Table of Contents

16.0 Aircraft

Introduction

The mineral exploration industry commonly relies on aircraft to access remote exploration sites. Various types of fixed wing aircraft and helicopters are used depending on availability and what is most appropriate for the job. Mineral exploration often requires operating aircraft in a wide variety of remote and challenging conditions. Aircraft related accidents, particularly those involving helicopters, have accounted for more fatalities than any other type of accident in exploration. Some fatalities could have been prevented if safe operating procedures (SOPs) had been followed. Four ways to reduce the likelihood of aircraft related incidents and potential fatalities are (1) carefully select charter aircraft companies and pilots; (2) do not accept unsafe practices by pilots or pressure pilots towards such practices; (3) thoroughly train all employees at any project serviced by aircraft to work safely in and around aircraft; and (4) provide refresher training for those who use charter aircraft on casual basis.

16.1 Risks and Hazards

All Aircraft

- Crashes resulting in injury or death caused by pilot fatigue, bad weather, overloading, inadequate maintenance
- Drowning caused by inability to escape a submerged or overturned aircraft after a crash in water.
- Death, dismemberment, severe injury, impact injury caused by contact with rotor blades or a propeller. This is particularly hazardous when mooring a float plane or when entering or exiting a helicopter during a toe-in landing
- Stranding caused by an accident, bad weather, mechanical problems, communication breakdown
- Pilot fatigue caused by difficult working conditions, stressful sling work, pressure by the company or contractor to complete a job
- Damage to property, aircraft caused by careless handling of freight, prop wash
- Hearing loss caused by lack of hearing protection
- Burns caused by contact with cowling around engines, areas near exhaust discharge, pitot tubes
- Accidental fires caused by prop wash, downdraft from rotor blades, fuel spills

Helicopters have additional risks and hazards

- Being struck by rotor blades or tail rotor, caused by unsafe movement through hummocky ground, wind causing blades to dip, toe-in landings
- Risks associated with slinging – see section 16.12 Slinging
- Injury or damage caused by people or equipment contacting main or tail rotor while loading

- Damage to main or tail rotor blades caused by coming into contact with trees or shrubs in tight landing spaces, which may result in potential stranding
- Falling out caused by flying with doors removed during some surveys

16.2 Responsibilities (Due Diligence) Regarding Aircraft

Implementing training and safe operating procedures (SOPs) are important ways to reduce potential incidents, which are often fatal. As presented in section 1.2 Due Diligence, companies should be able to demonstrate due diligence with respect to safety. For example, in Canada, Transport Canada regulations together with provincial and territorial Occupational Health and Safety legislation require companies to provide employees who fly and work around aircraft with training in safe work procedures regarding aircraft. The following are some requirements that demonstrate due diligence with respect to aircraft safety.

Exploration Companies

- Develop written safe operating procedures (SOPs), site specific SOPs (as needed), and SOPs for special aircraft operations (e.g., slinging, drill moves, hover manoeuvres, special surveys). SOPs should address flying to and from work sites and traverses etc. Some terrain requires specific safe operating procedures (mountains, glaciers, Arctic islands etc.).
- Develop a written emergency response plan (ERP) with procedures for overdue or missing aircraft.
- Hire (or train) supervisors who are competent, especially when slinging and drill move operations are required.
- Provide training and education for employees who fly or work around aircraft (e.g., traversing and slinging operations). Consider formal designation and training for those capable of supervising aircraft slinging operations to establish “load marshalls”.
- See that piloting, inspections and maintenance of chartered aircraft are carried out by competent personnel.
- Provide required PPE.
- Monitor the use of aircraft, behaviour around aircraft and implement consequences when SOPs etc., are not followed.
- Documentation: Keep records of training, accidents/incidents and corrective actions, mitigation of hazards, safety inductions and meetings, inspections, maintenance, infractions etc., that apply to aircraft.
- Carry adequate insurance.
- Sometimes only military aircraft are available for charter in less developed countries. Exploration personnel should be aware that normally military aircraft do not have or require airworthiness certificates. Flying in an aircraft with no airworthiness certificate may invalidate some insurance, such as life insurance, medical coverage etc. Military pilots may have different safety standards than civilian pilots.

Project Manager or Supervisor

- Implement company SOPs regarding aircraft. Develop site specific procedures and train employees in SOPs, as required.

- Make sure all employees are familiar with the project ERP procedures and are trained to respond correctly if an aircraft is late, missing or crashes.
- Repeat training periodically – whenever there is a change of pilot and/or engineer, change of aircraft, when new employees start work, and any time there is a slip up or reason for refresher training.
- Be sure pilots comply with jurisdictional transportation regulations. Do not request pilots to exceed the allowable duty hours and flight hours.
- Make sure pilots provide written flight plan records for all flights from the project and that they check-in on schedule.

Employees

- Follow company SOPs and training regarding aircraft.
- Follow training and instructions given by the pilot.
- Be familiar with and keep away from the danger zones around aircraft.
- Use PPE and safety equipment as directed.
- Report hazards or dangers to the pilot while in flight or to the supervisor or pilot while on the ground.
- Never engage in horseplay in or around aircraft.
- Be aware of their right to refuse to fly if they feel the situation is unsafe or they need more training to do a job safely (e.g., hover manoeuvres).

16.3 Aircraft Charters

Accidents and incidents involving aircraft (helicopter and fixed wing) are the principal cause of fatalities in the mineral exploration industry. Given that about 75% of accidents are caused by pilot error and 20% by equipment malfunction, it is imperative to use the safest pilots and aircraft possible. All companies registered in Canada that operate aircraft are required to have a Safety Management System (SMS) in place. No matter where in the world an aircraft is chartered, the presence or lack of a SMS will be an indication of a company's regard for safety.

Guidelines for Chartering Aircraft and Hiring Pilots

- Use only registered charter airline companies with good safety records that are in compliance with jurisdictional regulations – preferably one that has been audited. Request to review the company SMS documents and safety records and try to review audit information.
- There are consultants throughout the world that specialize in safety performance audits of charter aircraft companies. When planning an exploration program with extensive air support, the cost of performing an audit is only a small portion of the total expense.
- Obtain references for air charter companies and pilots from other companies that have used them. Preference should be given to pilots who have flown satisfactorily for the company before and whose competence can be effectively assessed.
- Discuss the charter company and aircraft selection process with someone who is familiar with the charter company under consideration and who has experience with the type of aircraft and terrain.

- Charter aircraft that are appropriate for project requirements e.g., ferrying employees to and from the site and/or traverse routes, capability to cover the required area, transporting equipment, flying required surveys or slinging required loads (e.g., equipment or drills). Make sure the aircraft landing requirements are fully discussed and understood.
- Specify the requirements for complete survival kits, training and emergency procedures when requesting proposals for aircraft charters.
- Make sure the aircraft landing requirements are fully discussed and understood.
- Hire experienced pilots. The Prospectors & Developers Association of Canada (PDAC) suggests that an exploration company stipulate that a pilot have a minimum of 1600 hours flying in the same type of aircraft. As an additional requirement for helicopter pilots, stipulate that a pilot has in excess of 800 hours experience in similar terrain and 300 hours of experience using unprepared landing sites. Also, the pilot should have flown a minimum of 300 hours as pilot in command during the last 12 months, and also have recent training and experience in slinging the particular type of work that will be required at the site. Some major mining companies require even more experience than outlined here.
- When helicopter slinging is required:
    - Helicopter: Tender documents and/or the helicopter contract should specify a type of helicopter capable of moving the drill components or any other required sling loads on site. Therefore, it is necessary to identify the drill equipment and accurate weights of component parts in the tender document. Helicopter specifications can be checked for lifting capacity, range, fuel capacity and other attributes to determine the best machine for a specific purpose but it is always advisable to discuss these requirements with experts.
    - Drill sites: Drill moves using helicopters require special pilot expertise such as long-lining ability and knowledge of how drillers work. Tender documents should specify that the pilot has recent experience and certification regarding drill moves and with the same type of machine. Specify a licensed aircraft maintenance engineer with sling expertise, as this person is responsible for the good condition of the sling equipment.
- It is recommended that a helicopter aircraft maintenance engineer be present at all projects where a contract helicopter is based. Discuss pilot and engineer rotations before the project starts.

16.4 Safe Operating Guidelines for All Aircraft

Follow strict safety rules when working around all aircraft. Propellers and rotor blades are invisible when engines are running; it is easy to become distracted and walk into them.

1. At the start up of the season or project, include an aircraft safety induction as part of the general safety induction meeting. The pilot should provide a full briefing at the aircraft for all personnel working on a site with aircraft support. It is advisable to repeat aircraft safety briefings at least monthly, but they must be repeated whenever a new pilot begins work, new personnel arrive on site, a new aircraft is used, or whenever an incident occurs involving aircraft. Employees and passengers should pay attention to all safety briefings.

- Hold full safety briefings before all flights for passengers who regularly fly (e.g., air support for traversing) until they are fully familiar with procedures. Less extensive briefings can be held once workers are well trained. Hold periodic refresher training.

- Brief passengers before all flights when there is a change or potential change in regular routine or there are unusual situations (e.g., hover manoeuvres).
- Hold full pre-flight briefing any time there are visitors or persons who do not regularly fly on the aircraft.
- All critical safety instructions and briefings should be in the local language, where relevant.

2. In many jurisdictions there are limits to the number of hours a pilot may fly in a given time period. Know these limits and do not request a pilot to exceed them. These regulations are intended to combat pilot fatigue, which is an important factor in many aircraft incidents and accidents. Transport Canada regulations permit 8 flight hours and 14 hours maximum duty time in a 24 hour period.
   http://www.tc.gc.ca/CivilAviation/Regserv/Affairs/cars/Part7/Standards/720.htm

   As a guideline, the International Airborne Geophysics Safety Association recommends the following hours, which are available on the following website:
   http://www.iagsa.ca/Contract_Annex990325.pdf

   Maximum flight hours

   40 hours in any 7 consecutive day period

   70 hours in any 14 consecutive day period

   120 hours in any 30 consecutive day period

   1200 hours in any calendar year

   Hours should be reduced if slinging or low level surveys are performed.

3. Plan flights schedules to comply with certifications of the pilot and aircraft. If using VFR (Visual Flight Rules) aircraft, always plan to have flights completed in daylight with a safety margin. This usually means planning flights during daylight hours that begin no earlier than 45 minutes after sunrise and are completed 45 minutes before sunset.
4. Develop a written emergency response plan (ERP) with procedures that address potential aircraft emergencies. Train all passengers and employees to know *what* to do and *in what order* for potential aircraft emergencies. Hold a drill to test the plans. Passengers should be fully familiar with relevant parts of section 16.15 Emergency Procedures.
5. Pilots should file a written record of the passengers on board, the route and destination for every flight.
6. Aircraft are required to carry safety and survival equipment for each passenger. All passengers should know the location and nature of this equipment; the location may differ between aircraft – even in the same type of aircraft. In addition, each passenger should carry basic personal survival items suited to local conditions distributed in their pockets.
7. All passengers must be transported in anchored seats with seat belts fastened. Wear hearing protection (ear muffs) whenever possible. Carry and use disposable earplugs for additional protection.
8. The pilot or co-pilot is required to supervise the embarking and disembarking of passengers. This is usually done when the engines are shut down.
9. When boarding or disembarking, never walk in the direction of the propellers of fixed wing aircraft or in the direction of the tail rotor of a helicopter.

10. Stand well back from all aircraft during landing or docking procedures. Never touch or stand within the arc of a stationary propeller. The engine's ignition circuits may be live and spontaneous ignition in piston engines can occur.
11. Never overload an aircraft. Follow safe loading procedures. Plan for the increased weight of samples. Make an extra trip if necessary. (See section 16.8 Safe Loading Guidelines.)
12. Notify the pilot of any dangerous goods cargo. Plan ahead as it may be difficult to ship some supplies to remote sites, depending on available air carriers. See section 16.9 Transportation of Dangerous Goods.
13. All employees are required to maintain vigilant, safe behaviour and refrain from all types of horseplay in and around aircraft at all times.
14. No smoking within 30 metres of aircraft or fuel storage areas.
15. In the event of a crash, *stay in the vicinity of the aircraft*. In the event of a hard landing, do not leave a helicopter until the rotor blades stop completely or the pilot gives permission. Know where the exit is relative to your seat (situational awareness) so you can find the exit even if you are upside down, under water or the cabin is dark and smoky.
16. Always wear clothing appropriate for the climate and weather when you fly. Keep essential survival items in your pockets, if permitted. You may not be able to retrieve heavy clothing and packs from the cargo compartment in an emergency. In winter in the Arctic, dress in layers, wear boots and carry a parka, mitts and hat in the passenger compartment. In summer, carry a warm jacket and bug repellent.
17. When ferrying crews to a destination, distribute the food and equipment, including survival kits, as equally as possible between flights. Then, if something prevents the completion of all flights, the risk is reduced for any group that may be stranded without food, water and shelter.

16.5 Pilot Fatigue

Fatigue is cumulative and affects pilots in insidious ways; their attitude toward flying changes so that personal safety standards decline and they take risks they would not normally take. Fatigue and tiredness are not identical. A person may feel *tired* after a long day of work, but after a number of long hard work days one may feel the cumulative effect of the work as *fatigue*. Piloting any aircraft is stressful work and may result in fatigue. Piloting helicopters is usually considered more stressful than piloting fixed wing aircraft – and slinging operations are rated as twice as stressful as normal helicopter flying.

Symptoms of pilot fatigue are difficult to pinpoint but they may include:

- Decreased mental alertness
- Emotional responses to minor irritants that become unpredictable
- Tuning out visual and auditory cues that would normally serve as warning signals to the pilot
- Pilots may exhibit distracted attention, slow reaction time or missed cues, grouchiness and irritability, atypical behaviour and/or isolation.
- Fatigue often leads to mistakes, which in turn leads to incidents, sometimes with tragic consequences.

The following contribute to fatigue:

- Long working hours without enough sleep
- Pushing the limits – of the aircraft, load capacity, the weather and available daylight
- Slinging difficult loads under marginal conditions – even when not actually pushing the limits
- While “fatigue” is most frequently an issue raised with reference to pilots, it is not limited to pilots. Field employees who undergo long stretches of work without a break and/or who endure stressful project situations may develop fatigue and be more liable to unsafe actions around aircraft.

16.6 Float Planes

Due to their design, additional safe operating guidelines apply to float planes.

- Pay close attention to the pilot’s safety briefing, especially regarding safe boarding and disembarking routines.

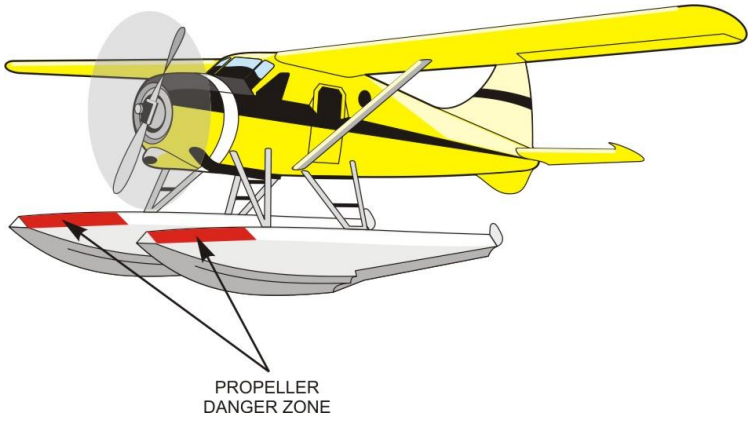

Figure 16.1: Float Plane propeller danger zone

- Danger zones: The propeller(s) is invisible and extends across the front of the floats. Watch out for the propeller overhang at a dock at all times.
- Be able to find and open the exits (situational awareness). In the event of an accident, float planes tend to come to rest upside down in water. See section 16.15 Emergency Procedures.
- Float planes are required to carry one life jacket for every person on board. Know where your life jacket is located, how to retrieve it, and how and when to put it on.
- The pilot should brief at least one passenger on the mooring procedures no matter what arrangements have been made at the destination. The passenger should be familiar with float planes, if possible. Do not assist in tying up a floatplane unless you have been trained to do so.

- Always follow the pilot's instructions when mooring a float plane. Always use a strut for the initial tie-up. Wait until the engine is fully stopped before securing the front of a float, as the engine may backfire causing the propeller to spin.
- Remember that the cowling around the engines and the struts near the exhaust areas will remain hot after the engine stops.
- Never touch the rudder, elevators, ailerons or connecting wires on the aircraft.
- Avoid surfaces coarser than sand when beaching and tying up a float plane on shorelines with no dock.
- Before loading, make sure the dock is firmly secured to the shore and the float plane is firmly secured to the dock.
- Remote landings:
    - Before landing, the pilot should verify that the float plane will be able to take off again, as take-off requirements change with load, elevation, wind conditions etc. While this is the pilot's responsibility, passengers should be aware of these constraints and not encourage a pilot to take chances.
    - The pilot should overfly the landing area and the takeoff area to check for floating obstacles, submerged or semi-submerged logs or rocks, wind direction and strength, trees, structures such as buildings, wires that may connect islands and the mainland, and other traffic on the water.
    - Glassy water landings: When possible, people on shore should make waves with a boat to disturb the water surface, which will help increase the pilot's depth perception and ability to judge altitude when landing.
    - In snowy conditions or on frozen lakes, use evergreen trees as markers to line runways and provide the pilot with a horizon reference in flat light or near white out conditions.
    - On ice: Check for other traffic, snow and ice conditions, wind direction and strength, cracks, obstacles, pressure ridges, wildlife and trees. Prevent skis from freezing in by placing brush under skis when the plane is parked.

16.7 Helicopters

Helicopters present a number of unique hazards by nature of their design and use. They are more susceptible to mechanical failure than fixed wing aircraft. Although they are particularly useful, never take safety for granted at any time, especially when accessing rugged terrain and/or flying in poor weather conditions where visibility is limited.

In addition to those listed in section 16.4 Safe Operating Guidelines for All Aircraft, the following guidelines apply to helicopters.

16.7.1 Safe Operating Guidelines for Helicopters

1. Avoid using piston engine helicopters.
2. Passenger safety briefings should stress the additional hazards associated with helicopters.

3. Never approach or exit a helicopter without the pilot's direct permission or signal. Pilots frequently do stability testing and shift the helicopter slightly before final landing. Establish a protocol with the pilot to signal that it is safe to approach or exit a helicopter. Also, establish a signal protocol that indicates it is safe for the pilot to lift off after all passengers have disembarked, unloaded gear and are well clear. This is particularly important when passengers disembark while the machine is under power.
4. Approach a helicopter by moving toward the *front* of it and in full view of the pilot. Try to keep eye contact with the pilot. Take care not to walk into the radio antenna or pitot tubes. Exit by moving away at the *front* of the helicopter. You may have to approach or exit to the side if it lands facing high ground or if it has a low blade clearance at the front (e.g., Sikorsky S-76). Never enter or exit toward the rear of a helicopter, as the tail rotor is invisible when the machine is running. See also # 6 and 7 below.

Figure 16.2 Helicopter

5. Always approach or exit in a *crouching* position to give your head more clearance from the rotor blades. Hold on to your hat or hard hat if it is not secured with a chinstrap. Do not reach up for your hat or chase it if it blows away.
6. *Never walk in the direction of the tail rotor*. If you walk into the tail rotor it will kill you! Inform the pilot before exiting if it is necessary to remove gear from the cargo compartment. Do this carefully and make sure to close the cargo compartment door correctly when finished. Then, return to the *front* in full view of the pilot and move away at the FRONT of the helicopter. Never go under the tail boom to get from one side of the helicopter to the other. Walk only around the front of the helicopter.
7. Always approach and exit using the *downhill* side if the helicopter is on a slope. The rotor blades will be much closer to the ground on the uphill side and they can hit your head. Be alert to this risk when moving through uneven or hummocky ground within the range of the main rotor blade. Passengers in rear seats should all exit from the same door on the downhill side of the helicopter. A front passenger who must exit on the uphill side should first retrieve gear stowed in the cargo compartment while staying close to the helicopter, and then move around the front and away from the machine on the downhill side.

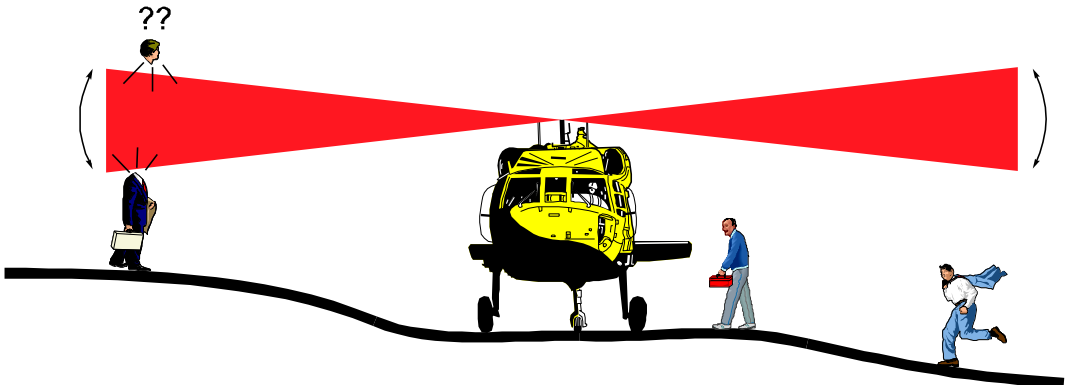

Figure 16.3: Approaching a helicopter

8. Do not approach or exit when the rotor blades are moving slowly. Blades will dip as the motor slows, and they can also dip unpredictably when it is windy.

Figure 16.4: Helicopter blades can dip down in wind

9. Establish a signal protocol between the pilot and all passengers to use when exiting and unloading gear. When exiting a helicopter that will take off immediately, move at least 10 metres away with your gear and crouch down in a safe place. Make eye contact with the pilot and signal that you are secure. Remain there during liftoff. This is very important when passengers are disembarking while the helicopter is under power.
10. Do not approach a helicopter when visibility is reduced with blowing sand, dust or snow from the downdraft of the rotors. Wait until visibility is clear or until the helicopter has shut down.
11. Do not distract the pilot or upset the balance of the machine with sudden or unpredictable movements during takeoff, landing or other manoeuvres. Nevertheless, if you notice a hazard while flying, be sure to point it out to the pilot. Do not assume the pilot has seen it.
12. Carry all long items horizontally (e.g., poles, oars, tools) when loading and unloading. Two people should carry long items – one at each end – to prevent contact with the rotors. Never carry them vertically or over your shoulder as they may hit the main rotor blades. Do not toss items from person to person.

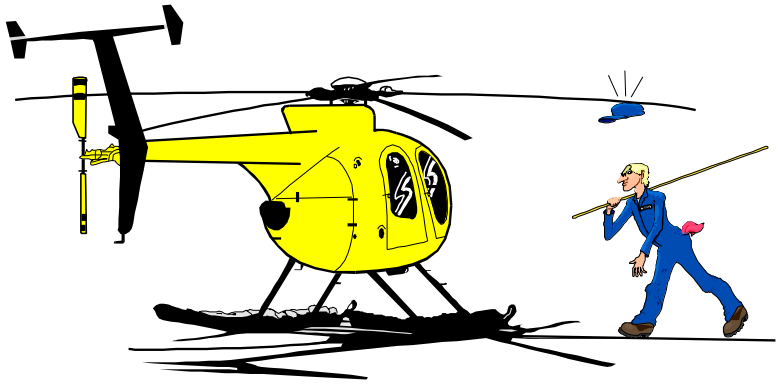

Figure 16.5: Secure loose items when approaching a helicopter

13. Stow small articles: Place hats, vests, sample bags, maps and clipboards etc., into a pack before boarding so they cannot be blown or sucked into the rotors or engine. Never chase something that blows away – you may be killed.
14. Never throw anything out of a helicopter. It may contact the rotor blades or be sucked into the jet engines.
15. Passengers should not ride in a helicopter during slinging procedures.

Note: Stay alert and constantly remind yourself to keep your distance from the rotor blades.

16.7.2 Additional Safety Guidelines for Helicopters

- *Do not rush* while working around aircraft. The tendency to hurry during loading and unloading procedures greatly increases the chances of injury. This is especially true when the machine is running and rotors are turning.
- Always plan who will do which job when loading and unloading a helicopter. Who will communicate with the pilot? Who will hold the door? Who will carry which items? How will the items be carried? This helps prevent confusion and accidents, as it is very noisy and windy around a helicopter with its rotors turning.
- When boarding or exiting a helicopter under power, keep a good grip on the door handle or door frame until both feet are safely inside the helicopter or on the ground.
- When exiting, refasten seat belts so they don't flap around inside the bubble or hang out the door. Close the door carefully.
- Do not touch a helicopter or the load before it has completely landed, as it is usually charged with static electricity.
- Stow field gear, samples and packs in the cargo compartment. Plan for the increased load at the end of the day due to the weight of samples.
- Close doors and cargo compartments carefully and completely. If the helicopter is unfamiliar, ask the pilot to demonstrate how to open and close the doors with minimum effort. Practice when the helicopter is shut down.
- Securely stow all items within the bubble. Unsecured, small heavy items can cause a lot of damage during turbulence or a hard landing. They may slide and jam the controls.

Never place items against the bubble as they may damage the surface or obstruct the pilot's view.

- Extra caution is required during some surveys such as when a helicopter door is removed. When working on such a survey, do not unfasten your seat belt until the pilot gives permission.
- When traversing or working off site, use hand-held FM radios for communication between the pilot and other parties on traverse. Supply the pilot with a frequency so field parties can communicate with the pilot from the ground. At least one FM radio per group working in any one location should be provided. Compact satellite phones capable of communicating with the project site can be used if the project site has the capability of contacting the pilot by radio.
- Carry a fluorescent orange helicopter cloth and signalling mirror to attract the pilot's attention in case radio communication fails. The cloth is useful to indicate wind direction to the pilot, but then pack it away securely to prevent it being sucked into the rotors.
- Protect your eyes from dust produced by the downdraft during arrival or departure. Wear safety glasses or goggles.

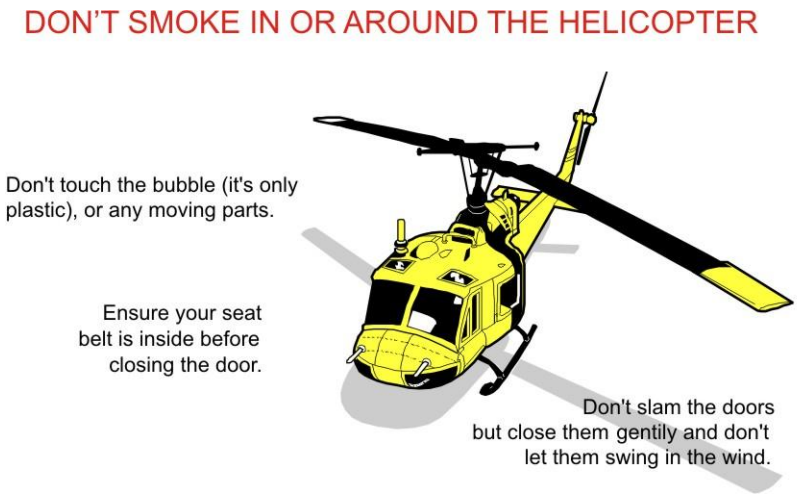

Figure 16.6: Helicopter safety

General safety around helicopter landing sites

- Stand back at least 15 m from the landing pad during arrival or departure, preferably upwind and in view of the pilot. Remember – a helicopter can move in any direction including backwards.
- Weigh down or remove all lightweight materials, especially plywood, foam mattresses and tarpaulins that might be blown around by helicopter downdraft. A heavily loaded helicopter has a powerful downdraft that can send sheets of plywood, styrofoam or plastic sailing into the air.
- Locate all fires at least 100 m from a helipad so turbulence created by flying activity will not blow embers about and create a brush fire.
- Designate any required parking area for vehicles or ATVs etc., and set it well back from the landing site. Remove light weight material (e.g., empty cans, rubbish) from the back

of pickup trucks to prevent objects being blown about by the downdraft from helicopter blades.

- In some forested areas, few landing sites are available and it is imperative that a ground party carries an axe or saw to create or improve landing sites. Fly the traverse route prior to drop off to check for potential landing sites, as well as rivers that cannot be crossed, predatory wildlife and hazardous terrain. Communicate and plan with the pilot regarding when and where you expect to end the traverse so that a suitable pick up point is located. Mark it on the maps (yours and the pilot's).

Figure 16.7: Helicopter landing sites

16.7.3 Guidelines for Hover and Toe-in Manoeuvres

The following guidelines are adapted with permission from "Toe-in Pick-up Guidelines" in the *Canadian Mineral Exploration Health & Safety Annual Report 2008* issued jointly by AME BC (Association for Mineral Exploration British Columbia) and PDAC.

Hover Manoeuvre: Any passenger entry or exit from a helicopter that is required to be under power in order to maintain a stable altitude

Toe-in Manoeuvre: A passenger entry or exit when any skid is in partial contact with the ground

Exploration employees and helicopter pilots should strive to avoid hover and toe-in manoeuvres whenever possible. Field crews should always look for flat landing spots throughout the entire field season so the pilot can make a conventional, full skid landing. They are much riskier than regular landings, as it is critical for the pilot to maintain stability of the helicopter at all times. A hover or toe-in manoeuvre accident has a higher potential to become a fatal accident. The noise of the helicopter under high power is stressful for both the pilot and passengers. Passengers must remain calm and never rush or move rapidly when they embark or disembark from a helicopter under power.

- Factors that contribute to the safety of helicopter toe-in manoeuvres include: the type of helicopter, terrain, altitude, wind direction, the number of passengers and the loads to be removed or placed on board.
- Hover manoeuvres including toe-in pick ups and landings must only be done with experienced field crews who have developed a solid working relationship with a pilot experienced in making these manoeuvres.

- Hover manoeuvres including toe-in pick ups and landings should be discussed during the safety induction at the beginning of the season. If a pilot does not mention these manoeuvres at the safety induction or when the pilot starts work, the field crew should ask if they are part of the pilot's repertoire. Field crews should not assume a pilot will make toe-in landings and pick ups whenever they find it more convenient than searching for or preparing a good flat landing site.
- Entry and exit procedures for hover and toe-in manoeuvres should be practiced on the ground with the engine off before they are performed in the field.
- If a hover manoeuvre or a toe-in landing or pick up is anticipated during the day, the pilot and field crew should review and discuss the procedures prior to embarking on the flight and/or again prior to disembarking from the helicopter. The pilot should hold a drill before every trip when there is potential for a hover manoeuvre and especially for a toe-in manoeuvre.
- Establish the order of disembarkation or embarkation and sit in the helicopter accordingly. This order is usually determined by the weight of each passenger.
- As the pilot must keep both hands on the controls, he often indicates by radio contact or by eye contact and a nod that he is ready to have passengers board. Establish this procedure with the pilot beforehand.

Hover and Toe-in Landings (exits)

- Passengers should not participate in any hover exit when the skids are more than 0.6 metres off the ground.
- When disembarking, be especially careful not to make any unexpected movements that suddenly transfer weight onto or off a skid during the manoeuvre. All movements and weight transfers must be slow, smooth, efficient and controlled.
- After stepping carefully and smoothly off a skid, crouch at a predetermined distance while the helicopter takes off.
- When it is necessary to retrieve cargo from a compartment on the pilot's side of the helicopter, *never* duck under the tail boom. Only cross carefully in front of the pilot so you are always in view. Avoid this move if at all possible.
- *Never* walk upslope after disembarking from a helicopter in a hover or toe-in landing.

Toe-in Pick Ups

- A toe-in pick up location must be approved by the pilot – preferably by radio. If you are not in radio contact and the pilot does not land, it is because the pilot does not like your choice of pick up point. The pilot will go and find a good landing spot and you will have to walk to it.
- Before being picked up by the helicopter, all passengers should assemble with all gear in a location where it will be safe to board the helicopter. This position must be at a level no farther uphill than the level where the helicopter door will be so each person can walk carefully to the helicopter on a level or upslope path. Everyone must avoid the possibility of contact with the helicopter rotors.
- Each person must be able to make eye contact with the pilot. *"See the pilot see you".* Usually this will be 90º to the length of the machine on the side opposite the pilot.
- The crew must assume a crouched position with hat removed and all gear arranged ready to board. When the pilot signals (usually a nod), one person at a time will move slowly and deliberately to board the helicopter. The order that people board the helicopter

should be determined through discussion with the pilot *prior* to the manoeuvre, which probably means prior to being originally dropped off.

- When loading packs etc., carry items at or below waist level to avoid contact with rotors.
- The pilot can direct a passenger on board to assist by arranging seat belts and lifting or stowing packs in the cabin. The pilot should indicate where to sit to best keep the balance of the helicopter.
- Before boarding, hand in gear to a passenger already on board. Each person must slowly and smoothly step onto the skid and climb into the helicopter without creating a sudden weight shift. All movements and weight transfers must be slow, smooth, efficient and controlled.
- When it is necessary to stow cargo in a compartment on the pilot's side, NEVER duck under the tail boom. Only cross carefully in front of the pilot so you are always in view. Avoid this move whenever possible.
- Make sure all cargo is safely stowed and restrained before take off.

Because the safety of the operation is paramount:

1. The pilot makes all decisions regarding the helicopter and its capabilities – no exceptions.
2. Every passenger has the right to refuse to participate in a hover or toe-in manoeuvre if they do not feel competent to handle the situation.

16.8 Safe Loading Guidelines for All Aircraft

Know the load capabilities of the aircraft. Not only will this depend on the type of aircraft, it will vary with location, elevation and time of year – due to weather, temperature, humidity, the amount of fuel on board, as well as the weight of the passengers and samples (wet or dry).

Follow these guidelines:

- The pilot must load all aircraft personally or closely supervise the operation.
- He or she must know the weight and size of the cargo to correctly balance the aircraft.
- Loads must be secured so the centre of gravity does not shift during flight and endanger the aircraft.
- Plan for the increased weight of samples at the end of the day.
- Never urge a pilot to overload the aircraft. Make another trip.
- Notify the pilot of any dangerous goods to be transported in the aircraft. Verify how bear or pepper spray, firearms and flares, explosives and detonators etc., may be transported before any flight (see section 16.9 below).
    - It is recommended that bear spray be placed in hermetically sealed containers. Ammunition cases that seal tightly work well.
    - Transport aerosol bug spray in the cargo compartment.
    - Firearms must be transported unloaded and with the safety on.
    - Explosives and detonators must be transported separately.
- Make sure any loading ramp is firmly secured before use.

- When loading, take care not to bump or damage the fuselage, floats or rotor blades.
- When loading and unloading fuel drums from fixed wing aircraft, roll them on secured planks with ropes wrapped around the drums for control.
- Use care when loading sharp tools or equipment such as shovels in the helicopter cargo compartment. Often only a thin wall separates the fuel tank and the cargo compartment.

16.9 Transportation of Dangerous Goods

The pilot must be notified in advance about all hazardous cargo. The pilot is in charge of loading or directly supervising the transportation of all hazardous or dangerous goods cargo. When the pilot does not perform this duty, the person in charge is required to have adequate training in loading, securing, inspecting for damage and proper segregation of the load. Many apparently harmless items that are routinely carried by ground transportation can become extremely hazardous when carried by air. Some items can cause immediate life-threatening situations (e.g., fire or leaked toxic gases); other items can damage an aircraft's structure over a very short period of time (e.g., spilled acid or other corrosive material that causes rapid corrosion leading to a structural failure in flight).

- Dangerous goods restrictions vary between passenger, cargo and chartered aircraft; they are imposed by relevant national regulatory authorities.
- Dangerous goods may only be packaged for and shipped by air transport by individuals who have received formal training and hold current dangerous goods certifications.
- A dangerous goods declaration is required to accompany all hazardous cargo. Pilots are required to reject any hazardous cargo that does not agree with the TDG declaration. Generally, the training given to pilots does not allow them to package dangerous goods or prepare relevant documentation.
- Examples of some common items typically used in exploration that are classified as dangerous goods include but are not limited to: lead acid batteries, acids, flares, ammunition, explosives, detonators, aerosol containers (bear spray), solvents. Regulations governing the transportation of dangerous goods by air are found at the following website: http://www.tc.gc.ca/eng/tdg/clear-part12-466.htm.
  A detailed list of dangerous goods is included as schedule 1 of the Consolidated Transportation of Dangerous Goods Regulations including Amendment SOR/2008-34.
- Transport dangerous goods according to safe methods e.g., bear spray in sealed containers – never inside the aircraft cabin. See section 16.9 Safe Loading Guidelines.
- *TP 11504 – The Marks of Safety* shows the symbols and placards of classes of hazardous goods on the following Transport Canada website: http://www.tc.gc.ca/media/documents/tdg-eng/tp11504e.pdf
- Access to a variety of links regarding dangerous goods is available on the following Transport Canada website: http://www.tc.gc.ca/tdg/training/menu.htm

When placing a dangerous goods order from a supplier, have the supplier:

1. Deliver the goods directly to the field location
2. Make sure the supplier (shipper) ships the order as dangerous goods with the shipper's declaration form fully completed and attached to the dangerous goods. The consignee should be qualified to receive the shipment.

3. An alternative solution would be to use a dangerous goods shipper for regulated items.

16.10 Training

Due to the potential for fatalities and serious injuries resulting from aircraft accidents, it is imperative that everyone who uses or works around aircraft is thoroughly trained in SOPs. Everyone must be aware of their responsibilities that contribute to safe operations regarding aircraft. This is best accomplished through well planned and comprehensive site safety inductions and thorough safety briefings before flights and special operations.

16.10.1 Aircraft Safety Induction Meetings

A thorough aircraft safety induction should be part of the general site safety induction at the start up of the field season for all sites that use aircraft. Everyone (all employees and contractor's employees) should be required to attend. The appropriate topics should be thoroughly covered by the project manager and pilot with regard to landing sites, fuel storage and handling, remote airstrips or water/ice landings etc.

- SOPs
- Conduct around aircraft, landing sites and remote airstrips
- Fire prevention around aircraft and fuel storage areas
- Housekeeping around the landing area
- Communication equipment, channels and schedules and emergency communication procedures: Train employees how to place a call on the aircraft radio, if necessary.
- Responsibilities regarding trip plans, drop off and pick up points, check-in schedules for tracking aircraft and employee locations
- The ERP procedures regarding aircraft should cover:
    - An overdue radio call
    - An aircraft alert situation when an aircraft cannot be contacted after a specified length of time
    - An aircraft distress situation when an aircraft is overdue and cannot be contacted after a specified length of time
    - A declared aircraft emergency and other potential emergencies that might occur at the work site
- Safety at the aircraft:
    - Danger zones around aircraft: fixed wing, float or ski plane, helicopter, as required
    - Operations of features – doors, cargo storage, temporary tie up
    - Location and operation of emergency equipment – fire extinguisher, raft, life jackets, first aid kit; how to remove the ELT (Emergency Locator Transmitter) set up and activation; open and inspect the aircraft survival kit
- Capabilities of the aircraft and pilot – loads, possibility of hover manoeuvres
- Requirements for remote fixed wing aircraft landings

- How to create a safe temporary helicopter landing site for pick up, including the required dimensions for the helicopter in use.
- Personal emergency kit requirements for employees using aircraft

16.10.2 Regular Pre-Flight Safety Briefings

Passengers should receive a safety briefing from the pilot before each flight. Repeat briefings when new passengers board flights with more than one stop. At the start of the season, briefings should be longer and more thorough than later when field crews are familiar with routines and procedures. However, problems sometimes arise when field crews and/or pilots become complacent and forget that each flight is unique and circumstances change each day and throughout the day. Passengers may begin to take safety for granted and not be fully attentive to all SOPs. Experienced people have walked into rotor blades and propellers.

Safety briefings are essential for passengers who fly intermittently. Conduct refresher training, as required.

Pre-flight safety briefings should include the following topics:

- Aircraft description: Capabilities of the aircraft, the capacity, cargo compartments, location of safety equipment
- Entry and exit
    - Hazards of main rotor and tail rotor for helicopters *or*
    - Hazards of propellers for fixed wing aircraft
    - Make eye contact with the pilot before boarding
    - Crouch when approaching a helicopter and hold onto your hat
    - Hazards of sloping ground, obstacles such as stumps or hummocks
    - Understand the pilot's field of view and always remain within it unless the pilot knows your actions e.g., loading, unloading cargo
    - Floats – safe area to step on or over
- Beware of antennas, pitot tubes and cargo baskets for helicopters
- Doors: Know the correct way to open, close and latch them securely
- Cargo and baggage
    - Dangerous goods requirements including for bear spray, bug spray and firearms
    - Safe loading methods and plan for the weight of samples on return
    - Electronic devices shut off
    - Opening and closing cargo doors, cargo compartment secured
    - Cabin baggage secured
- Seat belts and/or shoulder harnesses: Know how to adjust them, release them quickly and when to do so in an emergency.
- Communications

- Appropriate radio and channels to use for communication, check that radios function before the aircraft departs
- Use of headsets for communication – wear them when the pilot wears them
- Correct hand signals
- How to aid a helicopter landing with hand signals and your body position

- Emergency Procedures
  - Pilot will direct when to leave aircraft
  - Passengers – situational awareness – know the location of exits relative to your seat and how to exit
  - Emergency brace positions, ditching procedures
  - Life raft and life jacket location – how and when to operate and inflate them
  - ELT location, manual set up, antenna placement and activation
  - Briefing card with features of the aircraft – location, importance
- No smoking rules – not permitted with 30 metres of aircraft or fuel storage area

16.10.3 Safety Briefings for Special Operations

Special operations: hover manoeuvres, slinging loads (drills, setting up camp etc.,) require special briefings.

- **Hover manoeuvres briefing**

  Hover manoeuvres should be avoided whenever possible. Refer to section 16.7.3 for details. When a hover manoeuvre is unavoidable, the briefing and drill should cover the following points.
  - Pilot's line of sight for the particular helicopter
  - Seat belts – fasten before exit
  - Headsets – listen for instructions
  - Weight transfer – seating order – everything planned and executed carefully. Last one out is first one in; shuffle across the seats to exit; make a slow careful exit but hang on tightly
  - Mustering (gathering) point for pick up – define what makes a good location
  - Pilot signals and instructions
- **Slinging briefing**
  - All aspects of helicopter safety including the pilot's line of sight and blind spots for the particular helicopter
  - Site selection: size requirements, terrain characteristics
  - Approach and departure requirements: angle of approach, clearance from trees, power lines, cliffs and other hazards
  - Site organization
    - Pick up and lay down areas, load organization

        - Personnel on site – only people with a work-related reason may be at slinging locations
        - Restrict vehicles from slinging locations during operations
        - Housekeeping – no loose objects such as plywood, tarps, clothing, rubbish
    - Special equipment for slinging
        - Job allocation – who does what job
        - Long line – type, function
        - Carousel – type, function
        - Hook(s) – release function
        - Special equipment – e.g., for lifting drill rods
    - Slinging procedures
        - Hook up procedures
        - Loading procedures
        - Unloading procedures
        - Special conditions
            - Pilot's instructions
    - Ground crew safety
        - Radio communication
        - Hand signals
        - Safe positions – always in sight of pilot, never stand under the load, never turn your back on a load
        - Special cases – a long tall load (e.g., drill mast) can fall lengthwise trapping someone who is off to the side
        - Always have an escape route available
        - Never ride on a sling or skid
    - Emergency Procedures
        - Where to go in the event of a helicopter emergency – in flight, in hover
        - How to handle load emergencies – groundman injuries, load problems

16.11 Responsibilities Regarding Aircraft

Exploration companies, contractors and all employees should have a clear understanding of their responsibilities to reduce risks and hazards and help eliminate aircraft incidents and fatalities. When companies use the Internal Responsibility System (IRS) approach, everyone follows SOPs, helps identify risks and hazards and contributes to safe aircraft operations. Refer to section 1.2 Internal Responsibility System.

16.11.1 Pilots

The pilot is in charge of all aspects of the aircraft. It is his or her duty to safely load the aircraft, brief passengers and conduct a safe flight. The pilot should receive a copy of Section 16. Aircraft and discuss the contents with the project manager and with employees during the aircraft safety induction meeting.

Responsibilities of the pilot include but are not limited to the following:

- Comply with all flight regulations of the country, province, territory or state (authorities having jurisdiction) and company requirements.
- Do not exceed the allowable duty hours and flight hours for the jurisdiction and/or the exploration company policy.
  http://www.tc.gc.ca/CivilAviation/Regserv/Affairs/cars/Part7/Standards/720.htm
- Identify and designate (with the project/camp manager) a safe landing strip, dock, helicopter landing site, and safe slinging pick up and drop off locations, as required. Inspect them daily when in use and keep them free of debris and obstacles.
- File flight plans and make sure the person in charge has a written record of passengers and monitors all flights.
- Perform all necessary pre-flight checks on the aircraft.
- Develop an appropriate check-in and tracking system for aircraft with the project or camp manager. It is appropriate for the pilot to report the aircraft position every 30 minutes when flying.
- Brief the passengers on all in-flight safety procedures, equipment and flight conditions, especially for project visitors and employees who fly infrequently. Hold refresher training as required.
- Make sure all passengers know how to access and use all safety and survival equipment.
- Grant permission for passengers to approach or exit the aircraft. Remind passengers of the safe routes, as necessary.
- Inform passengers of any unusual conditions at the time of takeoff, during the flight or when landing.
- Follow safe operating procedures regarding fuel:
  - Use the correct fuel and make sure it has not passed the expiry date.
  - Maintain safe fuel delivery systems including filtering and water contamination test equipment. Test fuel for the presence of water and reject any fuel where water is present. Check the fuel lines for water each morning.
  - Do not operate fuelling equipment during an electrical storm or high winds.
  - Make sure empty fuel drums are removed and stored away from the landing site.
  - Be familiar with the information regarding safe fuel handling in remote locations on the following website:
    http://www.tc.gc.ca/civilaviation/publications/tp2228/fueldrum.htm
- Supervise all aspects of loading the aircraft including the placement and securing any permissible external loads. Make sure freight or hand luggage does not block the aisle between crew, passengers and any exit.

- Approve loading of all dangerous or hazardous cargo. The pilot should have training in handling hazardous materials.
- Never indulge in or permit any “horseplay” at any time, for any reason around aircraft.
- Plan with passengers and clearly mark the location of drop off and pick up points on the pilot’s copy of the map.
- Brief passengers and make sure passengers are thoroughly trained and capable when hover or toe-in exits may occur.

16.11.2 Project Manager or Supervisor

Responsibilities of the project manager for sites serviced by aircraft include but are not limited to:

- Select the correct aircraft for the job and site requirements in consultation with the charter company and/or pilot (see section 16.3). This will reduce the temptation to overload the aircraft. For example, just because an aircraft has four seats, it is not necessarily able to carry four people. Take into account elevation, temperature, fuel, survival gear, weight of samples, as well as the weight of passengers and their gear.
- Make sure all employees receive training at the aircraft induction safety meeting regarding SOPs around aircraft. New employees should receive routine training in aircraft SOPs when they start work. Make sure project visitors receive full aircraft safety briefings.
- Make sure that passengers are (1) aware of their right to refuse to fly if they feel unsafe; and (2) understand their obligation to report what they feel are unsafe aircraft and/or flying practices.
- Develop a written emergency response plan with procedures to address potential aircraft emergencies. Make sure the plan is posted and accessible to employees and that they are trained to implement it, as needed. Test the ERP to make sure it works – hold a practice drill.
- Make sure emergency survival caches are available beyond an arbitrary distance (depends on location, terrain, number in party). The survival kit should be contained in a highly visible, waterproof, sealed bag that can float.
- Set up and maintain safe landing sites in consultation with the pilot.
    - Keep the landing area clear of loose debris.
    - Place an air sock or wind indicator at the landing site. Place secure flagging streamers on radio antennas so they are clearly visible from the air.
    - Regularly inspect aircraft landing strips and make sure no workers or equipment are present when aircraft are expected.
- Oversee fuel storage.
    - The fuel storage area should conform to all regulations of the AHJs (authorities having jurisdiction). Locate the storage area at least 100 metres from living quarters, lakes, rivers and major streams. Store fuel well above high tide and any possible flood levels. It is advisable to have a secondary containment system that is rated for aviation and diesel fuel. Check the specification sheet for rating information.

- Equip the fuel storage area with fire extinguishers, appropriate spill kits and posted with no smoking signs. At least one 20-lb BC extinguisher should be present.
- Make sure that adequate supplies of the correct fuel are available and they have not passed the expiry date.
- Keep an accurate account of the correct fuel in caches in consultation with the pilot or aircraft maintenance engineer.
- Store fuel drums on their side with the bungs in a horizontal position to prevent water contamination. Store aviation fuel separately from all other fuels. Mark the fuel drums with the company ownership when required.
- Refer to section 18.4.3 Fuel and Fuel Handling

- Discuss the pilot's flight plan and maintain a log and/or map of the specific remote locations where employees are working in the event communications are lost and rescue is required.
- Remote project environments can be stressful places to work in. Form a stress free working relationship with the pilot and do all that you can to promote well being at a project or camp. Don't come across as telling the pilot how to do their job, but take action if there are any signs that the pilot is under undue stress. Discuss concerns with both the pilot and his or her supervisor, if necessary (see section 16.5 Pilot Fatigue).

16.11.3 Passengers

Passengers need to be aware of their responsibilities so they do not jeopardize the safety of a flight.

Responsibilities of the passengers include but are not limited to the following:

- Obey the pilot at all times and follow the project SOPs regarding aircraft.
- Pay attention to *all* safety briefings. Have situational awareness – know the location of all exits relative to your seat and how to open each one. Be familiar with relevant information in section 16.5 Emergency Procedures.
- Never pressure a pilot to (1) fly beyond allowable flight and duty time limits, (2) fly beyond his or her license limitations, (3) overload the aircraft, (4) fly in bad weather or in unsafe conditions, or (5) use an unsuitable landing strip or water port. Remember that the pilot is in charge of the flight at all times.
- Employees may refuse to fly if they feel the aircraft is unsafe, or if the pilot has flown or may fly in an unsafe manner. Inform a supervisor if any pilot engages in questionable behaviour.
- Employees may refuse to participate in a toe-in manoeuvre if they feel they need more training.
- Wear a seat belt at all times. Wear hearing protection. Wear the headset whenever the pilot is wearing one as it is the only means of communicating with you.
- Know the location and how to access and use the survival and safety equipment on board the aircraft.
- Inform the pilot if you are transporting dangerous goods (e.g., guns, ammunition, bear spray). These items must be correctly packaged and stowed. See section 16.9 Transportation of Dangerous Goods.

- Stow all hand luggage according to the pilot's instructions.
- *Never* indulge in "horseplay" in or near any aircraft. No one may ride on the skids or on the sling underneath the helicopter. Lifting people by helicopter line or sling may only be done by special emergency crews in the process of a rescue.
- Passengers should wear clothing suitable for the worst weather conditions they may encounter in case of delay, accident or stranding. Carry a suitable personal emergency/survival kit. Do not leave an aircraft without your pack – whether on traverse or at a work site – as something may prevent the aircraft from returning.
- Make sure you have a topographic map of the area and know where you and your co-workers are located when dropped off. Mark it on your map. Do not leave the aircraft unless you know your exact location.
- Discuss with the pilot how he prefers field crew to describe their locations by radio and by ground signalling. Ineffective communication costs valuable helicopter time, can contribute to pilot stress and can become a safety issue with respect to fuel consumption and helicopter range.
- If you suspect that you are off course, do not hesitate to communicate your concern to the pilot. Occasionally pilots get lost, especially in areas with few recognizable physical features and few roads. Indicate any hazard (e.g., birds, other aircraft) you observe to the pilot while in flight; don't assume the pilot has seen it.
- When a helicopter comes in to pick up passengers, someone may be designated to help to indicate wind direction. They should stand with their back to the wind and extend their arms straight out in front pointing in the direction the wind is blowing.
- The following websites provide general information regarding passenger safety on helicopters and float planes:

  http://www.tc.gc.ca/CivilAviation/systemSafety/brochures/tp4263.htm

  http://www.tc.gc.ca/CivilAviation/systemSafety/brochures/tp12365.htm

16.12 Slinging

Helicopters are often used to move supplies, fuel, project equipment and drills efficiently by slinging. Drill moves and airborne geophysics are special skill slinging operations and pilots who perform these jobs require special training. Slinging is hazardous work and accidents may occur even with experienced pilots. To minimize the hazards and dangers, employees and drill contractors need to develop, be trained in, and adhere to safe operating procedures (SOPs) for slinging.

16.12.1 Risks and Hazards

- Death, injury to pilot and/or ground personnel caused by helicopter crash
- Death or injury to people on the slinging route caused by loss of load or snagged sling gear
- Accidents resulting in injury or death caused by:
  - Pilot fatigue
  - Poor visibility (dust, blowing snow, flat light, rain)

  - Improperly secured load
  - Load exceeding lifting capacity of the helicopter
- Stress caused by noise, rotor downwash
- Hearing loss caused by lack of hearing protection
- Eye injuries caused by blown dust, grit
- Hand injuries caused by crushing or pinching or impact by sling loads
- Electric shock from grounding effect
- Injuries caused by slips, trips and falls due to poor ground conditions, obstacles, poor housekeeping at sling locations

16.12.2 Causes of Slinging Accidents

Employees should be aware of the potential hazards that cause accidents during slinging operations. Pilot fatigue is the root cause of many slinging accidents. 60% of slinging accidents occur during pick up. The following information is compiled with permission from the Transport Canada brochure *TP 3042 - Slinging with Safety*.

Source : *TP 3042 - Singing with Safety, Transport Canada in May 2000.* Reproduced with the permission of the Minister of Public Works and Government Services Canada, 2008.

Some major hazards are:

- Snagged sling gear
- Obstacles in the operating area such as stumps, drill equipment
- Untidy housekeeping around the drill site and landing site. Debris or loose plywood sheets etc., may be blown violently into the air by the downdraft from the helicopter's rotors.
- Poor surface conditions at the operating site such as snow, soft spots, mud
- Incorrectly rigged load
- Overloading
- Wind conditions not known beforehand, or variable wind conditions
- Inappropriate choice of machine for the task
- Inadequate condition and maintenance of slinging equipment

Here is how accidents happen:

- Inadequate planning
- Inadequate briefings
- Getting pressured into a risky operation
- Accepting hazards
- Flying when fatigued
- Lack of training for the task

- Unsure of what is required
- Operating in marginal weather conditions
- Ignoring safe operating procedures (SOPs)
- Becoming distracted and not spotting a hazard
- Poor communication or poor understanding between workers on the ground and the pilot
- Lack of respect for established procedures
- Ground crew placing themselves in a dangerous position under the load or out of sight of the pilot

16.12.3 Safe Slinging Guidelines

It is essential to carefully plan all slinging operations. Numerous factors contribute to safe slinging operations. These include (1) using the correct equipment, (2) careful planning and coordination of all manoeuvres between the pilot and ground crew, (3) accurate communication between pilot and ground crew, and (4) taking time to do the job safely and correctly. Hazards and risks can be reduced by following these guidelines.

1. Carry out a risk assessment to identify, assess and eliminate risks. Address the observations and conclusions of the risk assessment and mitigate the risks. Provide protection against risks that cannot be eliminated.
2. Make sure the helicopter has the lifting capacity to do the job.
3. Make sure the helicopter pick up and drop off locations are large enough for all required manoeuvres and are cleared of all debris and vegetation that might interfere with operations.
4. All personnel involved in slinging operations should be fully trained and experienced. All personnel (company employees, contract drillers) should follow safe slinging procedures. All personnel not directly involved with slinging operations must stay well away from the slinging locations and flight paths.
5. Consider having individuals authorized to manage and/or connect sling loads formally designated as “load marshalls”. Once they have specific training, the person designated as load marshall shall inspect all loads prior to hooking up, and be the only person allowed to actually hook up, or designate the person that hooks up the load. The load marshall is the only person who communicates with the pilot.
6. All ground crew should wear PPE: hard hats secured with chin straps, hearing protection, goggles that strap on securely for eye protection, reflective clothing and boots with good soles – preferably with safety toes, as required. The load marshal should wear fluorescent gloves and fluorescent arm bands.
7. Hold briefings for each slinging job so everyone fully understands their responsibilities for the task at hand. Include clear instructions regarding potential emergency situations.
8. Plan for site specific emergency response procedures. Define a NO-GO zone where the pilot may drop a load or make an emergency landing. Everyone involved must know where to go and what to do if a load gets snagged, is dropped, or if the helicopter must make an emergency landing.
9. Use the correct type of slinging equipment for the job and be sure it is in good working condition.
10. Organize the loads taking into account the weight, shape and type of loads.

11. Plan flight paths so helicopters do not fly over built up areas, established project areas or where people are working.
12. Ground personnel should never place themselves beneath a suspended load under any circumstances.
13. Never put pressure on the pilot to complete slinging operations under poor weather conditions or if the pilot and/or drill crew are in a state of fatigue.

Note that exploration companies can often negotiate a training session outside the field season with a helicopter charter company at the air base. Charter companies are usually willing to oblige as their pilots also receive valuable training under controlled conditions. If planning ahead is possible, an exploration company may bring drill company employees as well to take part in the training. Individuals who have taken the training may be designated as “load marshalls”.

16.12.4 Planning for Safe Slinging Operations

Include the following factors when planning slinging operations.

Risk Assessment

Conduct a risk assessment to identify, assess, eliminate or mitigate the hazards associated with slinging operations. Here is a partial list:

- Physical hazards such as trees, power lines, cliffs, bodies of water, project living quarters
- Weather conditions
- Fatigue potential: how rested are the pilot and crew?
- Ground conditions at staging, pick up, drop off and emergency landing sites
- Loose material, debris, temporary unsecured structures at any of the above locations
- Load aspects
    - Weight of items for slinging – “real weight vs. driller’s weight”
    - Lifting capacity of aircraft
    - Potentially difficult loads to sling
    - Potential pinch points, crush or other danger points specific to the loads

Helicopter Performance

- The elevation, air temperature and humidity significantly affect helicopter performance. Helicopters operating in mountainous or hot environments have reduced lifting capabilities and must carry lighter loads than when operating at sea level and/or in cool weather.
- Above certain weights, helicopters may not be able to take off vertically. It may be necessary to clear an area ahead of the site for the helicopter to execute a low-level transition to forward flight.

Site

- The pilot and project manager should identify and designate the pick up and drop off slinging sites. Clear the operating area of all stumps, brush, unnecessary equipment and

loose materials that might catch on a moving sling load or be blown about by the rotor downdraft.

- Inspect the sling operation sites daily and remove all debris and obstacles to prevent flying debris caused by downdrafts from the helicopter.
- Define the NO-GO area for each operation for emergency manoeuvres.

Communication

It is usually safer to use radio communication between the pilot and groundman. It is highly recommended that radios always be available and used during slinging operations.

- It is advisable to use handheld FM radios fitted with headsets or speaker phones. These provide hearing protection, noise reduction and a boom microphone that enables workers to speak without averting their eyes from the task. Holster radios to protect them from entanglement and allow a worker's hands to be free.
- Check radios during the briefing to be sure they function.
- The pilot should receive radio communication and hand signals from only one person on the ground.
- Pre-determine the radio calls that are expected from the groundman to the pilot. Choose good clear instructions as the background helicopter noise makes directions difficult to understand by either person. For example, mutually select radio calls when lowering a load like: 10 metres, 5 metres, 2 metres, down. Use clock angles to direct lateral movement of a load: 12 o'clock (forward), 6 o'clock (reverse) etc. Use "clear" only when the groundman or designate has hooked up a load and is clear of the area and wishes to direct the pilot to lift the load.
- Agree upon and be thoroughly familiar with hand signals to use, if necessary. See section 16.14 Commonly Accepted and Known Hand Signals.

Slinging Equipment

The size, safe working load, length of slings, hooks, nets, shackles and "D" rings will vary with the capability of the helicopter and the type of load.

- Slinging equipment is not standardized. Consequently crews involved in slinging require specific training for the equipment in use. Just because an individual has some slinging experience and/or training, it cannot be assumed that they know and understand the correct procedures for specific sling gear in use at the site.
- When a new helicopter arrives at a project, insist that the pilot present and inspect all slinging gear for suitability and condition prior to commencing any slinging operations.
- Make sure the appropriate equipment is available to do the job efficiently (various slings, cable chokers, lifting pods, lanyards etc.). Every item must be in good working condition.
- Clearly identify all slinging equipment for aircraft use only (colour code, if necessary) and store it separately from general purpose slinging equipment. Lifting equipment should be clearly marked with a unique identification number or symbol that indicates the maximum lifting capacity of the item. Store the slinging equipment up off the ground when not in use. Suspend it from the attachment hooks when possible.
- Use a long line (>15 m) for slinging, as it is safer. Avoid the use of a short line (<15 m).
- Maintain a register of all slinging equipment to make sure all items are within the life or test date.

- Wire ropes used for all slings, lanyards and nets should have a designed breaking strength of not less than 6 times the maximum lifting capacity of the helicopter. All items in the load chain must have a breaking strain of at least 4 times the weight of the largest load to be carried.
- Inspect all slinging equipment before initial use and daily for defects and damage for the duration of the slinging work. The inspector must be a designated, competent person. Keep a record of inspections.
- Inspect wire rope slings for (1) fatigue failure – small cracks in the wire rope, (2) abrasive wear – worn shiny spots and (3) abusive wear – kinking or bird caging.
- Discard wire rope slings that show severe corrosion, more than 1/3 reduction in the diameter of the outer wire and excessive abusive or abrasive wear. Abusive wear causes serious structural damage to wire rope and will cause the sling to become unsafe long before other factors.
- Use steel wire rope slings and/or fibre net slings in preference to nylon webbing slings. Nylon webbing may chafe very rapidly in flight if it is poorly rigged. Rough loads may require wrapping to prevent chafing of nylon webbing if it is used. If so, verify the appropriate wrapping material to prevent it coming loose and being sucked into the engines or rotors.
- Test electrical and emergency mechanical cargo hook release mechanisms daily. Keep all winches, shackles, line slings and hoists under one maintenance testing program.
- Make sure the aircraft hook assembly and operating system adhere to the same planned maintenance requirements as other aircraft components.
- Always insert a swivel between the fixed hook assembly of the helicopter and the external load.
- A shackle or hard eye must form the direct connection between the cargo hook and sling. Soft eyes and rope attachments may bind on the cargo hook and prevent release under normal release conditions or, more dangerously, in case of emergency.
- The pilot should release the long line every time the helicopter lands, even if for a very short time. Something may interrupt the slinging plans and the pilot might take off and forget the line is still attached.
- If a cargo hook has been impacted in any way, it must be inspected prior to continuing or resuming slinging operations.

Loads

- Make sure the cargo weight does not exceed the lifting capacity of the helicopter.
- Take great care when attaching slings to make sure they will not become detached during flight.
- Make sure the entire cargo is held securely by the net so nothing comes loose during flight.
- Properly prepare unusually shaped items for slinging. Follow best procedures when slinging difficult loads such as plywood or boats, as they can “fly” and be very dangerous during slinging if not correctly handled.
- Weigh down light loads (e.g., plywood) with heavy gear to keep the sling from swaying backwards into the tail rotor.

- Before slinging bundles of long timbers such as 2x4s, nail each 2x4 to an adjacent one. Then, no individual 2x4 will slip out of the bundle if the load starts to spin during flight.
- It may be advisable to pad or wrap core boxes with cardboard, canvas or something similar, to prevent them from chafing the sling net. Stack and fasten core boxes together to minimize any load shifting and spillage during flight.
- There are often special hooks for slinging drill rods. Make sure the person hooking up the rods is trained and understands how the hooks operate.
- Centre the weight by placing heavy items in the centre of the cargo net first and lighter items on top. Make the loads as symmetrical as possible. After the net is secure, look for holes where items might slip out. Pad sharp objects, as they could sever the net while in flight.
- Don't place a tarpaulin inside a net to carry many small items. The tarpaulin could potentially slip out and get tangled in the rotors. Small loose items should be placed in boxes with lids and then boxes securely strapped together.
- Place all sling net loops on a lanyard hook, and then attach this lanyard hook to the helicopter hook. If you know the number of loops around the perimeter of the sling net, you can count the loops on the lanyard hook to confirm that they are all attached.
- Never attach cloth straps or ropes directly to a helicopter hook. Attach them to a lanyard hook. Then, attach the lanyard hook to the helicopter hook. If straps or ropes are attached directly to the helicopter hook, they may come off if the load rotates during flight.
- Make sure the lanyard hook-keeper is secured in the closed position before signalling the helicopter to lift.
- Never fly with an empty lanyard and/or long line as they may trail back into the tail rotor during certain manoeuvres. Remove the line and place it inside the helicopter for the return trip or weight it down. They can only be flown if they have at least 10 kg of fixed weight at the hood end of the line.
- When it is necessary to use a very long line attached to a sling (e.g., jungle, mountainous sites with very tall trees), always have a pile of rocks or logs available to use to weigh down the sling for the return trip. Under these circumstances, it may be impossible to detach the sling net or cables for the return trip**.**

Weather

- Be prepared to stop slinging operations if weather conditions are marginal. Check the wind direction frequently and be alert for changes. Stop slinging operations if electrical storms move into the area. Don't push your luck.
- Radio communication between the pilot and groundman is essential when slinging in snow conditions, as the helicopter can create blowing snow while it hovers. The pilot will have great difficulty seeing hand signals from the groundman. This may also occur when sand or dust obscures visibility.
- Flat light conditions make vertical referencing very difficult. To help the pilot distinguish the horizon, place visual cues or markers outside the pick up area. Use items like large rocks, large orange garbage bags filled with snow, spray paint large areas of snow or rocks. Whatever is used must not be affected by the rotor downwash.

Grounding Effect

- Electrostatic charges are built up by friction between the surfaces of the aircraft and airborne particles. Static shock can be particularly severe when the air is dry and dusty

and also when the aircraft flies through heavy rain, snow or ice crystals. It may be advisable to use a grounding hook to touch the load first. A person can be knocked to the ground or even become entangled in the cargo net from a charge of static electricity.

- The person hooking the cargo onto the helicopter load hook should wear lineman gloves for protection from static electric shock. Before attaching the load to the cargo hook, touch the load hook to the sling eye before touching the hook with your hand.
- If bad static conditions exist, have the pilot ground the load first, then pick it up to do final positioning.
- Do not stand in water when touching a cargo hook of a hovering helicopter.

16.12.5 Slinging Responsibilities

Responsibilities for safe slinging operations lie with the helicopter company to provide certified sling equipment in good working order, and with the pilot and the groundman/load marshall to carry out safe operations. Other ground workers at the sling location should follow the directions of the load marshall.

Pilot

It is very important for the pilot to be well rested. He or she must not exceed the legal number of flight duty hours. During slinging operations, it is imperative that the pilot feel complete confidence and control after taking into consideration all the external factors affecting the operation. Because slinging operations require such intense concentration by the pilot, everyone must *watch for signs of pilot fatigue*, which may include inattentiveness, slow reaction time or missed cues, grouchiness and/or atypical behaviour. See section 16.5 Pilot Fatigue.

The pilot's responsibilities include the following:

- With the project manager, designate and inspect the staging area, the sling pick up, drop off, and emergency drop locations.
- Make certain that everyone is thoroughly briefed for the required moves. See section 16.10.3 Safety Briefings for Special Operations.
- Establish signals for communication – radio and hand – and make sure everyone is familiar with them. See section 16.14 Commonly Accepted and Known Hand Signals.
- Check the release mechanism and sling gear serviceability. If present, the aircraft maintenance engineer may have this responsibility.
    - Check the cargo hook.
    - Check that the release mechanisms physically open – normal and emergency.
    - Inspect all slings, straps, nets etc. Nothing must be worn or frayed and all hooks must have a safety latch.
    - Inspect the position of the helicopter mirror.
- Follow proper slinging procedures.
- Clarify emergency procedures for everyone to follow in the event of an emergency – both during hook up and during flight.
- Coordinate the makeup of loads with the groundman. Be familiar with and estimate the flying characteristics of each load.

- In the case of a failed or dropped load, halt slinging operations until the root cause of the failure is determined and mitigated.

Groundman (Load Marshall)

A slinging site may use one or more people on the ground. The person in charge is designated as the groundman or load marshall. This person may or may not hook up the load to the helicopter. It is safest if a groundman stands off to one side and coordinates the hook up, which is done by a second trained person.

- The groundman must be fully trained for the job and have a complete understanding of the task to be performed. The groundman responsibilities include the following:
    - Manage activities on the ground and define the positions and responsibilities of the team.
    - Make sure the load is safe. Be familiar with the weight and specific attachment gear required for specific types of loads.
    - Communication: Only the groundman or one designated person may send signals to the pilot. The pilot and groundman must confirm the signals with each other. Use radio communication, whenever possible. Hand signals may be acceptable, depending on visibility conditions.
- It is essential to wear PPE (see # 6 in section 16.12.3). The groundman should also wear reflective arm bands and fluorescent gloves for greater visibility when signalling.
- Communicate the load weight to the pilot each time, as it may be very different from the previous load.
- Place loads so they are free of obstructions before lifting.
- Do not allow the cable to be placed across the skids when attaching the cable to a load.
- Verify that the lanyard hook-keeper is secured in the closed position before signalling the helicopter to lift.
- Never step directly in front of a sling load after hooking it onto the helicopter. Exit forward but to the side to avoid being struck by the load as the helicopter aligns for take-off. Stand or crouch in full view of the pilot. Then, keep well away from the flight paths while sling loads are transported.
- Never under any circumstances will a ground crew or driller place themselves beneath a suspended sling load or in the path that a forward moving helicopter is expected to take. Be aware of the area the load would cover if dropped and stay clear of that area.
- Never turn your back on an incoming load.
- Allow the load to settle before removing chokers and slings.
- Use a second groundman when slinging a drill rig and equipment or when slinging a complicated load. This person is required to be familiar with safe slinging procedures and should be equipped with a radio. Only one person, however, may give signals to the pilot.
- Know the emergency procedures for the job. Know where to go and what to do if a load gets snagged, is dropped, or if the helicopter must make an emergency landing. Designate and observe the NO-GO zone.
- If the ground crew sees any equipment that may be suspect in any way they must bring it to the attention of the pilot immediately.
- Take time to do the job safely and correctly.

Other ground crew workers

- Only workers who have a specific task related to slinging may be at the site. All others must remain well clear of the operations.
- Every worker at any slinging site must wear PPE including gloves to protect hands. Wear a head set with receiver to hear communications between the pilot and groundman. Do not communicate with the pilot unless designated to do so by the load master.
- Know the emergency procedures for your job – where to go, what to do if a load fails or is dropped, or the helicopter engine fails or makes an emergency landing.

16.12.6 Guidelines for Drill Slinging Operations

Be familiar with section 16.12.3 Safe Slinging Guidelines as well as the following guidelines.

- Prior to a field program involving drill slinging operations, make sure the tender document and/or helicopter contract specifies the type of helicopter capable of performing the required drill moves and other slinging procedures. Request specific pilot experience related to drill moves as part of the contract as well as for the aircraft maintenance engineer, who is responsible for maintaining slinging equipment. See section 16.3 Charter Aircraft)
- Only long line sling equipment should be used (minimum 15 metres – maximum 38 metres) unless the geographical and/or windy conditions require more than 38 metres to allow a safer and more stable hovering position for the helicopter. Using long lines will minimize the effect of downwash from the rotors and place the aircraft in cleaner air. Short line slinging (<15 metres) does not provide enough manoeuvrability and reaction time for the pilot or ground crew in the event of an emergency load release or engine failure.
- Inspect slinging equipment for damage before use. Use only steel cables as rope may break and whip into the rotor blades. Inspect cargo nets for rips and tears where the contents may come out while in flight.
- Pre-plan drill moves and/or any load preparation with <u>all</u> personnel involved in the operation. Designate a groundman (load marshall) to manage activities on the ground and define positioning and responsibilities for the personnel who are specifically designated to be present in the immediate area of the move sites (tear down and assembly sites). Only the designated groundman should be responsible for two-way radio and hand signal communications with the pilot, unless otherwise assigned.
    - All employees working at the slinging site must wear PPE (see # 6 in section 16.12.3).
    - Only employees directly working with slinging operations may be present at the sites. This is critically important for safety.
    - Where available, use a competent observer to monitor activities from a distance and who can act as a second load marshall in specific cases.
- The briefing plan prior to any sling load movement must include clear instructions regarding what to do for possible emergency situations. Define a NO-GO AREA on each drill site or storage area where the pilot may drop the load or make an emergency landing.
- During slinging, ground personnel will not place themselves beneath a suspended load under any circumstances.

- Designated positions should be within sight of the pilot at all times. *"If you can't see the pilot's eyes, he can't see you"*. Note that different helicopters will have different pilot line-of-sight characteristics. The pilot should review these characteristics with the ground crew prior to all drill moves.
- Communication: It is best to use radio head sets to communicate with pilot. Chatter should be kept to critical conversation only. Keep communication equipment fully operational until the slinging operations are complete. Hand signals (marshalling signals) must be well known and may also be used by the designated load marshall. Remember that only one person sends the signals to the pilot. See section 16.14 Commonly Accepted and Known Hand Signals.
- Establish with the pilot that current weather conditions permit safe operations and under no circumstances should the pilot be badgered into completing the operations under poor weather conditions or if he and/or drill crews are in a state of fatigue.
- Organize the tear down and assembly sites and keep them free of clutter. Secure all materials to prevent flyaway material during slinging.
- The tower is the most challenging and dangerous part of a helicopter supported drill move. The ground crew and pilot should work together to achieve a smooth and safe tower move and re-attachment. The load marshall should try to position him/herself upwind of the approach direction, unless the pilot decides on a different approach for safety reasons.
- Whether positioning the tower vertically or horizontally, the tower should approach the drill at mount or eye level (unless there are different instructions from the pilot pre-move briefing) and not from a height directly overhead.

    1. Marshal the pilot to bring the load in a lateral position at eye level to allow easier positioning, less intimidation and a safer environment for the ground crew. The tower should be level with respect to the mount. Mark or weld hanging points on the tower for future moves once the best strapping points are identified (for balance and flight characteristics). Critical for safety: make sure any welds are properly completed.
    2. Load stabilization should only be conducted with the approval of the pilot and with the use of straps or rope with sufficient length to allow the ground crew sufficient distance to be protected from an emergency load release. Over use of straps or ropes can be counter productive as the ground crew may in effect work against each other. One or two <u>experienced</u> ground crew should be easily able to stabilize the tower. (The method of strapping used is of prime importance).
    3. Fit the drill with a guide (welded guides) to force the base of the tower into the correct alignment.
    4. Paint a white or orange line along the tower rest bar and the side of the tower in view of the pilot so he can better gauge proper alignment. This guide line should be cleaned and refreshed, if necessary, before each drill move.

- Pin or bolt all drill rig parts immediately after they are positioned.
- If difficulties or confusion develop that cannot be easily and quickly resolved, the pilot should land the helicopter and participate with the ground personnel to solve the problems or concerns.
- Debrief after every move to identify problems and highlight successful work procedures.

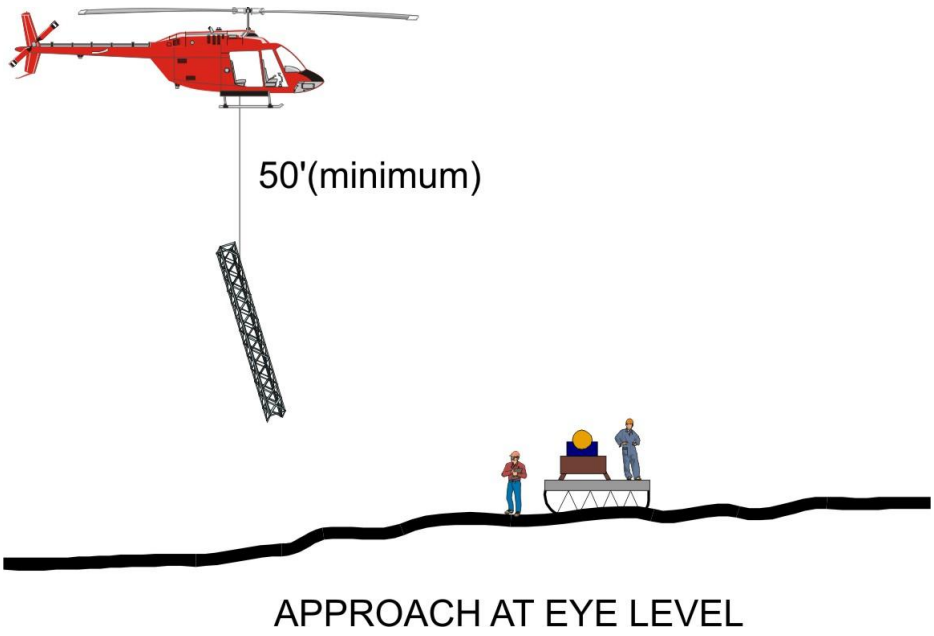

Figure 16.8: Drill slinging

16.13 Temporary Landing Sites

Safe operating procedures should be in place for landing fixed wing aircraft that land on lakes and rivers using floats, on unmaintained airstrips and ground such as beaches, eskers or gravel bars using tundra tires; and on frozen lakes and rivers using skis. SOPs should also be in place for helicopters, which may land in many conditions and terrain. Obtain environmental approvals and adhere to regulations of the AHJs when selecting and preparing landing sites. Landing requirements vary according to the type of aircraft.

16.13.1 Helicopter Landing Sites

The largest required helicopter determines the required dimensions of the landing site at a project or camp. Always discuss the exact requirements for landing sites with the helicopter contractor so they are fully understood by all parties. Good clearance in all directions is necessary for manoeuvring helicopters and slinging loads. Some terrain requires special construction to provide a safe landing spot. Where a helicopter downdraft creates blowing sand or dust, a raised helicopter landing pad may be a partial solution. Much of the following information is based on the Transport Canada Aviation Safety brochure *Safer Temporary Bush Helipads*.

> Source: *TP* 4262 -*Safer Temporary Bush Helipads*, *Transport Canada in April* 1999. Reproduced with the permission of the Minister of Public Works and Government Services Canada, 2008.

Selecting Temporary Sites

- The landing site surface should be on level, firm and stable ground under both wet and dry conditions. The site should be as level as possible with a slope not more than 3º.

- Understand the difference between the area required for the helicopter skids and the amount of area required for safe landing and takeoff.
- Plan the temporary landing site dimensions to safely accommodate the largest helicopter that will be used. A clearing, including the opening in the tree canopy, should measure *at least* 35 metres in diameter (more in areas of tall forests or jungle). The landing spot (helipad) should be at least 4 metres square. If the helipad is made of logs etc., they must extend sufficiently beyond the length of the skids and be placed at 90° to the skids for firm support.
- Take into account local prevailing winds and plan the flight access corridors in the direction of prevailing winds. If necessary, clear an access corridor. Consider a clearing beside a lake, river, road, or on a ridge top.
- Stay away from power lines, wires, cables or towers. Avoid obstacles such as cliffs and stands of tall trees that might cause dangerous downdrafts.
- The approach and landing paths should avoid passing over open water and over accommodations.
- Wildlife. Stay away from flight paths or feeding areas of flocking birds such as gulls. Flight paths are usually below 150 metres above ground level and birds are especially active at sunrise and sunset. This problem may occur near waste disposal sites, dumps, migratory waterfowl refuges and agricultural fields during harvest or plowing activities. Bears may also become a problem at landing sites near dumps.
- Choose an area that requires minimal site improvement – one relatively free of stumps, deadfalls, brush, rocks or other hazards.
- When possible, select a low dust area.

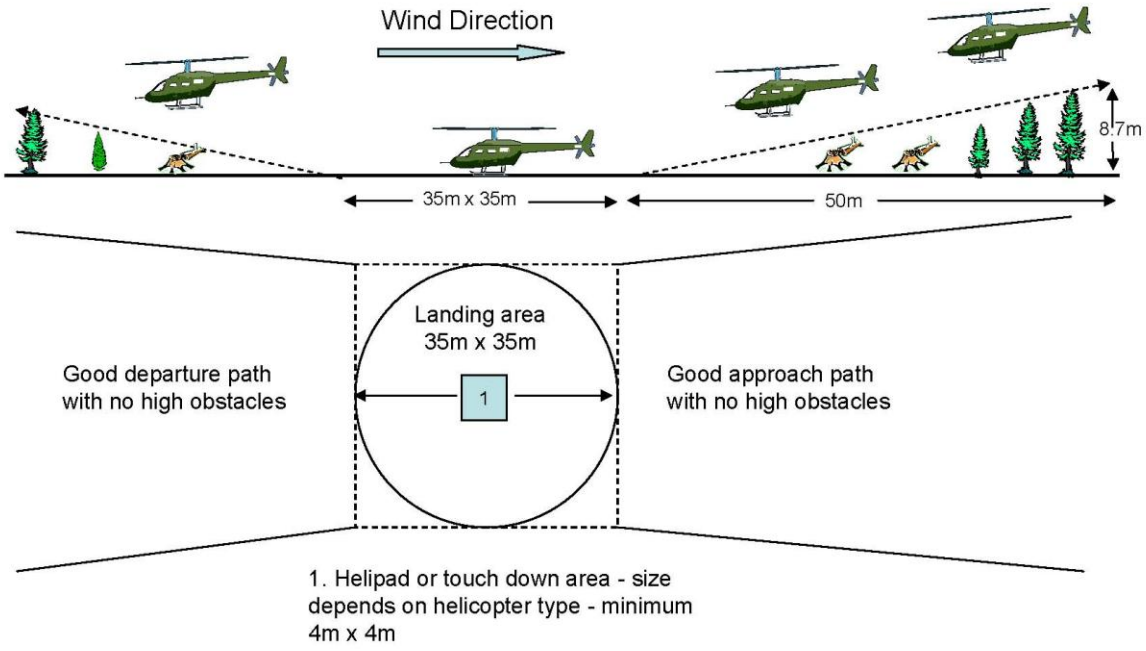

Figure 16.9: Elevation and plan views for suggested minimum dimensions of a temporary helicopter landing area

Improving a Temporary Site

- Cut down trees that may be a hazard on the approach and departure paths, especially if helicopters will be slinging external loads. Ideally, it is best to provide access with a 15º angle of approach. The angle of approach may not exceed 40º.
- Clear the manoeuvring area (e.g., within at least 15 metres of the landing spot). Remove all hazards such as stumps, brush, deadfalls, large rocks and loose debris. Remaining trees near the landing site must be firmly rooted, show no signs of decay or dead branches that may be blown down by the downdraft from the rotor blades.
- Clear the landing area to the ground surface within 8 metres of the helipad. Nothing must protrude that might contact the tail rotor.
- Provide a wind indicator such as flagging tape streamers or a windsock. Smoke flares may be used when necessary. Firmly secure all markers and flagging to prevent them from blowing into the rotors.
- In areas where dust or sand is a problem, use a binding agent (one permissible under local environmental regulations) in the immediate area of the landing spot.
- Make sure at least one 20-lb large multi-purpose (dry powder type) fire extinguisher is immediately available at the landing site.
- Provide a hazardous materials spill kit and a proper waste disposal container.

Temporary Bush Helipad Construction on Snow or Swampy Ground

- On deep snow or soft swampy ground, construct an evergreen bough mattress at least 15 cm thick and at least 3 m square for the helipad. Tramp the snow down with snowshoes first to make a base.

- Lay a minimum of 6 sturdy logs close together on the bough mattress (maximum of 50-60 cm intervals) and at right angles to the direction of helicopter approach. Ideally the logs should form a solid and continuous landing surface. They should be at least 3 metres long and 10 cm thick. Each helicopter skid must rest across several logs, not along one log.
- Make sure the pad is level to within 5º. Trim off all stubs and knots from the logs so the skids won't catch on them.

Long-Term/Heavy Duty Bush Helipad Construction on Snow or Swampy Ground

- Construct an evergreen bough mattress larger than for the short-term pad. It should measure at least 30 cm thick and 4 m x 5 m. Tramp the snow with snowshoes to make a base.
- On the bough mattress, lay 2 sturdy logs, each 4-5 m long, about 3 m apart. Lay these logs parallel to the helicopter direction of approach.
- Lay sturdy logs of equal thickness across the first two logs to form a solid and continuous landing surface to maximize the "ground effect". The logs should be 4-5 m long. Spike these cross-logs together with 30 cm spikes.
- Make sure the pad is level. Trim off all stubs and knots and make sure no spikes protrude.

Hillside Bush Helipad Construction

- Except for leveling considerations, the construction and dimensions should be the same as for level ground helipads.
- Build up the downhill side to make a level helipad. Often, a large log on the downhill side will suffice. On steep slopes, make sure the pad is securely braced so it will not slide or roll under the weight of a fully loaded helicopter.
- Lay the cross-logs on top of the built up braced logs in the same direction as the slope to form a continuous pad. Usually, the helicopter will approach on a course along the side of the hill and land with one side towards the slope and the skids supported by several of the cross-logs. Verify the best direction to place the logs with the helicopter pilot.
- Install a good, highly visible wind indicator. This is very important due to the variable winds that occur around hills and down slopes.

emporary Rock Hilltop Helipad Construction

- Clear all loose debris from the rock surface and mark the landing spot with conspicuous paint.
- A 3-metre circle around a large letter **H** is best, but any marking easily seen from the air will suffice.
- A wind indicator is important because of hilltop winds.

Temporary Ice Helipad Construction

- Check carefully for cracks and soft spots on the river, lake or sea ice, especially when the ice is snow-covered.
- Away from a shoreline it is often difficult for pilots to determine their height for landing or hovering. Provide visual references ahead or to one side of the landing spot. Piles of

equipment or weighted conspicuous markers such as orange garbage bags filled with snow or streamers can be used.

- All personnel must stand well clear of the helipad during landings, hovers or departures. Blowing snow can obscure the pilot's visibility and the helicopter could drift across the landing site.

16.13.2 Landing Strips

Remote landing strips

- Pilots and project managers should verify that the landing strip is long enough to accommodate the aircraft and that the condition of the strip is suitable for use.
- Pilots should fly over a remote unattended landing strip to check for wind direction, wild animals, obstructions and the condition of the runway before committing to land.
- Designated employees on the ground should inspect infrequently used landing strips on foot or by vehicle for obstructions and wild animals before flight arrivals and departures.
- People working on the ground near landing strips should be aware that pilots usually make a pass before landing. Anyone present on a landing strip on foot or in a vehicle should leave it immediately when aircraft approach. Designate an area off to the side for parking vehicles.

Landing on ice

- Verify the ice is thick enough to handle the fully loaded aircraft. Measure the ice if necessary. Clear snow from the ice and make edges to define the runway.
- If landing on an ice road, set up the strip in an area where the ice road banks are no higher than 2 m to avoid interference problems with the wings when the aircraft turns around. Block off both ends of the runway with vehicles. Keep the vehicle at least 30 metres from the lead-in and another vehicle 500 metres away from the end of the strip to allow for a run-off zone. Do not point the vehicle head lights onto the strip as the white light will wash out the visibility of the strip.
- If permitted, night landings require flares to be set up every 60 metres on both sides of the runway. As a potential alternative to flares, place a roll of toilet paper into a can of diesel fuel. These burn longer and make a more visible light. Position the flares in advance and wait for the aircraft arrival. When the plane arrives, signal to confirm arrival at the correct location. Light the flares.
- Keep the runway secure until the plane has departed.
- For additional information, refer to *Best Practice for Building and Working Safely on Ice Covers in Alberta.* Website: http://employment.alberta.ca/documents/WHS/WHS-PUB_sh010.pdf

Figure 16.10: Try to verify the condition of a remote landing strip; this aircraft had to be towed to firmer ground before departure. © Bill Mitchell

16.14 Commonly Accepted and Known Hand Signals

The Transport Canada poster TP 9528 has signals that are generally accepted for marshalling movements and helicopter instructions from ground to pilot. The poster measures 28x43.5 cm and is available in English and French. It can be ordered from the following website: http://www.tc.gc.ca/civilaviation/systemsafety/posters/menu.htm

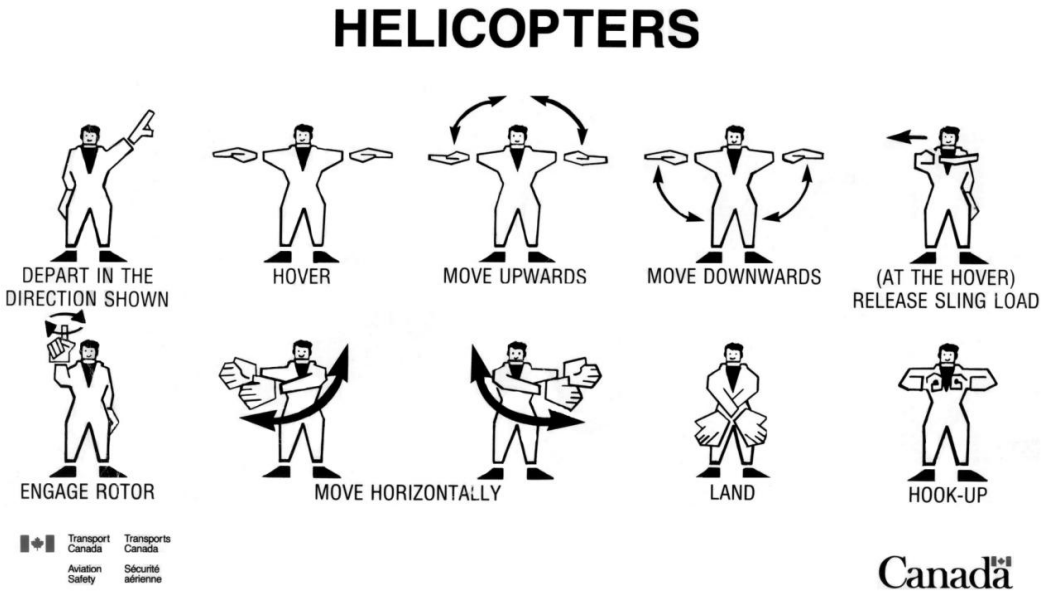

Figure 16.11: Marshalling Signals for helicopters

Source: ***TP 9528-1-Marshalling Signals, Helicopters****, Transport Canada in June 2000.*
http://www.tc.gc.ca/civilaviation/systemSafety/posters/menu.htm

16.15 Emergency Procedures

16.15.1 Emergency Guidelines for All Aircraft

Each project should have a written emergency response plan (ERP) that includes emergency procedures in the event of an overdue and/or downed aircraft. Everyone should be familiar with the ERP and with aircraft emergency procedures and routines in the event a crisis develops. Although the pilot is responsible for the safety of the flight, each passenger is also responsible for their own safety. In an emergency situation, a pilot may not be able to provide additional instructions regarding an emergency landing or evacuation. Therefore, you need to know how to get out of the aircraft.

The emergency procedures for fixed wing aircraft and helicopters are compiled from information available on the following Transport Canada websites. In addition, passengers should be familiar with the passenger safety instruction cards in the aircraft.

Source: TP 12365 – Seaplanes: A passenger's guide. *Transport Canada in January 2008.* http://www.tc.gc.ca/CivilAviation/systemSafety/brochures/tp12365.htm

Source: TP4263 – Helicopter Passenger. *Transport Canada in August 2004.*
http://www.tc.gc.ca/CivilAviation/systemSafety/brochures/tp4263.htm

Preparation for an emergency

1. Pay attention to every safety briefing. Know the location of exits and all emergency equipment including the ELT on board the aircraft. Equipment location varies between aircraft and even between the same type of aircraft. Know the "brace position" for your type of seat belt. See the safety card for details. Ask questions if you do not learn all the information you should know in the briefing or on the card.
2. Read the instructions for the operation of the doors and emergency exits. Know the location of and how to use all exits. The method of opening an exit may differ from one aircraft to another and even within the same aircraft. If you have not done so in a general safety induction, ask the pilot if you can practice opening the exit(s) before the engine starts up.
3. Locate the exit in relation to your left or right knee. If the exit is on your right while upright then it will still be on your right in the event the aircraft comes to rest inverted. No matter how disorienting an accident, as long as your seat belt is fastened, your relationship to the exit(s) remains the same. Be familiar with your surroundings so you can find your way to an exit – even with your eyes closed.
4. If you are flying over water, know the location of your life preserver. Locate it! Know how to reach it, how to put it on and how to inflate it. Float planes are required to carry life preservers or PFDs (personal floatation device) for every occupant. Check with the pilot
5. to see if it should be worn in-flight. If so, wear it, but *never inflated it while in the aircraft.*

During an emergency

1. Follow any instructions issued by the pilot.
2. Do not distract the pilot.
3. Check that any loose gear in the cabin is secured.
4. Wear a helmet if provided.
5. Remove eye glasses and put them in your pocket. Loosen your collar.
6. Assume the brace position.
    - **Tighten your seat belt.**
    - **With shoulder straps:** tighten and sit upright, knees together, arms folded across your chest
    - **Without shoulder straps:** bend forward so your chest is on your lap, head on knees, arms folded under thighs

After an emergency on land

1. Wait for instructions to exit or until rotors stop turning if in a helicopter.
2. Assist others to evacuate well clear of the aircraft.
3. Remove the first aid kit and other emergency equipment after there is no threat of fire.
4. Administer first aid as required.
5. Remove ELT, read instructions and activate.
6. Set up camp to be as comfortable as possible.
7. Make the site as conspicuous as possible from the air.
8. Stay near the aircraft – don't wander away from the site.

After an emergency on water, follow instructions for underwater egress.

In water accidents, float planes tend to come to rest inverted. Helicopters may tip over after an emergency landing on water. The key to your survival is to retain your situational awareness and expeditiously exit the aircraft. It may be advisable to be trained in underwater egress if you frequently fly over water or on float planes. The following actions are recommended once the float plane momentum subsides.

1. Stay calm – Think about what you will do next. Wait for significant accident motion to stop.
2. Grab your life preserver/PFD – If time permits, put it on, but at least grab it. DO NOT INFLATE IT until after exiting. It is impossible to swim underwater with an inflated life preserver. You may get trapped.
3. Open the exit – If sitting next to an exit, find it and grab the exit handle in relation to your left or right knee as previously established. Open the exit. The exit may not open until the cabin is sufficiently flooded and the inside water pressure has equalized. DO NOT RELEASE YOUR SEAT BELT AND SHOULDER HARNESS until you are ready to exit. It is easy to become disoriented if you release your seat belt too early. You may float upwards making it more difficult to get to the exit.
4. Release your seat belt/harness – Once the exit is open and you know the exit path, keep hold on a fixed part of the float plane and release your seat belt with the other hand.

5. Exit – Proceed in the direction of the nearest exit. If this exit is blocked or jammed, immediately go to the nearest alternate exit. Always exit by placing one hand on a fixed part of the aircraft and not letting go before grabbing another fixed part (hand over hand). Pull yourself through the exit. Do not let go until you are out. Resist the urge to kick, as you may become entangled in loose wires or debris, or you might kick the person exiting right behind you. If you become stuck, back up to disengage; twist your body 90° and then exit.
6. Getting to the surface – Once you have exited a float plane, follow the bubbles to the surface. If you cannot do so, as a last resort inflate your life preserver. Exhale slowly as you rise.
7. Inflate your life preserver – Inflate it only when you are clear of the wreckage, since life preservers can easily get caught on wreckage, block an exit, or prevent another passenger from exiting.

16.15.2 Ground to Air Emergency Signals

Routine methods for signalling aircraft from the ground include the following:

- Brightly coloured helicopter cloth: Fluorescent orange or red nylon cloth squares at least 2x2 metres. They are highly visible and all field workers who routinely use aircraft should carry one. If you are being searched for, a pilot or searcher is more likely to detect movement even in his/her peripheral vision, so *run* and wave the cloth(s). Join several together as the larger the coloured area the easier it is to see. Stake them together to the ground during the day. Use them for shelter at night.
- Mirrors: Aimed correctly, the flash of the mirror can be seen for long distances. Any mirror will work, but a mirror is most accurate when it has small sighting hole to use to pinpoint the target. Don't flash a mirror at an aircraft that is very close or landing as it can momentarily blind the pilot. Brunton compass mirrors work well and even a piece of flattened tinfoil may work in an emergency.
- Smoke and Fire: In most daylight, smoke is more visible than fire, unless it is very windy. Keep green tree limbs, woody matter available to make lots of smoke when a search plane approaches. Build a fire for a signal on very dull days, at dusk or dawn or at night. The fire needs to be large to be visible, but don't allow it to start a brush or forest fire.
- Pyrotechnic signals: Good signals can produce enough smoke or light to be seen from a long distance. Smoke flares work only in daylight and are effective for aerial searches. Small flares that are fired from pen-like holders are not very effective. Those fired from pistols are brighter and reach a higher altitude. Use red flares to indicate distress and use white flares for illumination. Be very careful not to start a fire with them. See section 8. Survival.
- The following symbols may be used to communicate with aircraft during an emergency. It is good to know them even though they are not used frequently due to the increased use of satellite phones. Create as much colour contrast as possible between the symbol and the background. Symbols should be at least 2.5 metres long – larger is better – and spaced at least 3 metres apart. Symbols 1 to 5 are internationally accepted; symbols 6 to 9 are for use in Canada only.

Table 16.1 :Aircraft emergency assistance symbols

Nº.	MESSAGE	CORE SYMBOL
1.	REQUIRE ASSISTANCE	V
2.	REQUIRE MEDICAL ASSISTANCE	X
3.	NO or NEGATIVE	N
4.	YES or AFFIRMATIVE	Y
5.	PROCEEDING IN THE DIRECTION	
6.	ALL IS WELL	LL
7.	REQUIRE FOOD AND WATER	F
8.	REQUIRE FUEL AND OIL	L
9.	NEED REPAIRS	W

Source: TP 14371 – SAR-4.0 Aircraft Emergency Assistance, *Transport Canada in December 2007.*
http://www.tc.gc.ca/CivilAviation/publications/tp14371/SAR/4-0.htm#4-8-1

16.16 Resources

The Prospectors & Developers Association of Canada (PDAC) thanks the following for granting permission to include material from their publications.

Association for Mineral Exploration British Columbia (AME BC)

Transport Canada

Their permission does not imply that they endorse the PDAC Health and Safety Guidelines. The PDAC is solely responsible for the content of these Health and Safety Guidelines.

Books

Health and Safety Committee. (2006) *Safety Guidelines for Mineral Exploration in Western Canada.* Fourth edition. Association for Mineral Exploration British Columbia. The Guidelines are also available by following the links on the websites: http://www.amebc.ca/documents/resources-and-publications/publications/current/safety%20guidelines-web.pdf. Accessed February 12, 2010.

Internet Resources

Alberta Employment and Immigration. (2009).Work Safe Alberta. *Best Practice for Building and Working Safely on Ice Covers in Alberta.* Workplace Health and Safety Bulletin SH010

http://employment.alberta.ca/documents/WHS/WHS-PUB_sh010.pdf. Accessed February 12, 2010.

International Airborne Geophysics Safety Association. *Recommendation to Include Specific Safety Requirements in Geophysical Survey Contracts & Proposed Survey Contract Annex*. http://www.iagsa.ca/Contract_Annex990325.pdf. Accessed February 12, 2010.

Enform. *Guide to Safe Work: Fatigue Management. An Employer's Guide to Designing and Implementing a Fatigue Management Program.* https://www.cagc.ca/_files/practices/pdf/gtsw_final_2007.pdf. Accessed February 12, 2010.

Enform. *Guide to Safe Work Fatigue Management. A Worker's Guide to Preventing Incidents and Injuries Related to Fatigue.* https://www.cagc.ca/_files/practices/pdf/enform_fatigue_2006.pdf. Accessed February 12, 2010.

Transport Canada. Aviation Safety Posters. *Marshalling Signals, Helicopters*. TP 9528-1. http://www.tc.gc.ca/civilaviation/systemSafety/posters/menu.htm. Accessed February 12, 2010.

Transport Canada. Aviation Safety. *Fuel Drum Etiquette*. TP 2228E-13. Take Five… for Safety. http://www.tc.gc.ca/civilaviation/publications/tp2228/fueldrum.htm. Accessed February 12, 2010.

Transport Canada. Aviation Safety. *Part VII – Commercial Air Services*. http://www.tc.gc.ca/CivilAviation/Regserv/Affairs/cars/Part7/Standards/720.htm. Accessed February 12, 2010.

Transport Canada. Aviation Safety. *SAR - 3.0 Emergency Locator Transmitter.* TP 14371. http://www.tc.gc.ca/CivilAviation /publications/tp14371/SAR/3-0.htm. Accessed February 12, 2010.

Transport Canada. Aviation Safety. *Seaplanes: A Passenger's Guide.* TP 12365. http://www.tc.gc.ca/CivilAviation/systemSafety/brochures/tp12365.htm. Access February 12, 2010.

Transport Canada. Aviation Safety. *A Safety Guide for Aircraft Passengers.* TP 7087. http://www.tc.gc.ca/CivilAviation/SystemSafety/brochures/tp7087.htm. Accessed February 12, 2010.

Transport Canada. Aviation Safety. *Helicopter Passenger.* TP 4263. August 2004. http://www.tc.gc.ca/CivilAviation/systemSafety/brochures/tp4263.htm. Accessed February 12, 2010.

Transport Canada. *TDG Regulations. Part 12.* http://www.tc.gc.ca/eng/tdg/clear-part12-466.htm. Accessed February 12, 2010.

Transport Canada. *TDG Training*. http://www.tc.gc.ca/tdg/training/menu.htm. Accessed February 12, 2010.

Transport Canada. *The Marks of Safety.* TP11. http://www.tc.gc.ca/media/documents/tdg-eng/tp11504e.pdf. Accessed February 12, 2010.