain tents, except in emergencies. Cooking in the Scott tents is safe with proper mitigation (see the next subsection).
- Use caution when priming the stove, as it can flare up when fuel is lit.
- Insulate the base of the stove so it does not melt through the tent floor. Use a rock-box lid, preferably covered in aluminum foil, a metal platform or another non-fabric surface.
- Do not release fuel tank pressure near an open flame.

Residues of evaporated gasoline are combustible. Designate a pair of rubber gloves for fueling operations, and do not use them near stoves. Should someone's clothing ignite, have them stop, drop and roll to extinguish the flames.

Use in Scott Tents

It has been common practice in Antarctica to use stoves inside Scott tents. Historically, many camps were small, and Scott tents were the main "home" for a field camp, so stoves were used inside. This is still a practice in various locations, either for full kitchen duties or to heat water and the tent in places with extreme cold or dampness. Stove use in tents is a strategy to stay warm and comfortable, but it can lead to complacency and is often discouraged in favor of safer ways of staying warm in tents. Do the following to use stoves safely:

- Ensure all sleeping bags, sleeping pads and personal clothing are stowed away from the stove before starting it.
- If running the stove, put a kettle on to boil water for hot water bottles, which also prevents an open flame.

- Communicate any signs or symptoms of CO poisoning, which is intensified by altitude.
- Use a CO monitor.

CO Risks

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

Inhaled CO displaces oxygen in the bloodstream, starving the heart, brain and other vital organs. People are even more susceptible to CO poisoning at altitude. Several cases of CO poisoning have occurred in Antarctic field camps due to improper stove use. The best way to avoid CO poisoning is by ensuring any structure in which cooking occurs is well ventilated. Because CO has no color, taste or smell, it is better to be safe than sorry:

- 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.**

Scott tents are the main type of tent in which a stove would be used. It is important to keep the tent door open and ensure all vent tubes at the top of the tent are free from snow and ice. If there is little wind, condensation can build up and freeze in the vent tubes, leading to poor ventilation.

Field teams must use a CO detector (issued by the BFC) when cooking in a tent. Do not directly attach the detector to the stove. The detectors are not foolproof, so all team members must be vigilant about CO risks and symptoms. See the “United States Antarctic Program Field First-Aid” manual, or contact Medical for more information.

Camps do their best to offer alternative means of staying warm and drying clothes, to avoid indoor stove use and its risk. Warm water bottles in the sleeping bag are a great way to stay warm at night, and they can be topped off by bringing a Thermos when you go to bed. Hanging cord above stoves in the larger, communal tents also allows for drying clothes.

MSR WhisperLite Stove

Assembly

1. Fill the MSR fuel bottle to within two inches of its cap.
2. Screw the pump snugly into the fuel bottle.
3. Pump the plunger 15 to 20 times for a full bottle. Additional strokes are 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. Securely snap the catch arm into the slot on the pump body.

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 half the priming cup.
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 reprime 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

1. The stove should burn with a steady blue flame.
2. To simmer, operate the stove with low pressure in the fuel bottle (see Handouts in the References section for manufacturer manual). There will be a delay between control valve turns and changes in flame intensity.

Shutoff

1. Turn the control valve off.
2. Wait for the stove to cool before disassembling.
3. Before depressurizing the fuel bottle, move away from heat, sparks and flames. Turn the stove assembly upside down, and open the control valve. Pressure will be eliminated through the jet.

PRO TIPS

- Do not use these stoves in mountain tents, except in an emergency and only in the tent's vestibule.
- 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.

Troubleshooting

MSR WhisperLite Stove Troubleshooting

Problem		Fix
No/low pressure		Tighten loose pump on fuel bottle.
		Replace damaged pump cup.
		Oil the dry pump cup to loosen plunger.
Yellow flame		Reduce fuel bottle pressure and allow more oxygen through windscreen.
		Close windscreen around stove and use heat reflector. (Generator tube may be too cold.)
		Ensure flame rings in correct order from top (burner cap) to bottom (flame reflector). 7 rings on wire-leg stoves = wavy, flat, wavy, flat, wavy, flat, wavy. 8 rings on flat-leg stoves = wavy, flat, wavy, flat, wavy, flat, flat, flat.
Weak flame		Pump plunger to increase pressure in fuel bottle.
		Ensure correct jet installed for fuel type.
		Clear jet and fuel line of any obstructions.
		Allow more oxygen through windscreen.
		If burner cap is bright red and stove makes dull roar, flame is burning under cap instead of flame rings. Clean jet, confirm correct jet installed, and ensure flame rings are clean and installed correctly (see last fix at "Yellow flame").
Fuel leak at	Control valve	Replace control valve O-ring if damaged.*
		Replace pump if control valve threads damaged or stripped from overtightening.
	Pump connection	Ensure only MSR fuel bottle is used.
		Replace bottle if threads damaged or bottle dented.
		Replace O-ring for bottle or fuel tube if damaged.*
		Replace fuel tube bushing if damaged.*

Problem		Fix
	Fuel line	Replace fuel line or entire stove if line damaged.
	Shaker jet	If fuel leaks through jet when control valve off, pump is damaged from overtightening valve. Replace pump.
		Tighten if necessary with jet and cable tool.*
		Replace jet if damaged.*

Note: Based on information from Cascade Designs, Inc., "MSR WhisperLite Stove Instruction Manual," https://cascadedesigns.com/cdn/shop/files/11368_Instructions_WL_All_Lang_33-946.pdf, and from USAP's Berg Field Center.

*Stove/pump replacement parts are available in the repair kit.

Coleman Gas Stove

Setup

1. Close the valve and unscrew the tank cap. Do this carefully if the tank has pressure inside.
2. Use a fuel funnel with a filter. Use white gas only.
3. Wipe off any spilled fuel, and replace the cap.
4. **Never open the tank around an open flame or remove the cap while the stove is running.**

Tank Pressurization

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

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 the fuel valve lever up.
5. When the flame is blue, turn the valve lever down.
6. Add pressure if needed while firmly holding the tank.
7. If the flame does not burn fully, open and close the valve to clean the tip.
8. 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 and the next Troubleshooting subsection here.

Shutoff

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.
3. When the flame is out, let the stove cool before packing it away.

PRO TIPS

Most problems with Coleman stoves occur in extremely cold temperatures, which the stove was not designed for. Take these measures to enhance its performance:

- Use only clean, filtered white gas.
- Do not overfill the tank, as this impedes performance.
- The pump mechanism becomes impaired as temperatures drop. Keep the pump plunger oiled. Also keep the rubber or leather pump cup oiled and pliable, as it can dry out.
- In temperatures below -6°C (21°F), 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, ensure 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.
- Place the stove where it can be thrown out of the tent in an emergency. Keep a small fire extinguisher nearby.

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 off completely. Remove the tank assembly and clean fuel from the manifold and burners with absorbent pads provided in the spill kit (i.e., the small, black nylon bag). Replace the tank assembly, and repeat the lighting process.

Access the control valve assembly (behind the knobs and under the burners) as follows:

1. Unscrew the burners.
2. Turn the stove over and unscrew the nuts on the bottom.
3. 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.
4. Remove the metal tray for access to the burner and control valve assemblies.

Additional troubleshooting tips are provided in the next table.

Coleman Gas Stove Troubleshooting

Problem	Fix
No pressure	Remove and inspect pump for cracks, dryness, creases, or tears. Replace and oil.
	Check tank lid gasket for pressure leak.
	Check for flooded pump cylinder. If so, pump valve is faulty and needs replacing.
	Check for broken seal at valve assembly and tank junction. Tighten by one rotation if possible.
Loses pressure	Tank naturally loses pressure the longer it sits without periodic pumping.
	If pressure is lost soon after pumping, check all joints and gaskets.
	Check for leaky cap gasket. Replace gasket/cap.
Yellow flame	Clean or replace dirty/faulty generator.
	If manifold assembly is flooded, turn stove off, cool, remove tank assembly, and wipe out excess fuel.
	Fuel may be contaminated. Drain and replace with new fuel.
	Ensure tank and generator seated properly.
Flame at generator tip	Tighten tip of generator if loose.

Problem	Fix
Poor gas flow to burner	If generator clogged, clean or replace.
	Check if cleaning needle at end of generator is bent. Replace needle.
	Ensure tank and generator seated properly.
Weak flame	Preheat generator.
	Clean or replace dirty/faulty generator.
	Increase pressure.
	If manifold assembly is flooded, turn stove off, cool, remove tank assembly, and wipe out excess fuel.
	Fuel may be contaminated. Drain and replace with new fuel.
	Ensure tank and generator seated properly.
Flaring	Tighten tip of generator if loose.
	Ensure tank and generator seated properly.
	If burner flooded, shut down and dry out.
	Reduce excessive pressure in tank.
	Shut down and reprime insufficiently primed stove.
	Refrain from opening fuel flow switch (i.e., changing to "on" position) too early.
	Fuel may be contaminated. Drain and replace with new fuel.
	If grease in stove, clean grease out, line bottom of stove with foil, and change foil when dirty.
Note: Based on information from USAP's Berg Field Center.	

Coleman Propane Stove

Propane cylinders must be stored outside of a tent. Use a long propane hose through an opening in the tent door or window to connect the cylinder to the stove.

Setup

1. Press on the latch to open the lid.
2. Position the wind baffles.
3. Insert the wire clips into the slots.
4. Firmly close both burner valves.
5. Remove the regulator from storage under the grate.
6. Attach and hand-tighten the regulator to the 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.
9. Ensure the regulator and connections are not cross-threaded, as this will cause a leak.

Lighting

For electronic ignition stoves, open the burner valve and rotate the igniter knob several times until the burner lights. Use a match to light the burner if the igniter fails.

For standard ignition stoves, hold a lit match near the burner and open the valve. Adjust the flame with the burner valves.

Shutoff

Firmly close the burner valves.

Storage

Remove the propane cylinder or hose, then unscrew the regulator from the stove and store it under the cooking grate.

Heaters

The Carp Shop maintains heaters in semipermanent field camps and sea ice huts. The continental field inventory has three types of heaters to warm tents. These may be used only in Arctic Oven, Weatherhaven or Scott tents. The heaters are not designed for mountain tents.

Use the heaters only on a non-flammable surface (e.g., aluminum table), keep them far away from combustible materials, and never leave them unattended. Take significant care to properly ventilate the tent to reduce the risk of CO poisoning. Do not use the heaters to dry clothing.

If you smell propane or gas when a heater or cook stove is in use, stop, turn off all valves and recheck the hose and cylinder connections. The odor may be more detectable closer to the floor since propane gas is heavier than air.

Do not store heaters or propane cylinders near the open flame of cook stoves. Store propane cylinders outside the tent when they are not in use.

Preway Diesel (AN-8) Heater

These heaters are installed in huts in the Dry Valleys.

Lighting

1. Ensure the Preway is level. If it is not, it will not burn correctly.
2. Ensure the outside fuel valve at the tank and the breather tube are 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.

Preway heaters usually burn poorly and produce excessive soot when their valve knob is set to “1” (too low) or “6” (too high). To avoid reduced performance and frequent cleaning of the heater, use settings “2” through “5.” A properly burning heater does not require cleaning more than once every couple of months.

Shutoff

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

PRO TIPS

- Do not use the Preway as an incinerator by leaving burnt tissue or tossing any combustibles in the chamber. Otherwise, the heater will stop working and fill with partially burnt ashes.
- At startup, do not immediately turn the valve knob to a high number. Let the heater warm up first on “3,” or it will make woofing sounds.
- Do not leave the burn chamber door open longer than necessary when the heater is burning. Otherwise, the heater will improperly draft by due to excess air.
- Never wire down the safety lever on the carburetor. If it needs to be “held down” for the heater to operate, then an internal problem must be fixed. Wiring down the lever poses two risks:
 - Flooding the heater with too much fuel (creating a mess)
 - Flooding the structure with the full contents of the fuel barrel (creating an even bigger mess)

Kuma Arctic Heater

Kuma Arctic heaters will replace the old Preway heaters and are installed in sea ice huts, some Dry Valleys huts and deep-field fixed camps. **Beware that the handles on the side of the heater are surprisingly hot.** Do not touch or hang towels or clothing over the handles. Read all the instructions before lighting the heater.

Lighting

1. Ensure the burn chamber is clean before lighting the Kuma.
2. Open the heater door, and remove the stainless-steel mesh cylinder and burn ring from the burn pot.
3. Turn on all supply valves (i.e., tank and in-line valves).
4. If there are any leaks in the system, immediately turn off all valves.
5. Turn the control knob on the carburetor to "1."
6. Move the "ON/OFF" lever on the carburetor to the correct position to start the flow of fuel oil into the burn pot. Based on the carburetor model, the lever may need to be pressed down or pulled up for "ON," as indicated on the carburetor near its lever.
7. When enough fuel has entered the burn pot to fill the center groove (~four tablespoons), turn both the control knob and carburetor lever off.
8. Replace the burn ring into the burn pot so the cupped part of the ring is face up (as if it would hold water). The heater 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.
10. Use the wire to spread the fireball around the fuel puddle.
11. Replace the mesh cylinder, and close the door tightly, turning the door handle until it is snug. Do not overtighten.

12. Wait for the fuel in the burn pot to catch fire. After the flame begins to die down, which could take several minutes, turn the carburetor on again using the "ON/OFF" lever and turn the control knob to "1."
13. The flame should slowly grow. Within a few minutes, the heater should begin burning a blue flame.
14. Run the heater for at least 15 minutes on "1" to allow the chimney and heater to heat up before adjusting the temperature. Failure to allow proper heating time will cause the system to soot up.
15. After 15 minutes, ensure the flue and heater are warmed before making any carburetor adjustments to achieve the desired heat level. Adjustments should be of no more than one-quarter turn, and each adjustment should be allowed to stabilize for five minutes before making any further adjustments. The highest setting is "6."

Shutoff

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.
3. Do not adjust the "firematic" valve that is between the fuel filter and heater (the only round handle on the fuel line that resembles a spigot).

PRO TIPS

- Do not use the Kuma as an incinerator by leaving burnt tissue or tossing any combustibles in the chamber.
- Do not light a flooded or hot heater!

Empire Vented Propane Heater

Empire heaters are installed in sea ice huts.

Lighting

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

Shutoff

1. Set the heat dial to "1" and the control knob to "pilot."
2. Close the combustion air vents.
3. Leave the pilot light on at all times, unless the tank is being changed or the hut is being moved. If moving the hut, turn off the propane at the tank.

Sleds

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

Nansen Sleds

Nansen sleds can haul two drums side by side.

Siglin UHMW Sleds

Siglin ultra high molecular weight (UHMW) sleds can accommodate two drums side by side. There are an eight-foot and a 12-foot version. A snowmobile can tow these sleds, which have side ropes for lashing down gear.

Komatik Sleds

Komatik sleds can carry up to five drums side by side.

Banana Sleds

Banana sleds have fabric cargo covers attached along the sides. The cover folds over the cargo and is tied down. These sleds are heavy and best towed by a snowmobile.

Loading and Securing Cargo

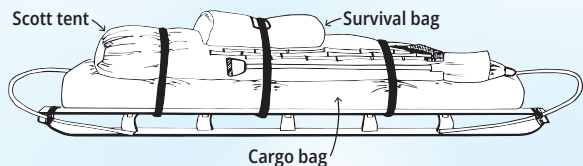
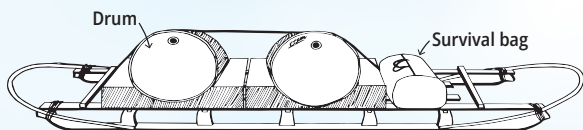
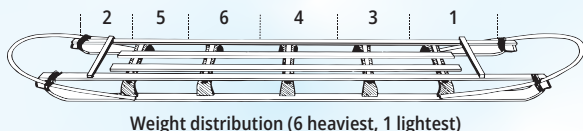
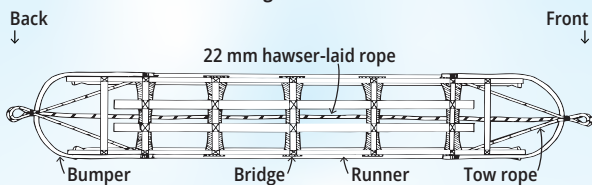
The following Nansen sled diagrams also apply to the other sleds. Load with the heaviest items on the bottom. Place small items in sled bags. Put the survival bag at the top of the load, along with anything the team members may need during the day. Rock boxes (wooden and measuring 18 × 12 × 12 inches) 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. Secure the finished load tightly with cord, cargo straps or bungee cords. 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 retension a cord.

Check all lashings periodically and every time the team stops for any reason. During this time, if towing the sled with a snowmobile, also inspect the snowmobile, tow plate, ropes and sled for any developing structural issues. Retighten the lashings if they have become loose. It is prudent to bring extra lashing supplies into the field.

Loading a Nansen Sled



Pulling Sleds by Snowmobile

With ideal surface conditions, a tail wind and light loads, a snowmobile pulling a sled can get seven miles per gallon (mpg) of fuel. Soft snow conditions, heavy loads and strong head winds significantly reduce fuel efficiency, to as low as two to three mpg. Likewise, a snowmobile can pull up to 1,500 pounds (lb) when conditions are good and much less when they are not. Keep these environmental conditions in mind when planning loads and fuel consumption.

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

1. Attach sleds equipped with rigid tongues directly to snowmobiles. Other sleds attach with a tow rope.
2. Before driving, rock the sleds back and forth to break the runners and the bottom free of ice.
3. Drive slowly. Driving fast over uneven terrain may cause a sled to tip over, which can severely injure people and damage the sled, cargo and snowmobile.
4. Drive even slower if pulling passengers. Everyone must wear a snowmobile helmet, including persons riding on the sled.
5. Maintain situational awareness and regularly look back to ensure everything is riding securely, especially passengers.
6. Stop gradually so the sled does not run into the back of the snowmobile.

Snowmobiles

Snowmobiles are maintained by the MEC, which provides a basic snowmobile course for groups who will them. This indoor class aims to familiarize you with the basic components and operation of the machines. FS&T provides more advanced training as needed (e.g., if you have new riders who would like to build confidence on snowmobiles or will work in a location with more complex terrain). This subsection provides general operation and troubleshooting guidance. For advice, contact

the MEC at 720-568-1080 (ask to be transferred) or MCM-MEC-Supervisor@usap.gov.

Safety

- All snowmobile riders and passengers must wear a helmet. This includes people towed 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 four-stroke engines and require MoGas (motor vehicle gasoline, or standard unleaded fuel).
- A snowmobile's center of gravity is just in front and toward the bottom of the fuel tank. Operators must shift their body weight for turning and as needed for the load, terrain and 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.
- Watch for loose trailing straps and ropes, as these can get tangled in the tracks and around axles.
- Never shift the transmission unless the machine 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 facing into the prevailing wind and always cover them. This reduces the likelihood of snow accumulating under the cowl.

Precheck

- Before starting the snowmobile, check all hardware on the suspension. Tighten any loose nuts or bolts with the tool kit under the seat.

- Look for broken components, such as H-arms, springs, the shock mount, the shock and tracks. Inspect everything.
- Remove any snow from under the engine hood, drive belt, pulleys, exhaust pipe and lower steering arms.
- Ensure the machine is in neutral. All riders should make it a habit to shift into neutral when stopping.
- Ensure the throttle moves through its full range of motion and snaps back to idle when released.
- Ensure the brake moves through its full range of motion. It is normal to feel resistance, and the brake lever should never pull all the way to the handlebar. Also, the brake should never go all the way to the floor.

Startup

1. Do the following for the first cold start of the day or if the snowmobile is off for more than an hour:
 - A. Ensure the transmission is in neutral.
 - B. Insert the key, and push the button to start.
 - C. Let the snowmobile warm up, bearing in mind that it will idle up to 12 minutes before automatically turning off.
2. Once the machine is warm, engage the gear then ease into the throttle.
3. If the engine is off for less than an hour, ensure the transmission is in neutral and engage the electric starter. Allow the engine to warm thoroughly before driving it.

Preventive Maintenance

Daily

1. Do a walk-around of the machine each day before starting, which is the single best thing you can do to keep it running throughout the season.
2. Check the suspension, especially when operating on ice.

3. Look for broken suspension components.
4. Importantly, check all parts at the end of the day! Finding a broken machine at the beginning of the following day can result in a lost day of science.

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

- Maintain a low center of gravity.
- Keep straps tied down, ensuring there are no loose ends.
- Place often used items where they are easy to get to.
- Do not exceed the 150-pound limit for loads on the rear of the snowmobile.

Towing

- Sleds may be towed with rigid tongues (preferred) or ropes, depending on the circumstances.
- Check the hitch mechanisms on both the 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.

Communication

Use the following hand signals when driving a snowmobile in a group.

Snowmobile Hand Signals

OK, ready to depart
(hand on head)



Watch out for crevasse/hazard
(arm out, pointing)



Stop or stopping
(fist in air; elbow at right angle)



Slow/slowing down
(arm out, palm down and patting)



Speed/speeding up
(arm out, palm up and pushing)



Driving

- Whenever possible, drive on a proven trail or hard surface.
- If the snowmobile begins to bog down while driving in powdery snow, maintain the throttle and head in the straightest line possible for firmer or packed snow. Sharp turns will compound the problem.
- If the machine slows and reaching firmer snow appears impossible, then **stop and do not continue spinning the track**. Instead, take the following steps:
 - 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.
 - Alternatively, use a tow rope and have another snowmobile pull the stuck one out.
 - If a stuck machine does not come out quickly, stop towing and dig more. Continual towing wears drive belts prematurely and can cause them to break. It can also damage the engine.

Honda Generator

Before science teams deploy to the field, the MEC trains them in the operation and maintenance of generators.

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 one meter (~three feet) away from tents or other equipment during operation. Do not place flammable objects close to the generator.

- Know how to operate all the controls and to stop the generator quickly.
- Do not let the generator get wet or operate it with wet hands. The generator is a potential source of electrical shock if misused.
- Gasoline is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks near any stored gasoline or the generator refueling area. Refuel the generator in a well-ventilated area, with the engine stopped.
- The engine muffler becomes hot during operation and remains hot for some time after engine shutoff. Do not touch the muffler or engine or store the generator indoors until the generator has cooled.

Precheck

1. Check and add MoGas to the generator if necessary.
2. Check the engine oil level with each fueling, and add any needed oil (i.e., 0W-30).
3. Check the air cleaner element to ensure it is clean and free of ice and snow. It should feel oily.

Startup

1. Ensure 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 — do not use the choke if the engine is warm.
4. Ensure the auto-throttle switch is off if the generator has one.
5. Move the engine switch to the “on” position.
6. Slowly pull the starter grip until resistance is felt, then pull briskly. 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.

Shutoff

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

Honda Generator Troubleshooting

Problem	Fix
Engine does not start	Turn engine switch on if off.
	If oil-alert lamp flashes when starter is pulled, oil is low. Add oil.
	Ensure all loads are unplugged from AC receptacles.
	Check for spark at spark plug, grounding side of electrode to engine and pulling recoil starter to see if spark jumps the gap. Replace plug if no spark.
	Place suitable container under carburetor, loosen drain screw, and ensure fuel flows freely to carburetor. If not, check fuel valve on tank.
Engine starts but stops immediately	Check for low oil level, fill oil reservoir to top of dipstick, then restart engine.
No electricity at receptacles	Turn on AC circuit breaker if off.
	Check the appliance or the equipment plugged into generator for defects. Fix as needed.
Note: Based on information from USAP's Berg Field Center.	

Mini Portable Field Power Systems

Before science teams deploy to the field, the MEC also trains them in the operation and maintenance of the mini portable field power system, a self-contained solar power supply that can be quickly assembled and connected for transportation. The unit includes a weatherproof box, solar panel stand and 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 direct current (DC).

1. Before the season begins, inspect the unit for damage or loose wires and fix them as needed.
2. Choose a configuration for the solar panels:
 - A. Mounted atop the box with four $1/4 \times 20$ bolts (i.e., bolts that are $1/4$ inch in diameter with 20 threads per inch)
 - B. Standing independently and tied down
 - C. Spread out to face the sun for maximum input
3. However configured, ensure the solar panels are secure against possible wind gusts.
4. Connect the three-pin solar plug to the three-pin receptacle.
5. Connect the five-pin extension cord to the five-pin receptacle.
6. Turn both the 40-amp breaker and the switch on the far side of the inverter to the "on" position. AC power will now be available.
7. When battery power is low, the AC and DC outputs will disconnect, and power will not return until battery voltage reaches 12.2 volts DC.
 - A. Disconnect loads, and let the system recharge.

- B. Recharging from an 80% discharge takes about three days in the sun.
- C. Plan for recharging to take time, especially during cloudy days and given three consecutive days of full sun in Antarctica is rare.



AIRCRAFT AND CARGO

Field teams conducting research within 100 miles of McMurdo Station, including near-station areas inaccessible by ground vehicle, will likely be transported via helicopter. Teams working further afield will likely travel via fixed wing aircraft.

In the months leading up to deployment, project PIs identify desired flight dates, destinations and cargo requests when submitting their SIP. Through discussions and logistics planning with all groups, each team is allotted a certain number of flight hours and flight days, as well as cargo limits, all of which is determined prior to deployment and outlined in the RSP. (As flight hours and days are carefully planned for the entire season, midseason requests for more hours or flights are often declined.) Deadlines for submitting SIPs to USAP Cargo (aka Science Cargo) are established by Science Cargo staff and included with the helicopter or fixed wing instructions in the Crary Grantee Binder upon arrival.

When teams arrive on station, flights approved in their RSP will have been established in a weekly schedule of placeholders. Shortly after arrival, teams meet with fixed wing or helicopter staff to discuss their field plans in detail and obtain aircraft designations and the planning ACLs. Field teams must request each flight three business days in advance. Exact flight dates and times are decided the day before the flights and may change due to aircraft availability or weather.

Cargo Requirements

Before their scheduled flights, field teams must carefully review their field planning checklists for critical timelines. Teams are responsible for preparing cargo and providing cargo information and passenger names to fixed wing and helicopter staff.

Fixed wing cargo prep takes place at Science Cargo (BL073), where items are packaged, weighed, labeled and given a shipping number. Field teams are responsible for gathering their cargo (including field gear) and ensuring it is transported to Science Cargo. To obtain the mandatory shipping numbers for fixed wing cargo items, complete the Science Cargo form

that records the weight and cube (i.e., volume in cubic feet) of each item, physical description, deliver-by date and project number. If you have any questions, ask Science Cargo staff for assistance. Field teams must maintain a list of their shipping numbers and related information to plan cargo loads. Ensure you know the timeline for packing and submitting cargo, as cargo submitted too near your departure may be rejected, which can delay your deployment to the field.

For helicopter flights, field teams must gather and weigh all their cargo and coordinate with helicopter technicians (helo techs) to transport it to the helicopter pad. All cargo weights and dimensions must be submitted to helicopter staff 72 hours before the flight.

Hazardous Cargo

Cargo that is flammable, explosive, poisonous, radioactive, corrosive, under pressure or capable of releasing toxic fumes is hazardous for aircraft operations. Contact the hazardous cargo supervisor with any questions about potentially hazardous items. Common types of hazardous cargo include the following:

- Battery (e.g., acid, car, lithium)
- Burn paste
- Detonator
- Explosive
- Fire extinguisher
- Fuel drum (e.g., AN-8, MoGas, Premix)
- Gas stoves (e.g., Coleman, WhisperLite)
- Hand sanitizer
- Heater (e.g., Herman Nelson, kerosene, propane)
- Hurdy gurdy (i.e., hand-cranked device for getting fuel out of drum)
- Isopropyl alcohol

- Jerrican, full or empty of fuel (e.g., AN-8, kerosene, MoGas, Premix)
- Jiffy drill (i.e., handheld, gas-powered ice drill)
- Matches
- MSR fuel bottle (for deep-field survival bag or WhisperLite stove)
- Power generator
- Pressurized gas cylinder (e.g., helium, nitrogen, oxygen)
- Propane
- Snowmobile
- Spray can (e.g., paint, WD-40)
- Stove fuel (i.e., white gas)

Preparation

Hazardous cargo must be packaged, labeled and handled to minimize danger to the aircraft, passengers and crew, a process that cannot be rushed. As such, field teams must identify and submit hazardous items to Science Cargo at least five business days before a fixed wing flight or three days before a helicopter flight. Failure to do so means the items may not be cleared for the flight, as last-minute assistance is usually unavailable.

Each hazardous cargo item requires a Shipper's Declaration for Dangerous Goods (haz dec). This form records details on the item's type, packaging and emergency response requirements. A haz dec for each item is included with the flight manifest paperwork. Field teams must keep copies of all haz decs, which may be needed during camp takeout.

Retrograde

Retro is any cargo heading in the opposite direction of its deployment (e.g., north from Antarctica or from field camp to station). When field parties retro hazardous cargo from the field, it must be properly packaged and labeled.

Partially full fuel drums must be tightly capped. Ensure spill containment is in place to catch any leakage, then tip the fuel drum on its side to confirm a good seal. Containment must also be used if the drums are shipped on their side. Snowmobiles must have between a quarter and half tank of fuel — no more, no less. Liquid fuel containers (e.g., drums, jerricans) must have the type of fuel written on them in permanent marker. Propane tanks and other pressurized containers must be in good condition and free of rust or damage. Package other retro similar to how it was originally shipped (e.g., matches in foil, 12-volt batteries in wooden boxes).

Preserving the packaging, labels and paperwork generated for the cargo's field deployment makes it easier to prepare cargo for return shipping or entry into the USAP logistics stream. Flight crews also require a haz dec for each hazardous retrograde item returning from the field to McMurdo Station.

Resupply

Before deploying, field teams prepare their camp resupplies by packing boxes with desired items (e.g., food, fuel, equipment) and keeping a careful inventory of each box. Boxes are marked and equipment items are tagged with the science group number, item or box number, destination, and weight. If the project has been allocated a cage, non-hazardous items are stored there.

Field teams provide copies of the resupply inventory to the BFC supervisor, as well as the Fixed Wing Office or Helicopter Office depending on the type of aircraft supporting their camp, and take a copy into the field. When deployed teams are ready for a resupply, they contact the Fixed Wing Office or Helicopter Office (or Central Comms if there is no answer) to request a specific box (e.g., box #2). Camps with phone access to McMurdo Station can call individual departments for resupply items. When resupplying a hazardous item, field teams must provide Science Cargo at least two days' notice so it can deliver the item to the aircraft.

Resupply delivery will be coordinated. For helicopter-supported camps, flights already scheduled to move field camps during the season or provide transport for day trips away from camp are efficient ways to transport resupply boxes. Resupplies in fixed wing camps happen as flights are available. Typically, camps will have a notion of the week's incoming flights and can coordinate what arrives on each flight according to its ACL. Many deep field locations will not receive a resupply and should plan to take everything they need at the start of the season. See the Field Camp Operations section for more details.

Frozen Food

Frozen food for large, ASC-staffed field camps is pulled, packaged and turned over to Science Cargo by ASC personnel. The food is then stored in McMurdo Station food service freezers. For smaller deep-field camps, the food is pulled as close to the three-day advance deadline as possible then stored in the airfield freezer.

A few hours before the flight, Science Cargo transports the frozen food to the aircraft. If the flight is delayed or canceled, Field staff must ensure the food is returned to the airfield freezer. For helicopter flights, the food is stored in the BFC freezer until it is ready for transport to the aircraft by helo techs.

Frozen food that has traveled to the field cannot be returned for use at McMurdo Station. At the end of the season, frozen food can be left at camps that it will be occupied the next season or is treated as food waste.

Fixed Wing Support

Teams entering the field via fixed wing aircraft will fly on an LC-130 Hercules operated by the New York Air National Guard (NYANG) or a Basler or Twin Otter aircraft operated by Kenn Borek Air, Ltd. (KBA). Flights on these aircraft are scheduled by the Fixed Wing Office after you have put in your flight request.

Aircraft and Flight Characteristics

Characteristic	LC-130	Basler	Twin Otter
Maximum seating	40 passengers 2 pilots 1 navigator 1 flight engineer 2 loadmasters	18 passengers 2 pilots 1 flight attendant	19 passengers 2 pilots
Cargo door	Aft door w/ramp (10' × 9' 2")	Side door (5' 11" × 4' 8")	Side door (4' 8" × 5' 1")
Cargo space	4,016 ft ³ (6 pallets; various configurations)	1,225 ft ³	126 ft ³
Maximum round-trip flight	~8.0 hours	~10.0 hours	~10.0 hours w/fuel stops
Flight from McMurdo to			
Siple Dome	2.0 hours	2.5 hours	3.3 hours
South Pole	2.7 hours	4.5 hours	6.0 hours w/fuel stop
Byrd Camp	3.0 hours	4.5 hours	6.0 hours
West Antarctic Ice Sheet (WAIS) Divide	3.3 hours	5.0 hours	6.0 hours w/fuel stop

LC-130

The LC-130 Hercules is the largest ski-equipped aircraft used in Antarctica. These airplanes have four turboprop engines and can carry more payload than the Basler or Twin Otter but require a longer skiway length. LC-130s are loaded and unloaded via a large rear hatch with a ramp, which can accommodate a small forklift.

Basler

Baslers are twin-turbine, propeller-driven airplanes outfitted with skis. They are the larger of the two KBA-operated

aircraft used in Antarctica. Baslers are loaded and unloaded from a cargo door near the left rear of the aircraft. They cannot accommodate U.S. Air Force pallets. Cargo and equipment going on Baslers must be packed in containers that can fit through the cargo door and can be moved by one or two people.

On KBA-operated aircraft (i.e., Baslers and Twin Otters), field parties must help load and unload cargo. Snowmobiles are lifted to or from the cargo door or slid onto the cargo ramp, while full fuel drums are rolled down the cargo ramp for offloading. Always consult with the aircraft crew for directions.

Twin Otter

Twin Otters are short-takeoff-and-landing utility aircraft that can operate in a variety of conditions. Like Baslers, they are equipped with skis, have twin engines and are loaded and unloaded by hand through a rear cargo door. The space in a Twin Otter is limited, but it can be fully utilized by preparing small cargo packages that are easily handled by one or two people. Allowable Cabin Load

The ACL is the amount of weight allotted for cargo and passengers on a given flight and varies by the aircraft's capacity, trip distance, airfield conditions and other factors. The planning ACL is determined by the aircraft crew during the flight's planning stage and may change during the lead-up to flight day. A field team's total cargo and passenger weight cannot exceed the ACL.

Camp Put-in

Camp put-in may require multiple flights. Field teams must ensure all essential, life-sustaining supplies and equipment are on the first put-in flight in case the second is delayed. This includes radios, satellite phones, sleep kits, stoves, matches, extra clothing, tents, and enough food, fuel, and water for an extended period. There have been cases where a field party waited two weeks for a second flight that was

supposed to arrive on the same day as the first. Field teams must be flexible and have plans for a worst-case scenario.

Radio Issue

Before field deployment, project personnel must obtain a frequency assignment plan and radio call sign from Central Comms. Every member of the field party should attend the Field Party Shop radio briefing, where they will be issued the following items and receive instructions:

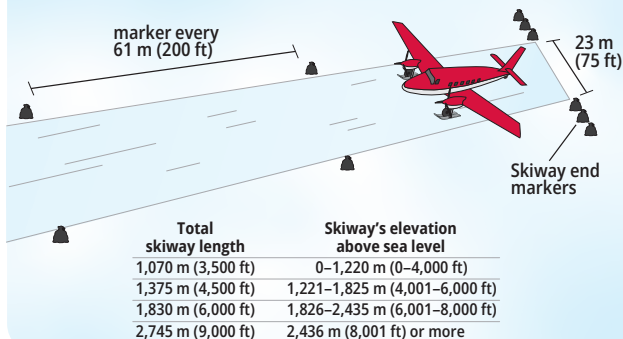
- VHF radios with field party frequency plan
- Iridium satellite phone(s)
- HF radios
- Handsets
- Antennas
- Batteries and recharging capabilities for the entire deployment
- Complete backup radio

Skiway Preparation

Before deploying, field teams must discuss how to prepare the skiway (a runway cut into the snow for planes with skis) for the takeout flight with fixed wing staff. If a team is preparing a skiway, fixed wing staff must provide bamboo poles, flags and large black trash bags (filled with about two shovels of snow each) to use as skiway markers. The flags also help identify wind speed and direction.

This task is specific to the camp location and type of aircraft, so prior planning is essential. Teams involved in any way with creating a skiway must attend a meeting with Fixed Wing and KBA. Below is an example of a Basler skiway for KBA aircraft. Skiways for LC-130s require meeting with NYANG, Field Ops and the Fixed Wing Office.

Basler Skiway Specifications



Recce

NYANG, KBA, FS&T or the Fixed Wing Office may determine that a reconnaissance flight (recce) is required to assess aircraft landing conditions or surface routes before the put-in. Fixed wing staff work with the aircraft operator and field team to define the recce's scope and requirements. Taking additional people or cargo on recce flights is situational and at the discretion of the operator and ASC.

Bag Drag (LC-130s Only)

Bag drag involves weighing field personnel and their baggage. It occurs at least 12 hours before an LC-130 flight and is when all personal gear (e.g., clothes, personal items) must be checked in. Checked-in items will not be available if the flight is canceled. But passengers are allowed one hand-carry bag for shoes, a change of clothes, medications, and needed toiletries (e.g., toothbrush). Phones, radios, and weather kits must also be hand-carried so they stay warm and operational and so field teams can establish communication with McMurdo Station or field camps before the aircraft departs. Air Services posts bag drag details, the flight schedule, and flight updates

in three places: the transportation channel, at the MCC, and outside the dining facility in BL155.

Flight Day

These are general guidelines for flight day. Minor schedule changes may occur each season. Check and adhere to the flight day instructions on the McMurdo intranet and in the Crary Lab / grantee binder.

On flight day, field teams must be prepared to report to the MCC (BL140) for LC-130 flights or to their shuttle pickup area for KBA (i.e., Basler or Twin Otter) flights. You will receive the reporting time on the Fixed Wing flight schedule the night before. Verify that time on the Public Area Display System (PADS; Channel 7 on the television) 7 on the morning of the flight. All passengers must wear ECW gear. Passengers wearing personal ECW gear must present the yellow form titled Bring-Your-Own ECW Clothing Program (FLD-FRM-0002) at the MCC or airfield as applicable. At the airfield, passengers must follow the instructions of the loadmaster for LC-130 flights or the flight crew for KBA flights, who direct all movement in and around the aircraft.

Check your cargo at this time. Do not assume all cargo details have been addressed. Inspect snowmobiles, and ensure the keys are available. Ensure all survival gear (e.g., radios, sleep kits, tents, stoves, food) is present. Check the cargo manifest against what is actually on the aircraft. If something is missing, immediately notify the loadmaster, who will inform the aircraft commander to halt flight preparations. Cargo staff must also be advised of the missing cargo.

During put-in and before the aircraft departs, field teams must radio Central Comms and erect a tent for shelter, well away from the aircraft and turning area. (See the Field Camp Operations section for details on field planning and tasking and the Communications section for operating various radios.) If possible, split the team into one group who sets up the tent and lights a stove and a second group who sets up the radio and antenna and communicates with Central Comms.

Field teams must also establish grid north at camp and obtain the camp's altitude from the aircraft navigator or pilot. They must immediately mark grid north with two flagged bamboo poles and use the altitude reading to set the altimeter in the meteorological kit. Both tasks are necessary for weather observations and reporting.

Takeout

- **Scheduling:** Coordinate the camp takeout schedule with the Fixed Wing Office, which will need details on the following:
 - Weight, cube and type of retro
 - Estimated weights and dimensions of any cargo pallets
 - Handling requirements for any science samples (e.g., do not freeze [DNF], keep chilled [KC], keep frozen [KF], keep upright [KU])
 - Any additional lead time needed for ice core samples
- **Waste Removal:** Remote deep-field teams must return all waste to McMurdo Station, which may include human waste. All waste needs to be labeled and sorted into categories. See the Environmental Policies section for details.
- **Equipment Staging:** Break down the entire field camp. Stage all gear so it is ready to be quickly loaded onto the aircraft when it arrives. LC-130 flights require all gear to be palletized.
- **Skiway Preparation:** Prepare the skiway well in advance of the aircraft's arrival, as instructed by the Fixed Wing Office or pilot before deployment.
- **Weather Observations:** When an aircraft mission to camp is planned, field teams must report weather observations every hour, starting six hours before an LC-130 takes off or three hours before a KBA-operated aircraft departs. These observations continue until

the aircraft lands in camp. See the Weather and Sea Ice section for details.

- **Aircraft Communication:** The field team member assigned to the radio is responsible for communicating information to the incoming aircraft. They must be aware of and able to relay the skiway condition, current wind conditions, and altimeter setting to the aircraft. While on final approach, the aircraft commander will limit radio communication but appreciate brief statements about any wind direction or weather changes. Do not interfere with the aircraft during final approach unless there is an emergency.
- **McMurdo Arrival:** Return all field equipment to the appropriate work center. Package and mark retro cargo that will return to the U.S. For details, see the “Instructions for Packaging and Shipping” document provided to all researchers before they deployed to Antarctica.

Helicopter Support

All USAP personnel must attend helicopter training before boarding a helicopter for the first time. This occurs at the end of your AFS course. If you will be required to build any sling loads, you must also attend a sling load training in the Helo Hanger. (See Building Sling Loads below for details.) USAP operates a small fleet of helicopters in the McMurdo Station area under Federal Aviation Administration regulations. The fleet consists of two models: the A-Star (aka Airbus AS350 B3 or “Squirrel”) and Bell 212. These helicopters are single-piloted, meaning the pilot is responsible for all aspects of the aircraft’s operation.

Helicopter and Flight Characteristics

Characteristic	A-Star	Bell 212
Maximum seating/payload	3 passengers or ~800 lb	8 passengers or ~1,800 lb
Hatch	5' 6" × 3' 6"	7' 8" × 4' 2"

Characteristic	A-Star	Bell 212
Cargo space	5 ft³	253 ft³
Maximum round-trip flight	~2.5 hours	
Flight from McMurdo to		
Cape Bird	30 minutes	
Koettlitz Glacier	30 minutes	
Minna Bluff	30 minutes	
Mount Erebus	30 minutes	
Marble Point	31 minutes (47 minutes w/external load)	
Lake Hoare	34 minutes (50 minutes w/external load)	
Cape Crozier	35 minutes	
Dry Valleys	35–40 minutes	
Allan Hills	1 hour	

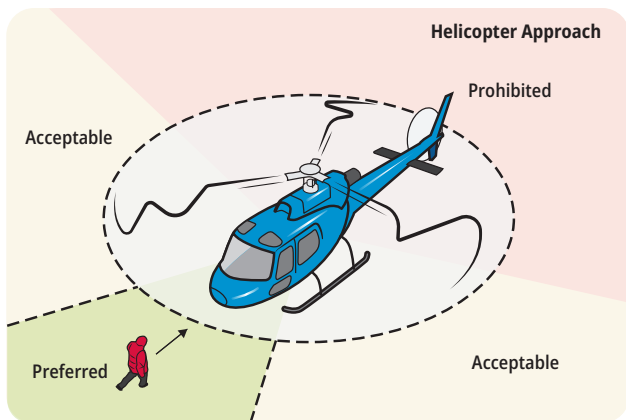
Helicopter Pad

Aviation administrative and logistics offices, including those of the helicopter supervisor and aviation coordinator, are in the maintenance hangar at the helo pad. The small silver structure to the side of the hangar is the passenger terminal, where field teams report for helicopter flights. There, a helo tech will brief deploying field teams and escort them to the helicopter. Personnel may walk to the passenger terminal without clearance or an escort. However, never drive onto the helo pad without radio clearance, and never walk onto the helo pad without an escort.

Safety

- Any movement on the helicopter pad or in the hangar must be authorized by helo pad staff.
- Always follow the pilot's orders.

- Never approach a helicopter until the pilot gives a thumbs-up signal.
- When permitted to approach, remain in the pilot's view and approach from the front of the helicopter whenever possible.
- Never walk near the tail rotor.
- Never reach up or chase after a hat or other item that has blown away.



- Carry long loads (e.g., bamboo poles, Scott tents, survey rods) low and level to the ground.
- Always approach or exit the helicopter on the downslope for more clearance from the main rotor.
- Stop if you are blinded by snow or debris being kicked up by the rotor wash, crouch low or sit, and await help.
- Exit slowly and smoothly if disembarking while the helicopter hovers.
- Never approach or leave when the engine and rotors are running down or starting up.

Helicopter Safety

Carry supplies and tools horizontally and below waist level.



Always approach or exit on the downslope for more clearance.



Stop if blinded by snow or debris, crouch low or sit, and wait for help.



Exit slowly and smoothly if disembarking while the helicopter hovers.



Never approach or leave when the engine and rotors run down or start.



- Do not smoke in or near the helicopter.
- Remain seated with seat belts and helmet fastened while inside the helicopter.
- Assume the crash position if warned by the pilot.
- In 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 bags, which helicopter staff ensure are aboard the aircraft and will be pointed out during the final safety briefing on flight day. (Note that if the flight is for a camp put-in and all the required camp survival gear is aboard, no aircraft survival bags are required.)

Camp Put-in

Radio Issue

During the pilot brief, team members should discuss which channel will be used for communications between the helicopter and field team. For a camp put-in, teams must have the following equipment:

- VHF radios with field party frequency plan
- Iridium satellite phone(s)
- HF radios
- Handsets
- Antennas
- Batteries and recharging capabilities for the entire deployment
- Complete backup radio

Field Plan

Field parties must confirm their field plan for the season with the Helicopter Office. This plan should include estimated

dates for camp put-in, camp moves, day trips, close support, resupplies and camp takeout.

Cargo

Before deploying, field teams specify estimated cargo weights, passenger names and a list of hazardous cargo in their flight request, which must be submitted to the Helicopter Office via the McMurdo intranet three days before flight day. Field teams are also responsible for delivering hazardous cargo to Science Cargo for packing no later than three business days before the flight.

The day before the flight, field parties collect all cargo (including BFC, MEC and science equipment) and arrange for its transport to the helo pad. Special arrangements can be made for gear or equipment that the teams must have access to until flight day. A helo tech will prepare the cargo and provide a final manifest to the pilot. Each passenger will be weighed, and the weight and volume of all cargo will be measured. The helicopter schedule is posted by 1900 hours on the McMurdo intranet and also sent to each passenger via email. Unexpected or emergency flight requests should be communicated to the Helicopter Office as soon as possible.

Flight Day

The Helicopter Office must be able to quickly notify the field team of any schedule changes on flight day. Weather-related changes are common. If a field team was issued a pager, it must remain switched on. If the team does not have a pager, the Helicopter Office must know where to contact the team.

All personnel and equipment must be at the helo pad 45 minutes before the flight. All passengers must wear USAP-issued or personally owned ECW gear. Passengers wearing personal ECW gear must present the yellow form titled Bring-Your-Own ECW Clothing Program (FLD-FRM-0002) at the helo pad.

Loading and Unloading

In McMurdo Station, helo pad staff will load and unload cargo. (At field locations, field teams must perform this function.) On most Bell 212 flights, a helo tech will be aboard to assist with loading and unloading. Helo techs do not fly on A-Stars, so all field team members are responsible for knowing how to load and unload the helicopter. The helicopter pilot is ultimately responsible for passenger safety and will determine whether the helicopter can be loaded or unloaded while the rotors are running. However, each passenger has the right to request that the rotors be shut down if there is any safety concern.

For all flights, helicopter pad staff will ensure enough survival bags are on board to accommodate all passengers. If a flight is for a camp put-in and all the required camp survival gear is aboard the aircraft, no survival bags are required.

Boarding

On Bell 212 flights, a helo tech leads field teams to the helicopter when the pilot is ready for boarding. On A-Star flights, the pilot will indicate when passengers can board. At the helicopter, the pilot or a helo tech will give a final safety briefing and identify where survival bags are located. Once seated, passengers must strap themselves in and connect to the intercom system. Passengers must not talk to the pilot during takeoff or landing.

Disembarking

At camp put-in, after passengers disembark the helicopter, the pilot monitors Channel 7 and delays departure until a field team member establishes radio contact with the pilot and calls out the helicopter's tail number. If communication cannot be established because of radio malfunction, the team will be flown back to McMurdo Station.

Day Trips

Projects that plan to remain in the field for the day must have at least two people, survival bags, ECW gear, urine bottles, plastic bags for human waste and two forms of communication devices (e.g., VHF and Iridium). All personnel should be aware that weather or other circumstances may require them to stay in the field overnight. As such, pack extra water, extra high-energy food, extra warm clothes, reading material, and a toothbrush for day trips. Sunscreen, ear plugs, and a Thermos with hot liquid are also recommended.

In-field Coordination

Helo Ops staff begin developing their operational plan after 0730 hours each day. On the day a flight is scheduled for a field camp, the deployed field team must provide a local weather observation to the Helicopter Office between 0700 and 0730 hours. Any changes to the day's plan or information about the support needed must also be communicated at that time.

New flight requests and changes to flight schedules must be submitted to the Helicopter Office three days in advance. Requests may be communicated via radio or telephone, or they may be written and passed to helo pad staff via a pilot.

Sling Loads

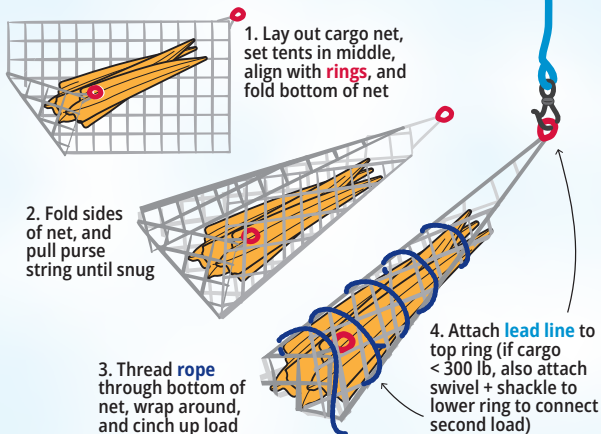
Sling loads are cargo suspended from aircraft and commonly used to transport equipment to or from McMurdo Station. You may be responsible for or assist with building the loads, which is most common in the Dry Valleys and on Mount Erebus. Sling load training covers several techniques for building and staging loads. Only trained persons can build or assist with sling loads, as faulty cargo rigging and transport can lead to catastrophic accidents.

PRO TIPS

- Helicopter pilots approach sling loads into the wind, so build loads with wind direction in mind. Also ensure there are no obstructions to the approach.
- Loads must be placed in the center of the cargo net as symmetrically as possible.
 - Barrels are much easier to de-rig when they are upright.
 - For propane tanks, use extra cargo straps to create a barrier across their tops and keep net lines away from valves.
- Before hooking up sling loads to a hovering helicopter, discharge the static electricity the aircraft generates (e.g., with a grounding pole).
 - Ideally, attach sling loads while the helicopter is on the ground.
- Watch loads being lifted into the air or placed on the ground. Field staff can assist with any issues that arise.
- You can always ask the pilot to power down the helicopter to inspect the load before attaching it to the aircraft.

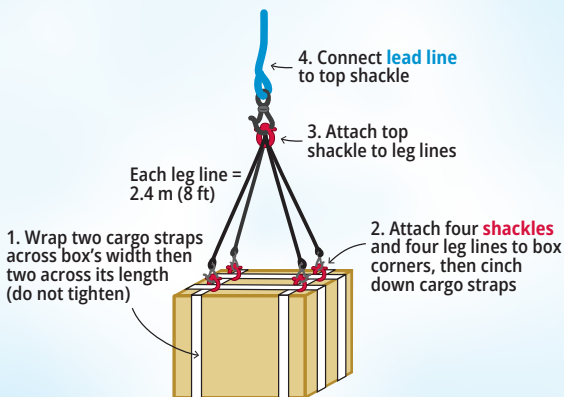
Some examples of sling loads are depicted next. Detailed instructions are also available in the Marble Point Operations Manual (FLD-MAN-0001; formerly OPS-MAN-0009).

Sling-loading Scott Tents



Sling-loading a Christmas Package

(Method when cargo [e.g., Jamesway floors] exceeds size of net)



Sling-loading White Pallet Boxes

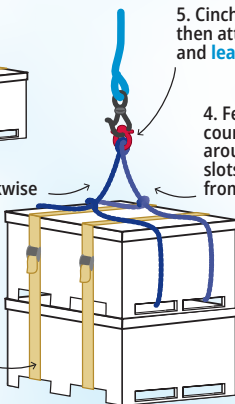
(Method when camps move several times during season)

1. Load box evenly then secure lid with cargo straps so ratchets are on long side of box



3. Feed first **choker** clockwise around top box, through slots then up into loop from left

2. If stacking two boxes, put heavier box on bottom and run cargo strap around both



5. Cinch chokers tight, then attach to **shackle** and **lead line**

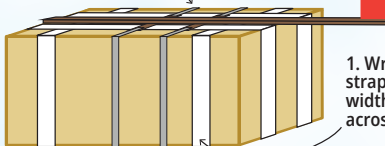
4. Feed second choker counterclockwise around box, through slots then up into loop from right

Adding a Fin to Long, Bulky Cargo

(Method to reduce swinging and spinning of load in flight)

2. Set fin atop cargo so it extends far off the end

3. Secure fin with its own two cargo straps



1. Wrap two cargo straps across box's width then two across its length

Takeout

- **Scheduling:** Coordinate the camp takeout schedule with the Helicopter Office, which will need details on the following:
 - Weight and type of retro
 - Handling requirements for any science samples (e.g., DNF, KC, KF, KU)
- **Station Accommodations:** Before returning from the field, all field parties must contact the Housing department at McMurdo Station to arrange accommodation.
- **Incremental Retro:** Returning unneeded material and equipment to McMurdo Station throughout the season makes camp takeout easier.
 - Whenever possible, use helicopter flights scheduled for resupplies, camp moves or day use to retro your cargo. This reduces the number of takeout flights.
 - Helicopters can sling loads back to McMurdo Station or Marble Point for staging, so do not let boxes and barrels pile up at camp. Retro them early.
 - Indicate what cargo is ready for retro during daily communications with Helo Ops staff, so they can schedule retro on flights of opportunity.
 - Properly label retro waste per instructions from the Environmental Engineering and Waste departments.
 - See the next subsection for special handling of science samples.
- **Last Flight:** To ensure all camp items are picked up and nothing blows away, two field team members should remain in the field to accompany the last flight.

Retrograde of Samples

Fixed wing aircraft or helicopters can transport unaccompanied scientific samples from the field to McMurdo Station. All

persons involved with handling or transporting samples must follow established procedures to protect the scientific data and reduce the potential for loss or damage during transport, receipt and storage. Years of planning, months of work and extensive NSF funding have been invested into these samples. They are irreplaceable.

Field teams intending to retro unaccompanied scientific samples follow these steps:

1. Before deploying to the field, discuss the retro process with Crary Lab staff.
2. Obtain “sensitive sample” chain-of-custody (COC) forms and green Day-Glo labels, or “non-sensitive sample” COC forms and pink Day-Glo labels, from Crary Lab.
 - A. COC forms and labels are available for all samples sent unaccompanied to McMurdo Station from the field.
3. While in the field, package the samples in a manner that adequately protects them against temperature variations and vibration during transport.
 - A. Proper packaging is the grantees’ responsibility.
 - B. Packaging should be sufficient to cover extended periods due to weather or other delays.
 - C. If you require insulated packaging, (e.g., coolers, AcuTemp containers), contact Crary Lab.
4. Notify the Crary Lab POC (x44175, pager 855 or at MCM-Lab-Samples@usap.gov) or the Science Cargo supervisor that the samples are ready for pickup and provide the following information:
 - A. Number of containers
 - B. Storage requirements
 - C. Time of pickup
 - D. ETA in McMurdo Station
5. Schedule the pickup with AvOps.

6. Make necessary entries on the COC forms.
7. Attach the Day-Glo notice to the sample boxes to facilitate identification and tracking later.
 - A. These brightly colored labels draw attention to the boxes and reduce the likelihood they will be misplaced or overlooked.
 - B. If the form cannot be attached to the box's exterior with tape, it can be tucked inside.
8. When the samples are loading onto the aircraft, update the COC forms with the aircraft tail number and the time the samples were loaded.
9. Pilots, loadmasters, helo techs, ground crew, Crary Lab staff, Science Cargo and other persons involved in the cargo process will fill out their portions of the COC forms and deliver the samples to the appropriate location.
10. If any samples are missing form, staff will assist field teams with getting the samples transported, documented and handled.



WEATHER AND SEA ICE

Antarctic Weather

Weather in Antarctica is characterized by extremes in temperature, wind and the variability of local conditions, making Antarctica a challenging place to work and live. Weather conditions also depend substantially on elevation, topography and distance from the ocean. Temperatures can vary from below -40°C (-40°F) to above freezing (0°C , or 32°F) during the austral summer.

It is an unusual day when there is not at least a breeze. The wind can take its toll on people, making tent setup and other camp chores difficult. Improperly anchored tents can blow away or rip apart. Tent guylines must be continually retensioned. And wind chill raises the risk of hypothermia and frostbite. The wind chill chart in the References section shows how wind affects how we experience temperature.

Storms Around McMurdo

Around McMurdo Station, storms arrive quickly and are sometimes fierce enough to halt all outside activity. Storms can also be very localized. The station can experience near-zero visibility with blowing snow that halts flight operations, while the McMurdo Dry Valleys are calm and sunny 50 miles away. High, thin bands of cirrus clouds (aka mare's tails) followed by thicker layers of cirrus, which may produce halo-like effects around the Sun, often precede a storm, with clouds growing thicker and lower during the next six to 12 hours until low cumulus clouds and the main storm front arrive. Blizzards can happen any time of year and may last from hours to 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, signaling bad weather will likely arrive in less than one hour. 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, the horizon is obscured, and it is difficult or impossible to determine distance, object size, and if a surface is flat or sloping.

Travel during a whiteout may be attempted only 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.

Working in the Continental Environment

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 extremely cold due to its higher altitude and distance from the moderating effects of the seas. 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 remote field parties plan for weather conditions at a given site. Still, it is safest to expect the unexpected when it comes to weather.

Forecasting

Weather forecasting for USAP is done under the auspices of NSF and coordinated through the Naval Information Warfare Center Atlantic (NIWC), which has a presence at McMurdo Station. Antarctic weather forecasters have fewer data collection sites to feed their forecasting models than do forecasters elsewhere in the world. Antarctic forecasters rely heavily on weather observations called in from remote field sites. They also use satellite imagery, data from automated weather stations, and the Antarctic Mesoscale Prediction System, which produces twice daily forecasts for the Antarctic continent.

Terminal Aerodrome Forecasts

A weather forecast for a remote site is called a Terminal Aerodrome Forecast (TAF). TAFs are generated each day for sites scheduled to receive an LC-130, the only aircraft with

instrument-landing capabilities that USAP utilizes. A TAF is automatically generated for a given site based on the aircraft schedule. Field teams 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 is issued between the standard issue times. Amended TAFs are issued when the current TAF no longer adequately describes the current or expected weather. Corrected TAFs are also issued if there is an error on the original TAF.

Weather Observations in the Field

Observing weather conditions at a camp is important for making safe decisions about daily activities. Field team members should maintain awareness of changing weather conditions and note drops in barometric pressure, which signal changing weather and potentially an approaching storm. Watch for changes in cloud cover or appearance, changes in wind direction or intensity, rapid changes in temperature, decreasing visibility and increasing precipitation.

Prepare early for shelter from storms. Have a predetermined set of weather guidelines for field parties. Be aware of the increased risk of hypothermia due to wind chill. Blizzards and whiteout conditions can make any travel hazardous. Double-check the camp area to ensure all equipment and supplies are secure. Check all tent anchors and guylines before gale force winds arrive.

Daily Tasking

Field parties must identify the person or persons responsible for making daily weather observations in the field and reporting them to MacWeather. These observations assist with safe and timely aircraft operations to remote locations and support the continentwide weather forecasting system. Determine which team members will be weather observers before deploying to the field so expectations and roles are clear. Before deploying to the field, you must meet with

MacWeather for information on the tempo and type of weather observations it expects.

Here is an example of a normal weather-observation schedule if no aircraft activity is planned:

1. Make three daily weather observations and report them to MacWeather at six-hour increments (e.g., 18:00, 00:00, and 06:00 Zulu). See the References section for Zulu time conversions.
 - A. Only three of the four six-hour increments in a day need be reported.
 - B. On holidays, report only two observations at 18:00 Zulu (morning) and 06:00 Zulu (evening).
2. Begin the observation about 15 minutes before the top of the hour. Weather observations take 10 to 15 minutes to complete.
3. You may be asked to record the observation on AF Form 3803.
4. Call in the observation to MacWeather within five minutes of the hour.

Do the following when a fixed wing aircraft is scheduled to arrive in camp:

1. Make hourly weather observations, beginning six hours before an LC-130 takes off or three hours before a Basler or Twin Otter departs for a remote camp.
2. Continue hourly observations while the aircraft is on the ground at camp.
3. If there is a change in the weather before an hour has passed since the last observation, report a special observation.
4. When the aircraft is halfway back to its point of origin, return to the normal weather-observation schedule.

5. If a helicopter is scheduled to arrive, field teams must call the hangar's Iridium satellite phone with a weather update between 0715 and 0730 hours or between 0745 and 0800 hours.

Observation Site Setup

The aircraft pilot can provide key information for setting up a weather observation site. Upon arriving in the field, the designated weather observer asks the pilot for an exact altitude reading, which is required to take accurate pressure readings with the Kestrel handheld weather meter. The pilot can also identify which direction is grid north, which is used to set up the flagged weather observation site.

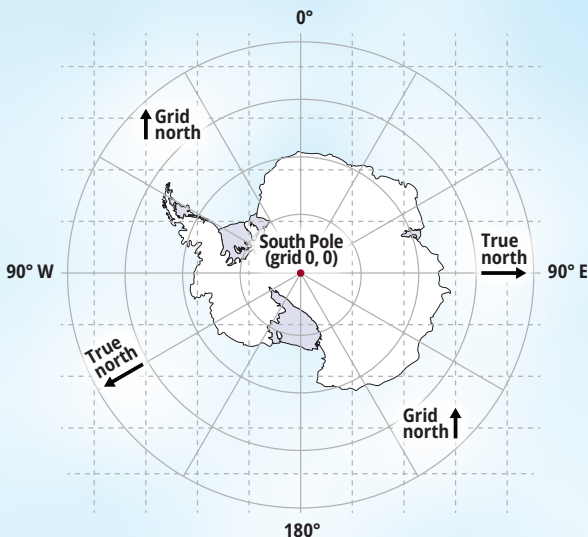
Grid Markers

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). In comparison, true north is the direction of a line of longitude that ends at the North Pole. To avoid confusion, especially when traveling where lines of longitude converge near the South Pole, fixed wing pilots navigate using directions based on grid north rather than true compass directions.

The designated weather observer in a fixed wing-supported camp must always report observations in grid directions, not true or magnetic directions. Observers using a magnetic compass to determine grid north must use an accurate declination for their position, as declination between magnetic north and true north varies widely throughout Antarctica.

To determine grid north, face true north and treat your meridian as the prime meridian (00 or 360). For east longitude camps, grid north is true north (360) minus the longitude of the camp. For west longitude camps, grid north is true north (0) plus the longitude of the camp.

Grid North and True North



After identifying grid north, stand up a flag representing grid north, label it as grid north, then repeat the process for grid south, grid east and grid west, ensuring the four flags are a few meters from each other. For example, subtract 1670 from 3600 for a camp at 1670 E, place a grid north flag at 1930 true (i.e., “true” to your subjective orientation, where 1670 E is treated as 00), then use the grid north flag to set up the remaining flags. For a camp located at 600 W, add 600 to 00 (true north) and place the grid north flag at 600 true.

The four flags delineate the weather observation site. The observer stands in the middle of the flags when making weather observations. This helps the observer determine wind direction and maintain a consistent reference point for observing sky and ground conditions.

Visibility Markers

To help determine visibility levels, field teams should set up a second set of flags that are 400 meters (1/4 mile) away from and in line with each grid marker. If possible, also place flags at 800 meters (1/2 mile), 1,600 meters (one mile) or 3,200 meters (two miles) from the grid markers. Also record distances to landmarks that are visible from camp and can serve as aids for assessing visibility levels.

Kestrel Setup

Weather observers in remote locations often use a Kestrel handheld weather meter to measure wind speed, temperature, dew point and pressure. This manual covers the Kestrel 4000. Observers using a different meter should refer to its user instructions.

The Kestrel 4000 is available from the BFC. The field team member picking up the equipment must ensure the Kestrel is set to measure temperature in degrees Celsius, wind speed in knots, and altitude in feet. Also carry extra batteries in case the installed batteries lose power in the field.

Store the Kestrel 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 is sluggish and eventually fades, although the device will still record data. Return the Kestrel to a warm, inside coat pocket as soon as possible after use. At the end of the field season, promptly return the Kestrel to the BFC.

Reference Altitude and Barometric Pressure

Obtain the remote camp's altitude in feet from the pilot. Be sure to notify the pilot in advance so they know 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 (0 at sea level). Ensure 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 altitude. Read the pressure from the BARO screen.

AF Form 3803

Record weather observations on a digital or hardcopy version of AF Form 3803 – Surface Weather Observations (METAR/SPECI). (See the References section for an example.) Each observation does not need to be recorded, as MacWeather records and tracks the observations called in.

Before field teams deploy to the field, MacWeather provides the form during a weather briefing and discusses how and when to complete it. Below is an overview of the main data entries.

Latitude and Longitude

List the latitude and longitude of the camp. If the camp has a name, provide that too (e.g., Whillans Ice Plain Camp, Latitude 83.65 S, Longitude 167.4 W).

Time

Report the observation time in Zulu (e.g., a weather observation at 07:00 New Zealand Daylight Savings Time is recorded as 18:00 Z).

Wind / Speed

Confirm the Kestrel is set to record wind in knots. Power up the Kestrel and navigate to the wind speed screen. Expose the impeller (the small, revolving wheel at the top of the weather meter) by rotating open the plastic cover. While viewing the Min/Max/Avg screen, hold the unit into the wind, with 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 cease data collection and hold the values on the display. Press the button when the screen displays "--clear" to remove the data. Collect enough data to calculate a two-minute average for all measurements.

Visibility

Visibility is determined as the distance that an observer at ground level can see objects (e.g., flags, rock outcrops) that are not obscured by weather. Measure visibility in meters as an average of all quadrants, then use the Reportable Visibility Values table to find and report the visibility value (e.g., 700 meters of visibility is reported as either 600 or 800 meters since 700 is not a reportable value; visibility of 9,999 or more meters is reported as "unrestricted").

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	1,312
500	5/16	1,640
600	3/8	1,969
800	1/2	2,625

Meters	Statue Miles	Feet
100	5/8	3,281
1,200	3/4	3,937
1,400	7/8	4,593
1,600	1	5,249
1,800	1 1/8	5,906
2,000	1 1/4	6,562
2,200	1 3/8	7,218
2,400	1 1/2	7,818
2,600	1 5/8	8,530
2,800	1 3/4	8,858
3,000	1 7/8	9,843
3,200	2	10,500
3,600	2 1/4	11,810
4,000	2 1/2	13,120
4,400	2 3/4	14,440
4,800	3	15,750
6,000	4	19,690
8,000	5	26,250
9,000	6	29,530
Unrestricted (≥ 9,999)	≥ 7	≥ 36,960

Weather and Obstructions to Vision

Describe the weather effects that may be restricting visibility as seen at ground level (e.g., snowfall, fog, drifting snow, snow showers, blowing snow) using the following terms. Report the type of present weather first, then any weather amplification.

Terms for Weather and Obstructions

Term	Description
Present Weather	
Blowing Snow	Snow blowing ≥ 1.8 meters high from the ground. Visibility $< 9,000$ meters.
Drifting Snow	Snow blowing < 1.8 meters high from the ground. Visibility $\geq 9,000$ meters.
Fog	Ground-level clouds. Reported only when visibility is $< 1,200$ meters.
Ice Crystals	Crystallized ice that may fall as snowflakes, form on surfaces, or create cirrus clouds or ice fog. Can be present in any level of visibility.
Ice Pellets	Steady precipitation of small ice balls (< 5 -millimeter diameter). Aka sleet. Visibility $< 9,000$ meters. Rare in Antarctica.
Mist	Like fog but less dense. Reported when visibility is $1,200$ – $9,000$ meters.
No Significant Weather	Visibility not obstructed by any weather condition.
Snow	Steady precipitation of discrete ice crystals. Visibility $< 9,000$ meters.
Snow Grains	Steady precipitation of small, round, flat grains of ice. Visibility $< 9,000$ meters.
Snow Showers	Intermittent snow precipitation. Visibility $< 9,000$ meters.
Weather Amplification	
Light	Weather severity with low effect on visibility (e.g., light ice pellets with unobstructed visibility, light snow with > 800 meters of visibility).
Moderate	Weather severity with medium effect on visibility (e.g., moderate ice pellets with $4,800$ – $9,000$ meters of visibility, moderate snow with 400 – 800 meters of visibility).
Heavy	Weather severity with high effect on visibility (e.g., heavy ice pellets with $< 4,800$ meters of visibility, heavy snow with < 400 meters of visibility).

Cloud Layers

Each cloud layer is reported using two entries:

- Amount of sky covered by a cloud layer
- Altitude of the cloud layer in feet (not meters)

Report the absence of clouds as “sky clear.” Reports usually include two or three cloud layers, with the lowest layer first (e.g., “Cloud layer 1, few at 1,000. Cloud layer 2, scattered at 5,000. Cloud layer 3, broken at 10,000). The clouds’ appearance or type will provide clues about their altitude.

Cloud Types

Cloud	Description	Usual Altitude
Stratus	Low, gray, wide, shapeless sheet of clouds	≤ 1,500 feet
Stratocumulus	Low, lumpy, rounded clouds amid some visible blue sky	1,000–5,000 feet
Cumulus	Low, puffy, popcorn-like, clouds with vertical development	1,000–5,000 feet
Altostratus	Midlevel, gray, uniform sheet of clouds	4,000–9,000 feet
Alto cumulus*	Midlevel, puffy clouds that may form patterns or castle-like upward projections	4,000–9,000 feet
Cirrus	High, transparent, wispy or feathery clouds	10,000–19,000 feet
Cirrostratus	High, transparent, very thin sheet of clouds	10,000–19,000 feet
Cirrocumulus	High, thin, wavy or rippled clouds in part of the sky	10,000–19,000 feet
* Includes lenticular clouds, which are dangerous for air operations and must be reported in the RMK (i.e., remarks) section of AF Form 3803.		

Cloud altitude can also be estimated by releasing ceiling balloons (aka weather balloons) from ground level, timing their

ascent, and observing them until they are obscured by clouds. Cloud height is then calculated based on a chart indicating the speed a given balloon will rise. Ceiling balloons require additional training and are not available for remote camps where compressed helium cannot be transported.

In limited cases, observers can also request a PIREP (pilot report; pronounced “pie rep”) of cloud altitude from incoming aircraft, whose instrumentation allows pilots to determine exact heights of cloud layers as they fly through them. Use this option only periodically.

After determining cloud altitudes, round the values and report them as follows:

- **Clouds at or below 5,000 feet:** Round to the nearest 100 feet.
- **Clouds from 5,001 to 10,000 feet:** Round to the nearest 500 feet.
- **Clouds at 10,001 feet or higher:** Round to the nearest 1,000 feet.

For example, report a cloud layer with a 1,150-foot altitude as 1,100 and a cloud layer with a 5,300-foot altitude as 5,500.

Temp and Dew Point

Use the Kestrel to record temperature and dew point. Navigate to the correct screen by using the up and down arrows and to lines within the screen by using the left and right arrows. Report temperature and dew point as the nearest whole °C (e.g., 2.8°C is 03). Report negative temperatures and dew points with an “M” prefix, not a minus sign (e.g., 6°C is M06).

The dew point will never be higher than the temperature. In extreme cold, the Kestrel may be unable to register the dew point. If this occurs, omit the dew point report from the weather observation.

Sta Pressure

Report the station pressure, not the altimeter. Station pressure is the atmospheric pressure at the weather observation site’s

elevation. Read the value directly from the Kestrel and report it in inches of mercury, rounding down to the nearest five-thousandths of an inch (e.g., report 29.249 inches as 29.245).

Total Sky Cover

Report all layers of clouds together in eighths (i.e., oktas, as if the sky were a pie divided into eight equal parts). Four-eighths coverage (i.e., four oktas) means half the entire sky is cloudy.

Sky Cover

Sky Coverage	Aviation Term	Description
0/8	Sky Clear	Sky completely clear and free of clouds
1/8	Few	0.1%–12.5% cloud cover or 1 small cloud
2/8		12.6%–25.0% cloud cover
3/8	Scattered	25.1%–37.5% cloud cover
4/8		37.6%–50.0% cloud cover
5/8	Broken	50.1%–62.5% cloud cover
6/8		62.6%–75.0% cloud cover
7/8		75.1%–87.5% cloud cover
8/8	Overcast	100% cloud cover with no breaks, including semitransparent clouds
Vertical Visibility	Vertical Visibility	Obscured. Unknown cloud cover due to fog, blowing snow, etc. Distance to cloud ceiling reported instead.

RMK

In the RMK (i.e., remarks) section of the form, report the surface definition first then the horizon description (e.g., “good and good,” “fair and poor,” “nil and nil”). These data help pilots anticipate visual conditions for landing. If a poor or nil horizon is visible in one grid direction only and the rest of the horizon is more easily seen, report the grid direction as well (e.g., “poor horizon grid south through west,” “nil horizon grid east”). Terms for surface and horizon definitions are detailed below.

Surface Definition

Surface definition is critical data 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 helicopter coordinator or helicopter supervisor if they are expecting a flight.

Be aware of how surfaces appear in good weather as a reference point. Report how the contours of the ground and/or snow surface appear. Judge by the relative distinctness of features on the surface (e.g., sastrugi, vehicle tracks).

Terms for Surface Definition

Term	Description
Good	Easily identify surface features (e.g., sastrugi, drifts, tracks) by shadows. Sun usually not obscured.
Fair	Can identify surface features by contrast, but no definite shadows visible. Sun often dimly visible.
Poor	Cannot readily identify surface features except up close. Sun often fully obscured.
Nil	Cannot identify surface features at all. No shadows or contrast visible. Dark objects appear to float in air. Sun fully obscured. May have considerable glare that is equally bright in all directions and reflecting from snow surfaces.

Horizon Definition

Report horizon definition as the ease with which you can distinguish the sky from the ground or snow surface.

Terms for Horizon Definition

Term	Description
Good	Horizon is sharply defined by shadow or contrast. Obvious difference between surface and sky (i.e., white surface and blue sky).
Fair	Can identify horizon, but contrast between sky and surface lacks definition (though is still distinguishable). Often observed when clouds approach or during light precipitation.
Poor	Horizon is barely discernible. Sky is difficult to distinguish from surface, but a faint separation between them can be detected. Similar to nil horizon definition but less severe.
Nil	Total loss of visible horizon. Surface merges with whiteness of the sky. Common amid low stratus clouds and blowing snow.

Other Data

In the RMK section, also describe any significant weather-related phenomena not otherwise reported on AF Form 3803. Examples include weather in the distance, a small quadrant or the vicinity (e.g., fog, mist, lenticular clouds at 2,000 feet grid northwest). Use plain language for these observations. No code is needed.

Call-ins and TAF Requests

Call in weather observations as follows:

- Contact MacWeather via Iridium (dial 8816-763-20030) or HF radio (use a stable frequency to call Central Comms and request the observation be passed to MacWeather).
- Hail the party you are calling (e.g., "Hello, this is Chris from Whillans Ice Plain Camp with the six Z observation."
- Pause for a moment after pressing to transmit, to ensure the entire transmission gets through.
- Wait for acknowledgment.
- Provide observation data (e.g., "We are at 83.65 south latitude and 167.4 west longitude. Winds, grid northwest at 12 knots. Visibility, 1,600 meters. Present weather, snow and mist. Amplification of weather, light snow. Clouds, broken at 1,000, overcast at 5,000. Total sky cover, eight-eighths. Temperature, negative 10. Dew point, negative 15. Barometric pressure, 28.245. Surface definition, poor, Horizon definition, poor. Remarks, all winds grid, mist in the vicinity at grid north. Thanks. Goodbye."

Request a TAF as follows:

- Any time of day that a flight is scheduled for your camp, contact MacWeather via Iridium or HF radio as detailed above.
- Have a pencil and paper ready at the start of each call to note down the TAF, which is relayed in an abbreviated format.
- Only the most recently generated TAF will be provided, regardless of the request time.
- Record the TAF, and translate it (see next table for guidance).

Terms in TAFs

Abbreviation	Description	Example	Translation
1st 3 letters	Station identifier	• 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	Byrd Surface Camp. Other examples: AGO3 = AGO Site #3, NZSP = South Pole, WSD = WAIS Divide.
2nd 3 letters	Report type (i.e., TAF)	NBY TAF 0915/1015 (1004/1104NZDT) GRID08010KT 8000	Terminal Aerodrome Forecast.
####/####	Forecast date and time	NBY TAF 0915/1015 (1004/1104NZDT) GRID08010KT 8000	Forecast from 9th day at 15:00 Z to 10th day at 15:00 Z of current month.
(#####/#####NZDT)	Conversion to New Zealand Daylight Savings Time	NBY TAF 0915/1015 (1004/1104NZDT) GRID08010KT 8000	Forecast from 9th day at 04:00 NZDT to 10th day at 04:00 NZDT of current month (this conversion may not be provided).

Abbreviation	Description	Example	Translation
GRID###_KT	Wind direction and speed	NBY TAF 0915/1015 (1004/1104NZDT) GRID08010KT 8000	Wind from grid 80 degrees (grid east) and wind speed of 10 knots. VRB = variable wind direction.
####	Visibility in meters	NBY TAF 0915/1015 (1004/1104NZDT) GRID08010KT 8000	Visibility on the ground is 8,000 meters.
XX XX	Forecast weather	-SN BR BKN010 OVC020 QNH2837INS	Light snow and mist. BLSN = blowing snow, BR = mist (e.g., baby rain), DRSN = drifting snow, FG = fog, IC = ice crystals, NSW = no significant weather, PL = ice pellets, SG = snow grains, -SN = light snow, SN = snow or moderate snow, +SN = heavy snow, SW = snow showers.
BKN010	Cloud layer 1 type and altitude in feet	-SN BR FEW005 BKN010 OVC020 QNH2837INS	Lowest layer involves few clouds (i.e., 1/8–2/8 coverage) at 500 feet. BKN = broken, FEW = few, OVC = overcast, SCT = scattered, SKC or CLR = Sky clear, W = vertical visibility (obscured sky). 005 = 500 feet, 010 = 1,000 feet, 100 = 10,000 feet, etc.
OVC020	Cloud layer 2 type and altitude in feet	-SN BR FEW005 BKN010 OVC020 QNH2837INS	Second layer up involves broken clouds (i.e., 5/8–7/8 coverage) at 1,000 feet.

Abbreviation	Description	Example	Translation
#####	Cloud layer 3 type and altitude in feet	-SN BR FEW005 BKN010 OVC020 QNH2837INS	Third layer up is overcast (i.e., 8/8 coverage) at 2,000 feet.
QNH#####INS	Barometric pressure	-SN BR FEW005 BKN010 OVC020 QNH2837INS	Station pressure is 28.37 inches of mercury (inHg).
TEMPO ...	Temporary weather condition lasting < 1 hour	TEMPO 0920/0924 (1009/1013) 2400 OVC010	Forecast on 9th day of current month during 20:00–24:00 Z (10th day during 09:00–13:00 NZDT), is 2,400 meters of visibility and a single overcast layer at 1,000 feet (excluded data [e.g., wind speed] remain the same).
BECMG ...	Becoming. New forecast will be in effect by end of BECMG period.	BECMG 0923/1001 (1012/1014) VRB06KT 9999 NSW SCT010 BKN030 QNH2834INS AMD 1900	Forecast starting 9th day at 23:00 Z and in effect by 10th day at 01:00 Z of current month (10th day 12:00–14:00 NZDT), is variable winds at 6 knots, unrestricted visibility, no significant weather, scattered clouds at 1,000 feet, broken clouds at 3,000 feet, and station pressure of 28.34 inHg, with this amended forecast issued at 19:00 Z.

Sea Ice Assessment

A McMurdo Sound Sea Ice Report is available biweekly while the sea ice is open for travel. The report consists of a satellite image overlaid with sea ice routes and text on current conditions. Review the report before traveling on the sea ice, and contact FS&T with questions.

Field parties can obtain current and historical satellite imagery for research areas from the Polar Geospatial Center. This imagery is gathered throughout the winter to track sea ice movement and development. Throughout the summer, imagery is gathered weekly.

Low-resolution visible imagery: This is published daily, but sea ice may be obscured by cloud cover. Historical imagery is available to 2000.

High-resolution visible imagery: This is published five to six times a year, mostly during the summer. The last two years of historical imagery are available.

Radar (SAR) imagery: This is typically published each week and can see through clouds. Only four or five days of historical imagery is available.

Sea ice concentration: This is published daily with a two-day lag. Historical imagery is available to 2002.

Managing the risk of traveling on sea ice requires teams to pay attention to weather conditions, ice thickness, ice color, ice temperature and cracks. All participants traveling on the sea ice must attend the sea ice training. If it is your first year in USAP, this includes a full day on the sea ice learning hands-on to measure sea ice thickness, recognize cracks and understand how weather affects the sea ice. The following information reflects much of what is covered in the training. Keep this manual with you in the field to aid your sea-ice travel decisions.

Weather

Poor weather conditions will obscure surface definition, making it difficult to 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 break off and blow north with little warning.

Thickness

Strong currents can erode sea ice from below. This is hazardous because there may be no obvious indication of ice thinning at the surface. Strong 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, areas near Cape Armitage (at the base of Observation Hill), Hut Point, and Knob Point/Cinder Cones can sustain strong currents and thinning ice later in the season. In addition, as the air and sea temperatures rise later in the season, the sea ice becomes progressively weaker and thinner everywhere.

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 that is at least 24 inches thick. Ice that is sky blue and has a slick, scalloped surface is multiyear ice that is several feet thick.

Ice of different ages and thickness are 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 by 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 thin and must always be avoided. Field team members should drill the ice every 100 meters if the ice surface is consistent, and much more frequently if there are variations in color or texture.

Temperature

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

Sea Ice Periods

Period	Surface Temperature	
	Celsius	Fahrenheit
1	< -10°C	< 14°F
2	-10°C to < -5°C	14°F to < 23°F
3	-5°C to < -2.78°C	23°F to < 27°F
4	-2.78°C to < -1.94°C	27°F to < 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 (e.g., wind, waves, tidal action, pressure applied by ice shelves and glaciers). 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.

Avoid cracks whenever possible. If one must be crossed, do so in a line perpendicular to the crack. Never cross a system of multiple, closely set cracks in a way that places a vehicle on two or more cracks at once or on a small piece of ice between cracks. Avoid sets of cracks that form triangular wedges, which could break off and flip over under a vehicle's weight.

Snow cover on the sea ice can hide cracks. 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 (e.g., feces, urine, seal shadows, breathing holes). Their presence anywhere on the sea ice indicates the presence of a crack. Seal breathing holes may become covered and obscured by thin ice or snow. A small mound of ice or snow on the otherwise flat surface of the sea ice may indicate the presence of a breathing hole.

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

There are four types of sea ice cracks:

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

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

Sea Ice Travel and Work

Sea ice must be at least 12 inches thick to allow for travel within 300 meters (~985 feet) of shore. Ice must be 20 inches thick to allow for travel beyond 300 meters. These thicknesses are the same for ski, foot and snowmobile travel due to the distributed pounds per square inch of ground pressure for each method.

The 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 the ice surface temperature's period. The effective width cannot exceed one-third of a vehicle track length or area of a tire in contact with the ice. Use the following guidelines to determine the required ice thickness and maximum effective width for vehicles.

Sea Ice Crack Guidelines for Light Vehicles

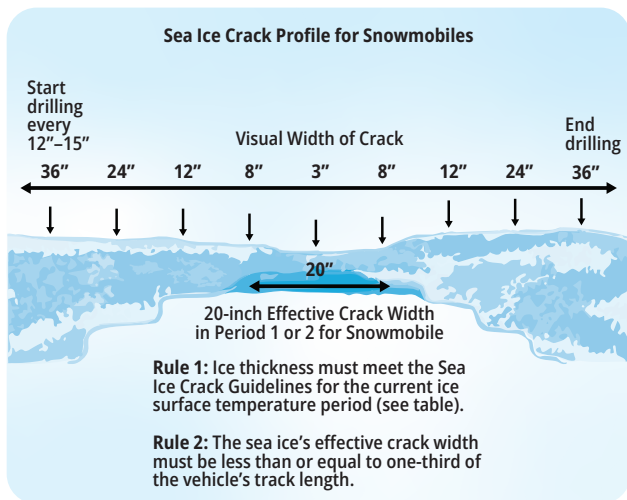
Vehicle	Maximum Effective Crack Width	Minimum Ice Thickness by Ice Surface Temperature			
		Period 1 ($< -10^{\circ}\text{C}$)	Period 2 (-10°C to $< -5^{\circ}\text{C}$)	Period 3 (-5°C to $< -2.78^{\circ}\text{C}$)	Period 4 (-2.78°C to $< -1.94^{\circ}\text{C}$)
PistenBully	36"	12"	12"	17"	17"
Hägglunds	27"	15"	16"	21"	7"
Snowmobile	20"	5"	5"	6"	7"
Mattracks	15"	12"	13"	17"	18"

Note: If towing a sled or trailer, different ice thickness requirements may apply. Contact Field Safety & Training at x2345 for more information.

Profiling a Sea Ice Crack

1. Stop the vehicle before reaching a crack, and check for other cracks nearby.
2. Determine the nearest edge of the crack by removing snow down to bare ice.
3. Using an ice ax, probe for open water or weak spots to determine if it is safe to cross by foot.
4. If safe, shovel the snow out of the crack from edge to edge, clearing at least one shovel blade's width of snow.
5. Drill holes every 12 inches in a straight line, beginning outside one crack edge and ending outside the other. Be sure to drill healed shelves and any visible fractures.
6. Drill each hole either to water level or a full Kovacs drill flight length (> 30 inches).

7. Measure the ice thickness in each hole.
8. Pay attention to the characteristics of the ice shavings (i.e., dry, moist or slushy).

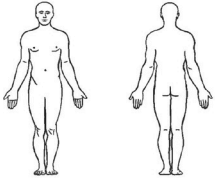




REFERENCES

SOAP Note

SOAP NOTE

Patient Name		DOB						
SUBJECTIVE								
S	Symptoms:	A	Allergies:					
		M	Medications:					
		P	Past History:					
		L	Last Meal:					
		E	Events:					
OBJECTIVE								
EXAM								
		VITAL SIGNS						
		Time	Pulse	Resp	BP	Skin	Temp	AVPU
					/			
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Access the controlled version of this form on the USAP Master List. / PARENT: MED-SOP-0003

REFERENCES

Emergency Incident Worksheet

EMERGENCY INCIDENT WORKSHEET

Expand the cells in this form or attach additional pages as needed.

INITIAL INFORMATION			
Time		Freq/Phone	Caller Name
Location			
Situation			
INJURY OR ILLNESS			
Information	Patient 1	Patient 2	Patient 3
Name			
Gender			
Age			
Conscious?	☐ Y ☐ N	☐ Y ☐ N	☐ Y ☐ N
Symptoms / Injury Type (Area of Body, Bleeding, Deformity)			
Mechanism of Injury (Possible Back / Spine / Neck / Head Injury?)			
Pain Level From 1 (Lowest) to 10 (Highest)			
Highest Level of Caregiver's Training			
SPILL			
Active Spill?	☐ Y ☐ N	If Yes, Fluid Type (e.g., Fuel, Glycol)	
Related Injuries?	(Specify in Injury or Illness section)		
Fire or Risk of Fire?	☐ Y ☐ N		
Volume of Spill (Gallons)	_____ Gallons		
Dimensions of Spill Area			
LOSS OF SHELTER OR INFRASTRUCTURE			
Shelter(s) Available (Type and Quantity)			
Already Set up?	☐ Y ☐ N		
Fire?	☐ Y ☐ N		
Related Injuries?	(Specify in Injury or Illness section)		
Food Available? (Estimate Person-Days)	☐ Y ☐ N _____ Person-Days		
Fuel Available? (Cooking + Heating: Estimate Days)	☐ Y ☐ N _____ Days		
Comms, Power, Batteries?	☐ Y ☐ N		
AIRCRAFT MISHAP			
Aircraft Type and Call Sign			
Related Injuries?	(Specify in Injury or Illness section)		
Crew Status			
Aircraft Engine/Prop/Rotor Still Running?	☐ Y ☐ N		
Fire or Risk of Fire?	☐ Y ☐ N		
Spill?	(Specify in Spill section)		
VEHICLE ACCIDENT			
Vehicle Type and ID			
Related Injuries?	(Specify in Injury or Illness section)		
Vehicle Still Running or Moving? Stable?	☐ Y ☐ N		
Fire or Risk of Fire?	☐ Y ☐ N		



Access the controlled version of this form on the USAP Master List. / PARENT: FLD-PLN-0001

[illegible]

Knots

Knots are essential for working and living in the field, and it helps to be familiar with knot terminology:

Knot: Ties a rope to itself.

Hitch: Ties a rope to another object (e.g., post, stake, = eye-ring grommet).

Bend: Ties two different pieces of rope together.

Bight: Curved or slack section of rope between two ends.

There are 13 knots you may find useful in the field (see figures at end of section).

Figure 8 on a Bight

The figure 8 on a bight forms a secure, non-slip loop at the end of the rope that is difficult to untie after a heavy load. Use the tail end to make a stopper knot.

Common uses: Climbing and mountaineering; making a loop for a carabiner to attach a sled to a snowmobile.

Bowline

The bowline is a loop knot that creates a closed, fixed circle at the end of a line. This is a secure knot that does not slip when loaded and is easy to untie. Learn to tie it with one hand for fun or for rescue situations. To tie a bowline, make a small loop, then with the running end of the rope, make the “rabbit come out of the hole, around the tree and back down the hole.” Use a stopper knot.

Common uses: Tying around a tent loop to use as a guyline; tying down cargo.

Clove Hitch (aka Double Hitch)

The clove hitch is a 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, with the running end then

passing under itself, making it a good binding knot. It is easy to untie but needs tension or will come undone. The clove hitch can be tied from the middle of the rope.

Common uses: Starting or ending lashing; attaching a rope to a carabiner, eye ring grommet, stake or post.

Round Turn and Two Half Hitches

The round turn and two half hitches ties a rope to an object (e.g., post, ring). It is a great all-purpose knot to secure a rope when pulled from a post in one direction. It is strong, does not slip, and is easy to untie.

Common uses: Lowering survival bags from a ship's deck to a small boat below; securing survival bags to a bamboo or metal stake so they do not blow away.

Sheepshank Knot

A sheepshank knot is used to shorten a rope or take up slack. It requires tension.

Common uses: When you need a short length of rope but do not want to cut the line.

Sheet Bend

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

Common uses: Lengthening a guyline; fixing a boot lace with paracord or string; using scraps of line to make a longer one.

Tautline Hitch

The tautline hitch is an adjustable loop knot that can slide on a line. It easily adjusts under tension and remains secure once the knot is pulled tight. This knot is a combination of the clove hitch and the round turn and two half hitches.

Common uses: Replacing a tent guyline; adjusting the tension on a guyline.

Square Knot (aka Reef Knot)

The square knot is a binding knot used to tie two ends of a single rope together, right over left, then left over right.

Common uses: Lengthening a rope by tying two lines together; tying a bundle of bamboo poles; tying bandages.

Prusik Knot

The Prusik knot is a friction hitch used to attach a loop of 5-millimeter cord around a rope.

Common uses: Climbing and mountaineering; tying items to a guyline so they do not blow away.

Trucker's Hitch

The trucker's hitch stretches a rope between two anchor points. It is 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. It can quickly be undone and retensioned, with more force than the tautline hitch.

Common uses: Tensioning guylines between deadman anchors and the tent; tying and securing sled loads.

Water Knot

The water knot joins two lengths of webbing or straps.

Common uses: Lengthening two pieces of webbing; joining two cargo straps or cam straps.

Double Fisherman's Stopper

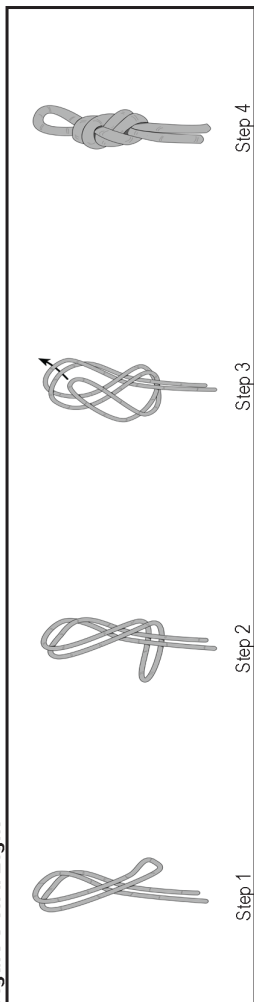
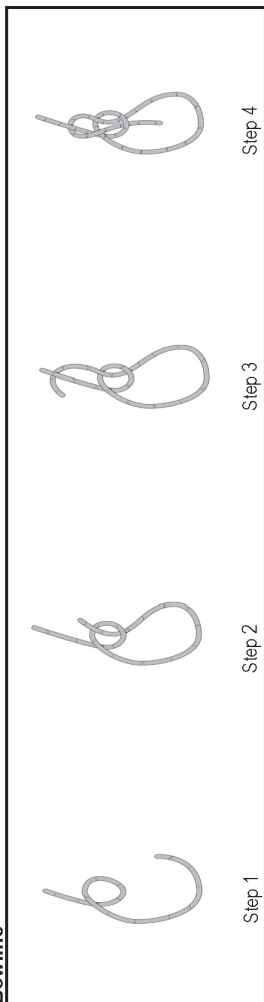
The double fisherman's stopper knot joins two lengths of rope and is very easy to tie. It consists of two overhand knots.

Common uses: Making slings in climbing; making adjustable necklaces and bracelets; camping crafts on bad-weather days.

Alpine Butterfly Loop

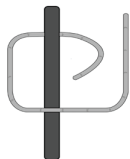
The alpine butterfly forms a fixed loop in the middle of a rope without needing access to either end. This knot shortens a long climbing rope or creates a bight in the middle of a rope.

Common uses: Connecting members of a roped-up mountaineering team.

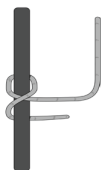
Figure 8 on a Bight**Bowline**

Note: Illustrated by GHG.

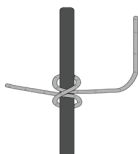
Clove Hitch (Double Hitch)



Step 1



Step 2



Step 3



Step 4

Round Turn and Two Half Hitches



Step 1



Step 2

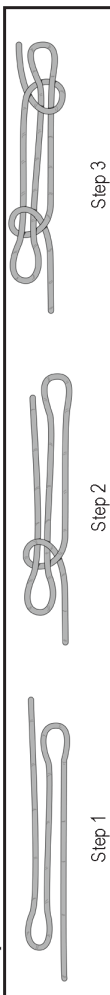
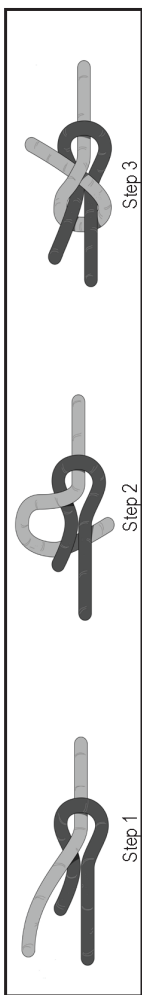
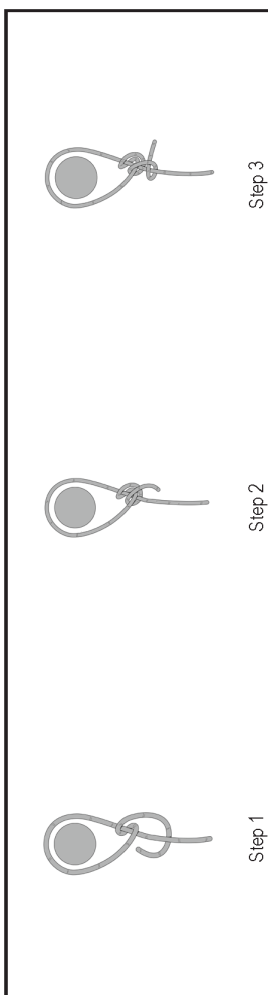


Step 3



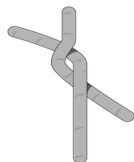
Step 4

Note: Illustrated by GHG.

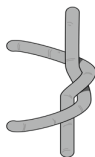
Sheepshank Knot**Sheet Bend****Tautline Hitch**

Note: Illustrated by GHG.

Square Knot or Reef Knot



Step 1



Step 2



Step 3

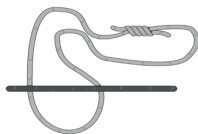


Step 4

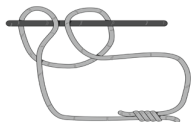


Step 5

Prusik Knot



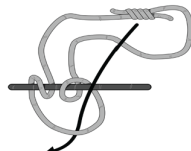
Step 1



Step 2



Step 3



Step 4



Step 5

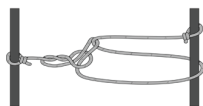
Note: Illustrated by GHG.

Trucker's Hitch

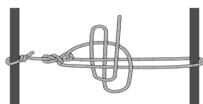
Step 1



Step 2



Step 4



Step 5



Step 3

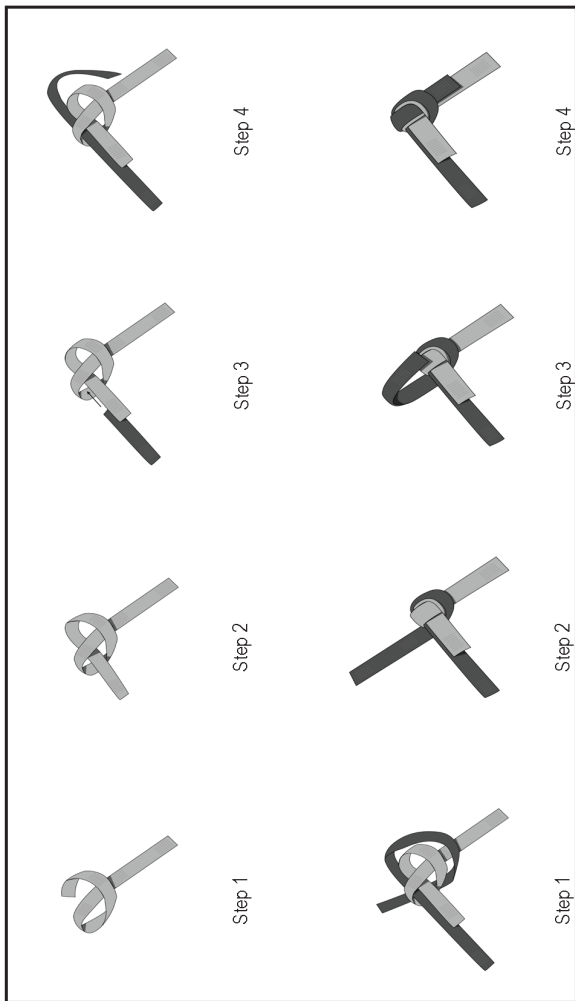


Step 6



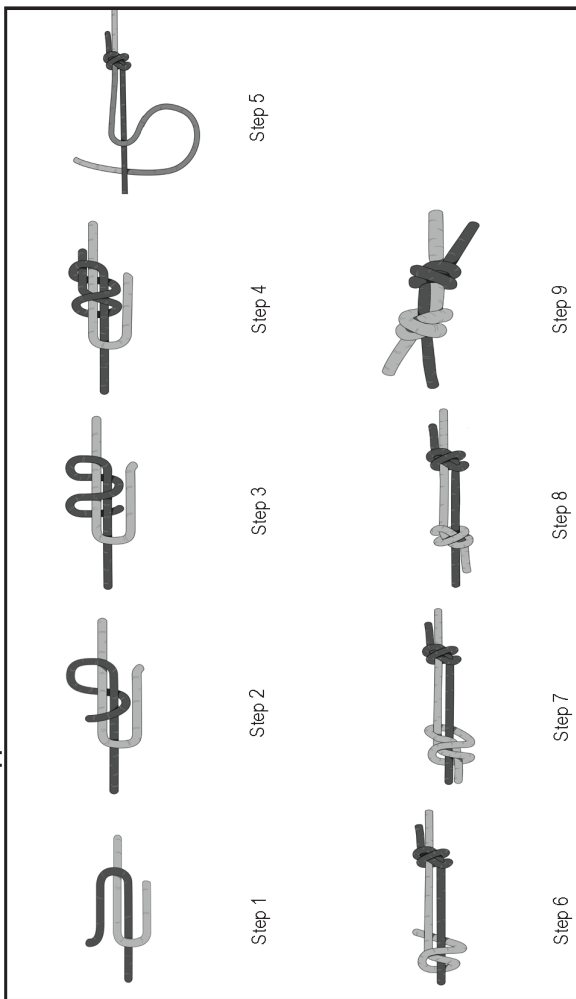
Note: Illustrated by GHG.

Water Knot



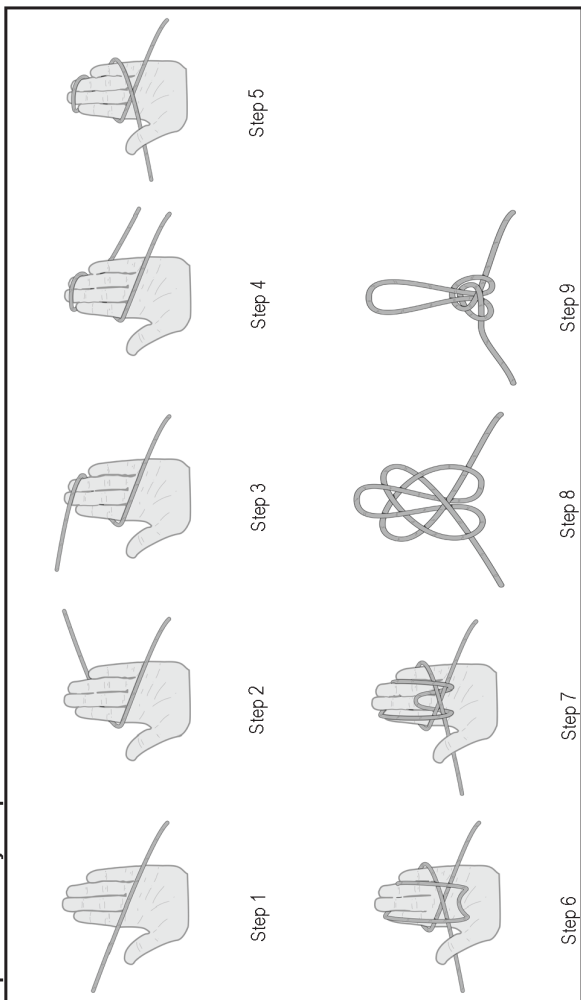
Note: Illustrated by GHG.

Double Fisherman's Stopper



Note: Illustrated by GHG.

Alpine Butterfly Loop



Note: Illustrated by GHG.

Common Conversions of Measure

Measure	Multiply	By	To Get
Weight	pounds	0.4536	kilograms
	kilograms	2.2046	pounds
Distance	inches	25.4000	millimeters
	millimeters	0.0394	inches
	inches	2.5400	centimeters
	centimeters	0.3937	inches
	meters	3.2808	feet
	feet	0.3048	meters
	meters	1.0936	yards
	yards	0.9144	meters
	kilometers	0.6214	miles
	miles	1.6090	kilometers
	kilometers	0.5396	nautical miles
	nautical miles	1.8530	kilometers
	statute miles	1.6093	kilometers
	kilometers	0.6213	statute miles
Density	cubic feet	0.0283	cubic meters
	cubic meters	35.3145	cubic yards
	cubic yards	0.7646	cubic meters
	cubic meters	1.3079	cubic yards
Volume	liters	0.2642	gallons
	gallons	3.7854	liters
	liters	2.1134	pint (liquid)
	pint (liquid)	0.4732	liters

New Zealand Daylight Savings Time – Zulu Time Conversions

NZDT	Zulu	NZDT	Zulu
00:00	11:00	12:00	23:00
00:30	11:30	12:30	23:30
01:00	12:00	13:00	00:00
01:30	12:30	13:30	00:30
02:00	13:00	14:00	01:00
02:30	13:30	14:30	01:30
03:00	14:00	15:00	02:00
03:30	14:30	15:30	02:30
04:00	15:00	16:00	03:00
04:30	15:30	16:30	03:30
05:00	16:00	17:00	04:00
05:30	16:30	17:30	04:30
06:00	17:00	18:00	05:00
06:30	17:30	18:30	05:30
07:00	18:00	19:00	06:00
07:30	18:30	19:30	06:30
08:00	19:00	20:00	07:00
08:30	19:30	20:30	07:30
09:00	20:00	21:00	08:00
09:30	20:30	21:30	08:30
10:00	21:00	22:00	09:00
10:30	21:30	22:30	09:30

NZDT	Zulu	NZDT	Zulu
11:00	22:00	23:00	10:00
11:30	22:30	23:30	10:30

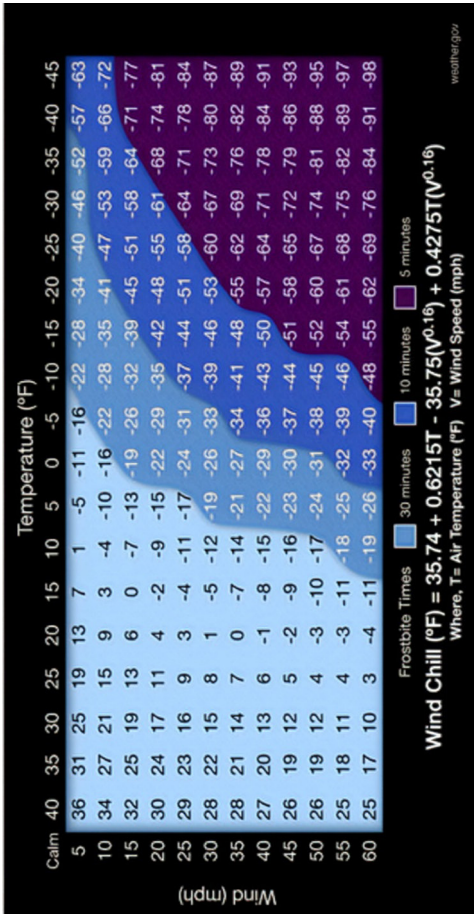
Note: NZDT = New Zealand Daylight Savings Time. Report weather observations in Zulu time (e.g., a McMurdo-based field camp operating on NZDT in the austral summer with an 08:00 weather observation calls it in as 19:00 Zulu).

Temperature Conversions

Degrees Fahrenheit (°F)	Degrees Celsius (°C)
40	4.4
35	1.7
32	0.0
30	-1.1
25	-3.9
20	-6.7
15	-9.4
10	-12.2
5	-15.0
0	-17.8
-5	-20.6
-10	-23.3
-15	-26.1
-20	-28.9
-25	-31.7
-30	-34.4
-35	-37.2
-40	-40.0

Note: Fahrenheit to Celsius = (Fahrenheit – 32) × (5/9). Celsius to Fahrenheit = (1.8 × Celsius) + 32.

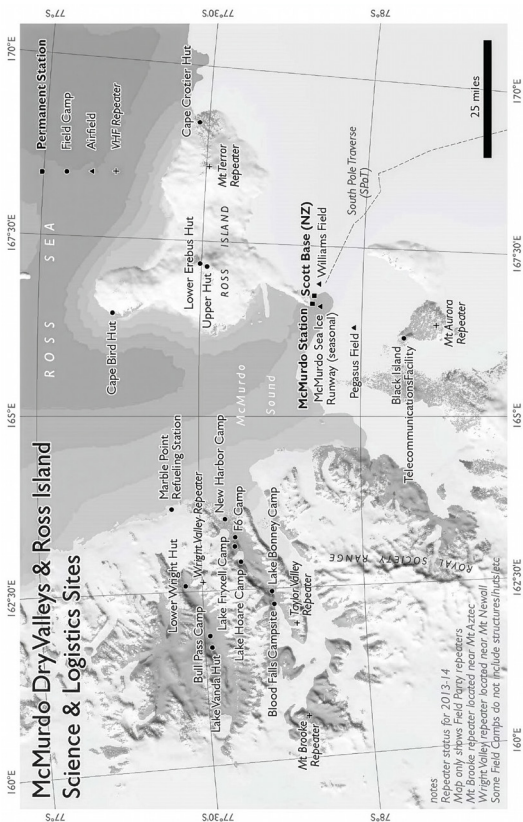
Wind Chill Chart



Note: Reproduced from "Understanding Wind Chill," National Weather Service, <https://www.weather.gov/safety/cold-wind-chill-chart>.

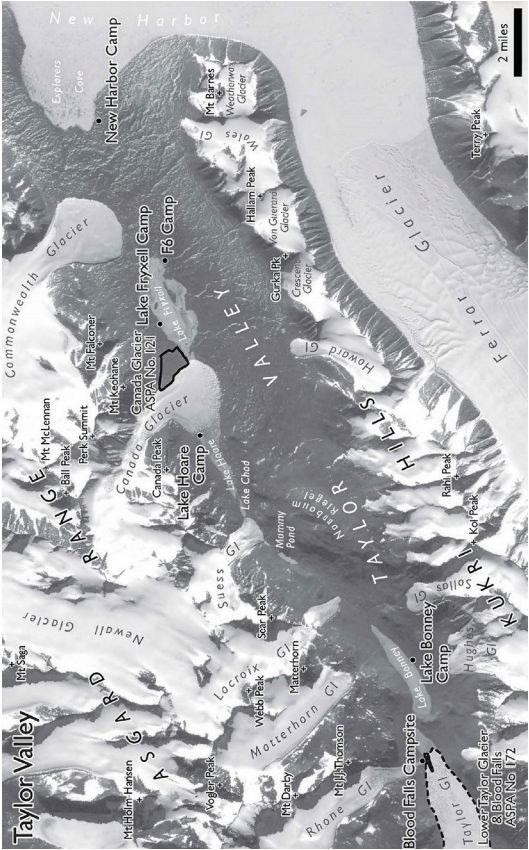
Maps

McMurdo Dry Valleys and Ross Island Science Logistics Sites



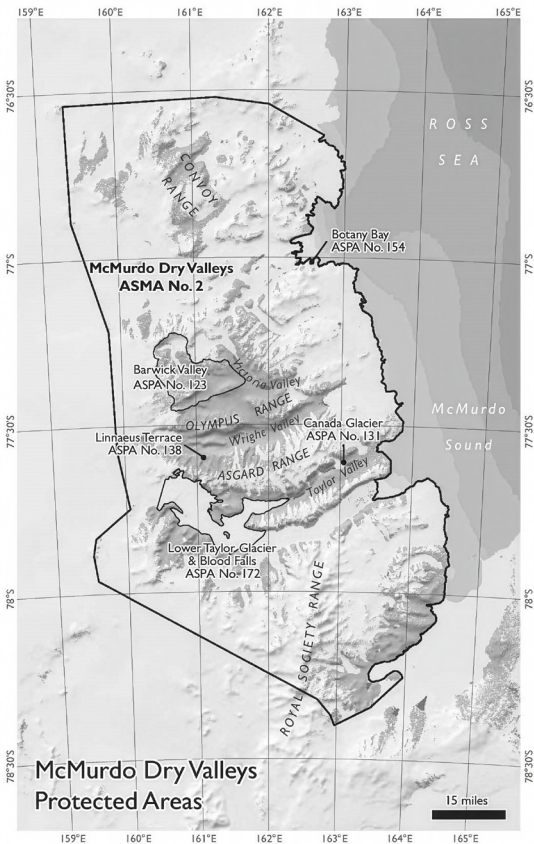
Note: Produced by Polar Geospatial Center (<https://www.pgc.umn.edu>), based on data from USAP's Environmental Research & Assessment, Antarctic Digital Database.

Taylor Valley Camps



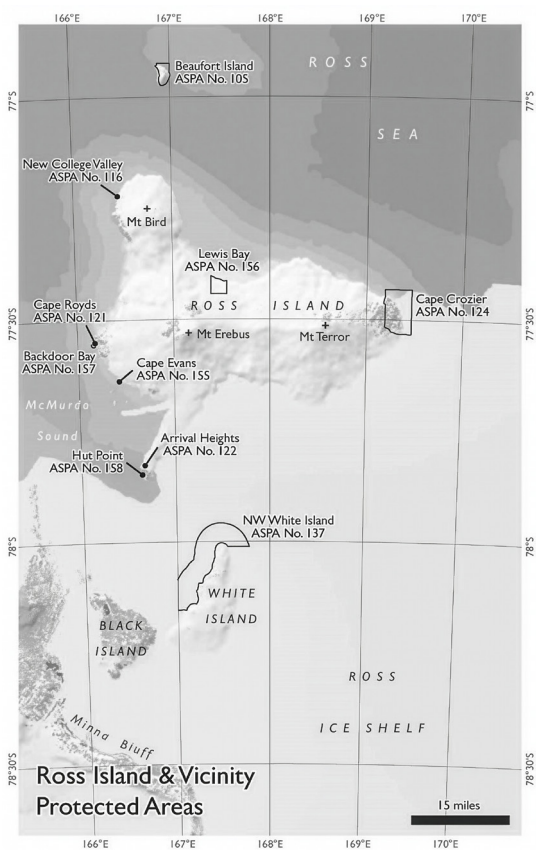
Note: Produced by Polar Geospatial Center (<https://www.pgc.umn.edu>), based on data from USAP's Environmental Research & Assessment, Antarctic Digital Database.

McMurdo Dry Valleys ASMA



Note: Produced by Polar Geospatial Center (<https://www.pgc.umn.edu>), based on data from USAP's Environmental Research & Assessment, Antarctic Digital Database.

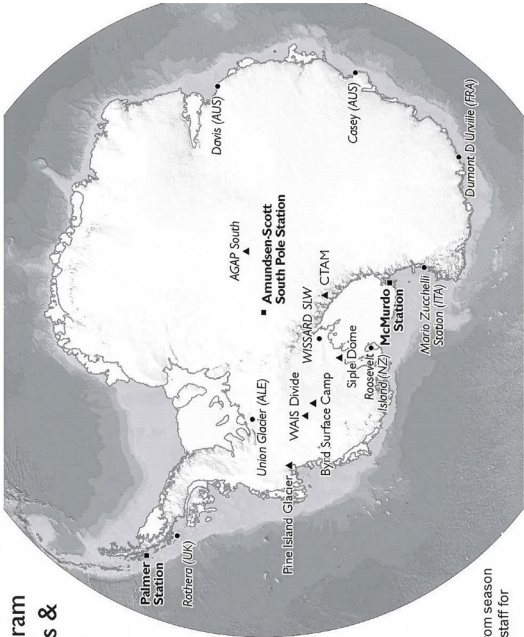
Ross Island and Vicinity ASPAs



Note: Produced by Polar Geospatial Center (<https://www.pgc.umn.edu>), based on data from USAP's Environmental Research & Assessment, Antarctic Digital Database.

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

Note: Produced by Polar Geospatial Center (<https://www.pgc.umn.edu>), based on data from USAP's Environmental Research & Assessment, Antarctic Digital Database.

Glossary

The following terms are used in this manual.

Term	Definition
AC	alternating current
ACA	Antarctic Conservation Act
ACL	allowable cabin load
AF Form 3803	U.S. Air Force form for recording weather observations
AFS	Antarctic Field Safety
AGE	Aerospace Ground Equipment
ANG	Air National Guard
Antarctic-Environmental Protocol	Protocol on Environmental Protection to the Antarctic Treaty
ASC	Antarctic Support Contract
ASMA	Antarctic Specially Managed Area
ASPA	Antarctic Specially Protected Area
AvOps	Aviation Operations
BFC	Berg Field Center
BL	Building
Central Comms	Central Communications
CMO	chief medical officer
CO	carbon monoxide
COC	chain of custody
Crary Lab	Crary Science and Engineering Center
DC	direct current
DID	direct inward dialing
DNF	do not freeze
ECW	extreme cold weather

Term	Definition
EOC	Emergency Operations Center
EOS	end of season
ETA	estimated time of arrival
ETR	estimated time of return
Fleet Ops	Fleet Operations
FP	field party
FS&T	Field Support & Training
FTS	Federal Telephone System
GPS	global positioning system
haz dec	Shipper's Declaration for Dangerous Goods
Helo Ops	Helicopter Operations
helo pad	helicopter pad
helo tech	helicopter technician
HELOFF	helicopter flight following
HF	high frequency
HPAI	highly pathogenic avian influenza
HSMs	Historic Sites and Monuments
IT	information technology
JSART	joint search and rescue team
KBA	Kenn Borek Air, Ltd.
KC	keep chilled
KF	keep frozen
KU	keep upright
lb	pounds
LDBF	Long Duration Balloon Facility
MacCenter	McMurdo Station Field Operations Center
MacOps	McMurdo Station Operations

Term	Definition
MacWeather	McMurdo Weather
MCC	Movement Control Center
MEC	Mechanical Equipment Center
medevac	medical evacuation
MERM	medical and emergency response manager
METAR	aviation routine weather report
MHz	megahertz
MoGas	motor vehicle gasoline
mpg	miles per gallon
mph	miles per hour
MRE	Meal, Ready-to-Eat
NIWC	Naval Information Warfare Center Atlantic
NSF	U.S. National Science Foundation
NYANG	New York Air National Guard
OPP	Office of Polar Programs
PADS	Public Area Display System
PI	principal investigator
PIREP	pilot report
POC	point of contact
Premix	Usually a 50:1 mixture of MoGas to “Blizzard” oil used by snowmobiles and similar equipment
PVC	polyvinyl chloride
recce	reconnaissance flight
retro	retrograde
RFI	ready for issue
RM	risk management
RSP	Research Support Plan

Term	Definition
SAHPR	Sexual Assault and Harassment Prevention and Response
SAR	search and rescue
SIP	Support Information Package
SOAP	subjective, objective, assessment, and plan
SPECI	aviation special weather report
SSC	Science Support Center
TAF	Terminal Aerodrome Forecast
triwall	triple-layered, corrugated paperboard box
UHF	ultra high frequency
UHMW	ultra high molecular weight
USAP	United States Antarctic Program
VHF	very high frequency
VoIP	Voice over Internet Protocol
WAIS	West Antarctic Ice Sheet



UNITED STATES ANTARCTIC PROGRAM

Field First Aid





This manual was prepared for the U.S. National Science Foundation (NSF) Office of Polar Programs by Antarctic Support Contract field area and other personnel. It brings together decades of first-hand field experience in Antarctica with the United States Antarctic Program.

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Please send suggestions and corrections to DEN-FieldSafety@usap.gov.

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Weddell seal pup near
McMurdo Station

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FIRST AID



Introduction

The “United States Antarctic Program Field First-Aid” manual describes medical issues that may be encountered in an Antarctic field environment. This is not an exhaustive manual but a guide for persons with a limited medical background so they can help treat their companions. Read this in advance to help field team members recognize dangerous situations and prevent injuries from occurring or worsening.

Antarctica is an inherently risky environment. Participants are often dehydrated, mildly hypothermic and sleep deprived. This can lead to an increase in accidents. It is essential that all team members slow down, assess each task and ensure the safety of the team.

A variety of medical kits are provided to teams depending on their activities, locations and needs. Team members should familiarize themselves with the contents of a kit before there is a need to use it.

Hygiene

Occasionally, people deploying to the deep field use the remote environment as an excuse to abstain from normal hygiene and sanitation. Extreme cold temperatures, lack of running water and communal living make bathing, brushing teeth and basic hygiene a chore. However, it is important to continue with a normal hygiene routine to avoid painful and distracting issues, such as dental abscesses, gum pain, yeast infections, skin rashes, cracked skin and trench foot.

Wet-wipe and sponge baths are the norm. If wet wipes are preferred, personnel should bring enough for the anticipated time in the field. Blanket partitions can be set up in large tents to create a semi-private space.

Sprains and Strains

Sprains and strains are the most common injuries in Antarctica. People must work carefully, thoughtfully and deliberately to avoid them. A sprain is an injury that involves

tearing the ligaments that help keep joints intact. A strain involves overstretching a muscle.

Signs and Symptoms

Sprains and strains will manifest as pain at the site of the injury that may radiate outward. There will also be swelling and discoloration.

Treatment

- R Rest:** Stop activity, make the patient comfortable, and set up shelter if necessary.
- I Ice:** Cool down the affected area with water, snow or ice for about 15 minutes. Do not apply it directly to the skin.
- C Compression:** Wrap the affected area with an elastic bandage.
- E Elevation:** Keep the affected limb raised to reduce swelling.

Immobilize the Joint

Fingers

Place gauze between the injured finger and the uninjured finger next to it. Buddy-tape the fingers in two places, but not over a joint, so the fingers can be flexed and extended.

Wrist

If swollen, splint it using a SAM Splint or materials on hand. If it is not swollen, or when the swelling subsides, bandage it from the hand to below the elbow with an elastic (e.g., ACE) bandage. The patient should exercise the fingers, elbow and shoulder regularly.

Knee

If it is very swollen, suspect a more serious injury. With the knee in a neutral position (slightly bent, between full extension and flexion) wrap a thick layer of cotton wool around the leg from mid-calf to mid-thigh. Apply a SAM Splint on the back of

the leg to keep it in position, and hold the splint in place with an elastic bandage.

Ankle

Remove the boot. Place the foot in a position of comfort. Using an elastic or tape bandage, wrap from the toes to just below the knee, keeping the foot up and covering all the skin. If the ankle is very swollen, especially on both sides, then a more severe injury should be suspected.

Do not wrap bandages too tightly. Toes must remain warm and pink and have feeling.

External Bleeding and Wounds

Treatment

Stop the bleeding with a gloved hand or finger(s), using direct, well-aimed pressure. Once bleeding has been controlled, clean the wound with mild soap and potable water, or use Hibiclens or povidone iodine. Remove any obvious debris with tweezers or forceps, and irrigate the wound copiously with high-pressure irrigation. If high-pressure irrigation is unavailable, continue to flush the wound until no debris is seen. Never use alcohol to clean a wound. Once the wound is clean, apply an antibiotic ointment, cover the wound with a clean dressing (sterile if possible) that extends well beyond the edges of the wound, and tape it in place.

Small wounds can be taped together with Steri-Strips or BAND-AIDs. Dry the edges of the wound, squeeze together, and stick the bandage across the wound. Several may be needed to hold the cut together.

All wounds should be cleaned twice a day, with a new, clean dressing applied. If a wound is contaminated and there is concern about infection, medical personnel should be notified.

Impaled Objects

Impalements to the head, face, trunk and other core parts of the body are usually left in place. Focus primarily on bleeding

control, with secondary efforts to stabilize the object in place with sterile bulky dressing. Minimizing movement of the impalement will help to reduce subsequent damage. In some cases when the impalement is from a larger object, consider reducing the size of the object to facilitate evacuation.

Impalements to the eyes get special attention. No objects impaled in an eye should be removed. Instead, both eyes should be patched, and padding should be placed around the injured eye to support it and decrease movement until it can be safely removed in a controlled environment.

Wilderness medicine guidelines suggest that impalements to the extremities can be removed too, but it is ideal to remove only objects that cannot be stabilized, will fall out easily or will prevent transportation. If needed because of one of the above criteria, prior removal of the impaled object can help. Proper wound management will help minimize the risk of infection. In some cases, extremity impalements remain stabilized in place.

Carbon Monoxide Poisoning

Carbon monoxide (CO) can be produced by burning anything containing carbon, including fuel in open flames, gas cookers or engines. CO poisons by attaching itself to the hemoglobin in the blood. It does so about 200 times as readily as oxygen, easily displacing inhaled oxygen. When enough hemoglobin is compromised, the remainder cannot carry sufficient oxygen to the rest of the body. Oxygen starvation of the brain will cause permanent damage, even if the patient is revived. CO toxicity also increases with altitude.

Signs and Symptoms

Often there are no signs or symptoms of CO poisoning. However, the following may occur:

Early Symptoms

- Slight headache
- Dizziness

- Nausea
- Fatigue

Progressed Symptoms

- Shortness of breath
- Confusion
- Panting
- Chest pains
- Dimming of vision/blurry vision
- Loss of consciousness
- Ringing in the ears

In Later Stages / Rarer Symptoms

- Patients with darker skin can appear dusky, darker than usual or purplish.
- Patients with lighter skin will appear pink to cherry red in the face, though the red and yellow polar tents will make it difficult to notice skin color change.
- Unconsciousness and death are often rapid.

Treatment

1. Immediately move the patient to fresh air or an uncontaminated tent.
2. Provide the patient with 100% oxygen if available.
3. Contact Medical, and describe the incident and symptoms.
4. Keep the patient quiet and resting for at least eight hours. Early exertion may cause cardiac arrest.
5. If breathing stops, commence cardiopulmonary resuscitation (CPR).

Prevention

Field parties must utilize the issued CO detector. Team members must ensure there is adequate ventilation at all times in all buildings, shelters and vehicles. Tents or other shelters must be thoroughly ventilated during cooking and before personnel go to bed each night.

Hypothermia

Hypothermia occurs when a person's core temperature is reduced to a level where normal brain and body functions are impaired. Hypothermia progressively affects a person's judgment, perception and coordination.

Wind greatly increases the chilling effect of cold. The faster the air moves, the more heat it can drag away. The cooling effects of air are shown in the wind chill chart in the References section of the "United States Antarctic Program Field Manual."

Wet clothes, from sweating, marine dampness or precipitation also cause chilling. Fatigue reduces people's ability to protect themselves and diminishes their physiological capacity to thermoregulate and maintain a proper core temperature.

Prevention

Hypothermia is prevented by wearing proper clothing and supporting and regulating the body's heat production. Good nutrition and hydration also help, and adequate rest is critical. Exhaustion promotes the onset of hypothermia and precedes its development in almost all cases. The tendency to "press on" has led to many unnecessary deaths.

A layered clothing system should be employed, with layers added or removed as needed. Field team members should not allow themselves to get either cold or hot and sweaty.

Signs and Symptoms

Hypothermia manifests in three stages.

Mild

This stage includes shivering and personality changes. A person may become withdrawn, apathetic or irritable or lose fine motor control. Field party members should always be on the alert for a team member displaying any of the “umbles”: stumbles, mumbles, fumbles and grumbles.

Moderate

At this stage, hypothermia progresses to violent shivering, altered mental states and disorientation. Moderate hypothermia also manifests as a loss of gross motor skills, such as balance and coordination (i.e., ataxia).

Severe

In this stage, shivering stops and the level of responsiveness drops. A person becomes unresponsive and may appear dead, with very slow and weak pulse and respiration rates. They will appear cold and blue and may have associated frostbite. Cardiac arrest is possible.

Treatment

The essential and immediate treatment for hypothermia is to insulate the body to prevent further heat loss. If any member of a field party shows signs of developing hypothermia, the person must be moved into shelter immediately.

Mild hypothermia may be turned around quickly. Do the following for persons experiencing this condition:

- Help them into additional clothing layers and feed them quick-energy carbohydrates and warm, sweet drinks, such as hot chocolate or warm electrolyte beverages.
- Encourage them to run in place or perform another exercise.
- Provide them dry clothes, if necessary, and external heat sources, such as hot pads or water bottles filled with warm fluid.

If moderate to severe hypothermia is suspected, contact Medical immediately. The patient should be placed in a hypothermia wrap, which is a bundle made of sleeping bags and reflective sheeting, with warm heat sources on the patient's neck, armpits and groin. Body-to-body rewarming in a sleeping bag is of limited usefulness and may result in two cold people.

Frostbite

Frostbite is freezing of body tissue. Areas most at risk are the extremities and exposed skin (e.g., ears, nose, face).

Risk Factors

The following raise the risk for frostbite:

- Previous frostbite injury
- Cold temperatures and wind
- High altitude
- Overexertion (e.g., fatigue dehydration)
- Touching metal or super-cooled liquid fuel
- Poor circulation
- Constrictive clothing or footwear
- Underlying medical problems
- Hypothermia

Prevention

Frostbite is often avoidable. A buddy system should be established to observe any whitening on the face or ears of a companion. If any whitening or tingling of the face, ears, feet or hands occurs, these areas should be warmed immediately. Socks and boots should fit snugly, with no points of tightness. Glove liners should be worn so that skin is never exposed when performing work that cannot be done in heavy gloves.

If the body's core gets too cold, the body will restrict blood flow to the extremities to prevent damage to internal organs.

This restriction increases the chance of frostbite. Strenuous exercise should be avoided in extreme cold, particularly at high altitudes. Very cold air brought too rapidly into the lungs will chill the body's core. Perspiration under conditions of extreme cold should be avoided. Perspiration evaporates, chilling the body.

Plenty of food should be consumed to produce maximum output of body heat. In cold weather, seek quick-energy food items first (i.e., those containing mainly fats and carbohydrates), followed by proteins. Personnel should also drink two to three liters of water per day to stay hydrated.

Avoid the following to prevent frostbite:

- Smoking
- Alcohol
- Excessive coffee and tea
- Excessive fatigue
- Improper or inadequate eating habits
- Unnecessary medication
- Exposure to fuel, especially on bare skin

Signs and Symptoms

Mild Frostbite (Pre-thaw)

There is an uncomfortable sensation of coldness, followed by numbness and skin anesthesia. In superficial frostbite (frost nip), lighter skin turns red, then pale or waxy white. Darker skin will appear lighter than usual. In partial-thickness frostbite, the skin becomes cold and frozen on the surface but remains soft and pliable when gently pressed.

Full-thickness Frostbite (Pre-thaw)

The skin is waxy white. Toes and fingers become solid, like a piece of chicken from the freezer. The digits feel wooden, and the skin cannot be rolled over the bone.

Full-thickness Frostbite (Post-thaw)

The entire hand or foot swells, which limits the mobility of the injured toes or fingers. Blue, violet or gray (the worst) discoloration appears. After two days, the patient suffers severe throbbing and shooting pains. Huge blisters form, usually between the third and seventh day. These usually dry up, blacken and slough off, leaving an exceptionally sensitive, thin, red layer of new skin.

Treatment

Frostbite should not be rubbed, as this will cause additional tissue damage from the ice crystals within. Treatment in the field for anything beyond superficial frostbite is challenging and increases risk to the patient. Thawing frostbite can be extremely painful. Consultation from Medical is recommended to provide direction on pain management. Prevention is paramount.

Superficial Frostbite aka Frost Nip

Superficial frostbite can be treated effectively in the field. If noticed promptly, it can usually be treated with the firm, steady (no rubbing) pressure of a warm hand or by blowing onto the frostbitten area with warm breath. Superficially frostbitten feet are best treated by removing the patient's footwear the moment there is any suspicion of danger and rewarming the feet immediately. After warming is complete, the affected feet should be covered with dry socks. If footwear is replaced, it should be done loosely to ensure adequate circulation and warmth is maintained.

Partial-thickness Frostbite

Partial-thickness frostbite of a small body area should be reheated in water that is between 42°C and 43°C (107°F and 109°F). Water at higher temperatures can burn the skin. The injury should then be treated to prevent infection, bandaged for protection and kept warm. Refreezing must be prevented, as this will cause major additional damage. Medical personnel should be consulted if necessary.

Full-thickness Frostbite

Because of limited resources in the field, full-thickness frostbite is a major medical emergency. Medical personnel should be contacted immediately for consultation and to discuss evacuation plans. Rewarming should not be attempted in the field if there is any possibility that the affected part may refreeze. In such cases, the affected part must be kept frozen until it can be rewarmed rapidly under controlled conditions.

If rewarming is recommended, remove jewelry (especially rings) if possible. Immerse the injured part in 42°C to 43°C (107°F to 109°F) water, continually adding water and stirring it to maintain a constant temperature, until the digital tips (i.e., ends of fingers or toes) turn pink or burgundy red. This takes approximately 20 minutes to one hour and is extremely painful. When adding water, ensure it is not more than 44°C (111°F) and is not poured directly over the injured body part.

Significant pain, swelling and blistering will develop after rewarming. Do not puncture the blisters, and do not allow the injury to refreeze.

Protect the thawed injury with sterile, soft, fluffy dressings. Separate toes and fingers with cotton wool. Wrap the whole body part lightly with gauze bandages. Do not change dressings unless they get dirty, and never rub the skin. Keep the patient and the injured body part warm. Pain medication will be needed, and medical personnel will advise on the specific type and dose. Also do the following:

- Elevate the injured limb(s).
- Commence antibiotic treatment per instruction from the medical team.
- Keep the patient absolutely still and lying down.
- Evacuate to a medical facility as quickly as possible.

Immersion Foot

Immersion foot aka trench foot is caused by prolonged exposure to cold, damp and unsanitary conditions.

Prevention

Feet should be kept warm and dry by wearing protective footwear, and they should be checked frequently during wet and cold conditions. Footwear should not be constricting, and it should be cleaned and dried at every opportunity. In the field, extra pairs of dry socks should be carried next to the abdomen under the shirt. Wet socks can be dried by placing them next to the abdomen, either inside or outside the shirt.

If feet get wet, they should be dried as soon as possible. They can be warmed by the hands. Foot powder should be applied, and dry socks put on. If it is necessary to wear wet socks and footwear for any length of time, then the feet should be exercised at regular intervals by wriggling the toes and bending the ankles.

Signs and Symptoms

The area becomes cold, swollen, waxy white and mottled with burgundy to blue splotches. The skin becomes numb, deep sensation is lost, and moving the affected area grows difficult.

If allowed to continue untreated, the area becomes red, hot and swollen and blisters appear. The victim experiences constant throbbing and a burning sensation. Skin numbness is aggravated by heat and relieved by cold.

Treatment

Remove wet footwear. Gently and rapidly rewarm the affected foot by immersing it in warm water of about 40°C (104°F). Once the foot is warmed, dry it completely and elevate it in a warm room. Swaddle it with clean bandages or cloth to keep it warm and clean.

The injury must not be rubbed or massaged. Blisters should be kept clean and dry. Do not apply ointments. Two 200-milligram (mg) ibuprofen tablets every four hours may be administered for pain if required. Evacuate the victim to a medical facility.

Tent Eye

Antarctica's extreme low humidity may cause the film of tears protecting the eye to dry up, making the cornea susceptible to damage from stove fumes in the tent. The condition can be treated by applying Chlorsig ointment to the eye when it occurs and before going to sleep.

Snow Blindness

Snow blindness is caused by ultraviolet (UV) light burning the eyes. The danger of snow blindness is greatest not on clear, bright days but on dull, cloudy (e.g., whiteout) days, when crystalline snow mist is present. There is no warning that damage has been done until the symptoms begin to appear two to 12 hours after exposure.

Signs and Symptoms

Snow blindness manifests as intensely painful, red, watering eyes that are sensitive to light. The victim will also feel as though there is grit in their eyes.

Treatment

A single episode of snow blindness may last up to five days, even while being treated. The eyes should be rested for at least 24 hours. That means closing them and covering them with a non-fluffy pad. If the temperature is above freezing, a cold compress may be placed over the affected eyes to relieve pain. Medical should be contacted for treatment recommendations and possible medications. Medical personnel may recommend providing the victim two 200 mg tablets of ibuprofen every four hours, as required, or putting Chlorsig ointment on the eyes every three hours.

Prevention

Snow blindness must be avoided, as it is a crippling injury that may seriously delay a field party. Team members should wear dark, UV-protective glasses or goggles with the appropriate

lenses (not yellow) at all times when in the field, especially on overcast days.

Sunburn and Windburn

Direct exposure to the sun, especially when it is very windy or the body is wet with sweat, can result in a sunburn and chaffed skin. Because the Antarctic air is cleaner and thinner, there is greater UV penetration, so sunburn can occur even on overcast days. If sunburn occurs, apply aloe vera gel to the burn and provide the victim 400 mg of ibuprofen every four hours, as necessary, to relieve pain.

Prevention

Prevent sunburn by applying sunscreen ChapStick to the lips and regularly applying sunscreen to other areas of exposed skin. Covering the face with a balaclava will prevent both sunburn and windburn to this frequently exposed area.

Dental Health

Oral hygiene can be inconvenient in the field, but it is just as important as bodily hygiene. Failure to maintain good oral hygiene may result in increased tooth decay (especially around the edges of fillings) and gingivitis. Ideally, teeth must be brushed after every meal, with snow if no water is available. Use toothpicks or waxed dental floss to clean gaps between the teeth that are hard to clean with a toothbrush.

Controlled Medications

Restricted Drugs

The Peninsula field supervisor issues a field medication kit containing over-the-counter, prescription and controlled (i.e., restricted) medications to each designated field party medical lead. This individual is responsible for the kit. The medical lead or any United States Antarctic Program (USAP) participant must contact a station doctor for consultation and authorization before administering any prescription

medication. Over-the-counter medication can be given without consultation from the doctor, yet the doctor always remains available for consult if there are questions. Always check for any known allergies before administering drugs.

Chain of Custody

The prescribing doctor, who is typically the Palmer Station doctor, will create a chain-of-custody form and provide it to the field medical lead via the vessel captain and Peninsula field supervisor. The lead must account for all controlled substances when the kit is checked out, weekly, and when the kit is returned. If the field medical lead departs before the end of the season, they must complete a new chain-of-custody form and count the medications before transferring the kit to another person. At the end of the season, the medical kit, controlled medications, and a completed chain-of-custody record must be returned to the prescribing doctor. Any shortage or shortfall in the chain of custody is a breach of licensure and could threaten USAP's ability to issue controlled substances to other groups in the future.

