

26 HELICOPTER LIFTING

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1. Introduction

Helicopter lifting can be a fast and efficient way to move materials and equipment to locations beyond the practical reach of perimeter cranes. For buildings or plants with large plan areas, helicopter lifting is often an efficient alternative to crane access through the roof, which can require major structural work and disrupt plant operations. Locations suited to helicopter lifting include auto plants with their typically large, sprawling plans.

The operation and control of helicopters requires highly trained and experienced personnel. Helicopter lifting demands careful planning. The work must be organized around the aircraft and the factors that govern its operation such as load limitations, surrounding terrain and structures, and weather conditions. The prime movers and key personnel during lifting operations are the pilots and the mechanics or marshallers who normally work for the helicopter rigging subcontractor.

This chapter provides information on hazard awareness and control. The information can be used to facilitate general introductory training for construction trades involved in helicopter lifts. To work safely on a particular lift, further job-specific planning and training will always be required.

Contractors who hire specialized companies for helicopter lifting have responsibilities before and during operations. This chapter outlines those responsibilities so that contractors can better understand the planning, procedures, and coordination required. This information will also help tradespeople work safely and effectively on helicopter lifting jobs.

2. General Information

Load Capacities

Capacity Range	Aircraft
up to 1,000 lb.	Bell 206 B
1,000 to 1,200 lb.	Bell 206 Long Ranger
2,000 lb.	AS 350 A-Star
4,000 lb.	Bell 204/205
8,000 to 9,500 lb.	Super Puma e.g. (AS 332)
	Gross weight 20,500 lb.
	Max. load 10,500 lb.
	Max. fuel load 2,500 lb.
	Sikorsky S 61
Up to 20,000 lb.	Sikorsky S 64 - Sky Crane

Basic Operating Conditions

About the aircraft and flight crew

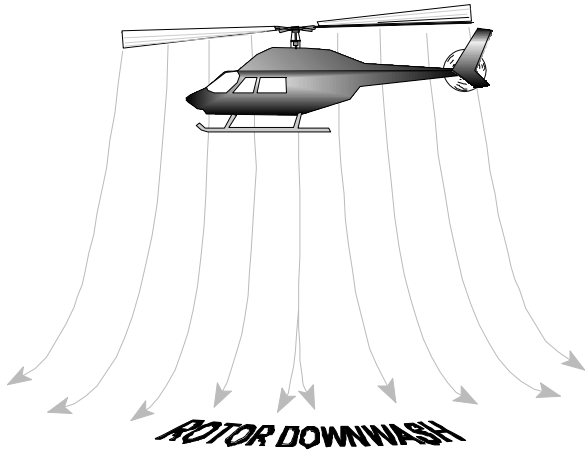
- A typical crew consists of 1 or 2 pilots (depending on aircraft) and 2 mechanics acting as loadmasters/signallers: 1 at staging area (ground) and 1 at drop area (roof).
- Aircraft load capacity varies depending on fuel load. The larger the fuel load on board, the less load the aircraft can carry. For example, a Super Puma with maximum fuel load has its load capacity reduced to about 8,000 lb.
- In addition, aircraft load capacity depends on temperature, relative humidity, altitude, wind strength, size of staging area, and available flight space (Transport Canada regulations prohibit lifting over people or buildings).

During load handling

- The ground activity must be under the control of the signaller and the pilot.
- The pilot needs direction from the ground signaller. The signaller has a clear view of the load and its position as well as a clear view of the personnel and situation on the ground.
- The pilot generally cannot see the hook location from the cockpit. It's difficult even with plexiglass side bubbles on the cockpit or with removable doors. The pilot must rely on the signaller for communication.
- Hover time with a load should be kept as short as possible. It's a difficult and potentially dangerous activity, requires high concentration by pilots, and is fatiguing.
- The air crew controls a remote electric hook release at the bottom end of the load line.
- In case of an emergency, the air crew also has a remote electric hook release and access to a manual release at the aircraft end of the load line for cutting everything loose.

Under the aircraft

- Downwash from aircraft rotors produces high winds and turns dust, dirt, and loose objects into airborne projectiles.
- Noise and high wind under a hovering helicopter contribute to tense working conditions that can be tiring for the ground crew.
- Constant concentration, safe practice, and vigilance are required.
- High wind conditions require extra protective clothing, especially in winter.



3. Helicopter Lifting Accidents

Statistics

- 90% of accidents occur during pickup or laydown
- 5% are caused by defective sling gear
- 5% have other miscellaneous causes.

Source: Department of National Defence
(DND does a lot of bulk lifting using nets as rigging.)

Accident locations

41% occur at pickup point
51% occur in flight
8% occur in drop zone

Accident causes

20% due to sling failure (material failure)
21% due to air crew error
49% due to improper load preparation
10% due to inadvertent load release

Note: DND summarizes that up to 70% of the accidents are due to human error

Hazardous Conditions

- Fatigue—air crew or ground crew
- rushing or taking chances
- overloading the helicopter
- short load line which can lead to 1) increasing the effective weight of some loads, 2) aircraft instability due to downwash, and 3) higher wind effects on the ground

- static build-up and discharge on contact with the load (This can occur when there is no non-conductive element in the load line or no static discharge procedure. The discharge can give a ground worker a high-voltage jolt. The result can be injury to those at risk—workers with heart problems, for instance—or loss of balance, slips, and falls.)
- untrained or inexperienced ground crew (Unprepared for high winds and noise, they can be injured by flying objects or distracted from their jobs and injured.)
- poorly equipped ground crew (for instance, with unsecured hard hats or inadequate eye protection)
- poor communications (confusion over signals, inaudible radio messages, etc.)
- ground crew too small or poorly organized
- no pre-flight briefing
- unsecured loads overhead
- fall hazards: unprotected roof openings, hatches off or open, roof edges
- long tether or tag lines that can blow into rotors
- weighted tag lines (such as shackles) that become dangerous when they blow around
- loose garments or PPE worn by ground crew
- injury from blown objects, unsecured structures, or obstacles on the ground
- impact or pinch-point injuries from loads swinging as they first clear the ground
- crush injuries during lowering and placement of load
- pinch points during load alignment (using “rat tails”, drift pins, etc.) or during initial clamping and bolting up.

4. Planning and Preparing for the Lift

The key element in a helicopter lift is planning. This requires the participation and cooperation of all workplace parties. Planning includes, but is not limited to, the following points.

Communications

Several planning meetings are required to arrange contracts and organize the work. Some training and a pre-job briefing are also essential.

Load weights and sizes

It's critical to know accurate as-built load weights and sizes since each helicopter, no matter how large or powerful, has a limited lifting capacity. Certifying load weights is recommended. This can be done during offloading by using a crane or boomtruck fitted with a load cell. Load weights can be stamped or otherwise marked on loads.

Load shape, orientation, and packaging

Load shapes can affect in-flight handling. Loads can be marked with their required orientation by using north or other marks to match mark to laydown locations. Remove loose sheeting, tarps, or other wrappings. Loose material can blow around, injure workers, and damage the aircraft if drawn into engine intakes.

Rigging plans

Rigging devices and assemblies must be selected or designed, and plans drawn up and approved, for each load or type of load. Nylon slings are lighter and less damaging to weaker loads than wire rope but are more susceptible to abrasion and cuts.

Lifting equipment

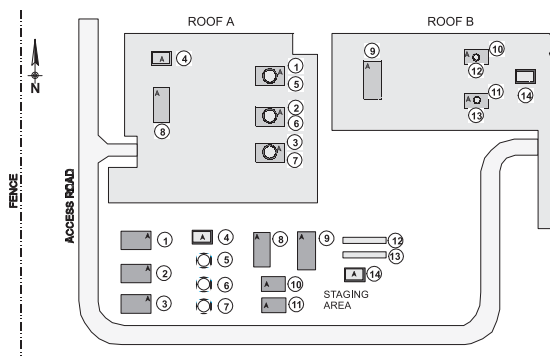
The lifting contractor must be selected and the helicopter type and capacity determined. Considerations include load line, hook-up device and configuration, cable and sling lengths and type, and a device or procedure to protect against static discharge. One possible procedure is to clamp one end of a jumper cable to the roof structure and discharge each load by touching the other end of the cable to it before it contacts the laydown location. Static buildup is greater with larger aircraft.

Flight plan

- Locate and plan the staging area.
- Designate a refuelling area.
- Provide for fire watch and spills.
- Prepare flight plans.
- Divide the job into lifting zones.
- Plan the load lifting sequence.
- Do alternate day planning.

Lifting plan

Prepare a lifting plan to cover load identification, lifting sequence, and load orientation marks or tags. Loads that don't require upending should be oriented in the same direction in the staging area that they will require in the laydown area. Plan the layout of the staging area to avoid flying over any light or unstable material that may blow around. Plan the lifting and flight path to avoid flying over workers and any material still being installed or not yet secure in the laydown area.



Simplified pickup/laydown sequence & orientation plan

Risk assessment

Identify, assess, and eliminate or provide protection against risks posed by

- powerlines
- cranes in the area
- structures, roof and structure profiles
- loose, unsecured material in staging or roof landing area
- temporary, unsecured structures in staging or landing area
- roof openings and roof access—cover both to prevent building pressurization and to eliminate fall hazards
- unprotected roof edges
- pinch, crush, and similar danger points in the load/lift/land sequence
- weather conditions
- public safety.

Rigging inspection

Inspect, record, and have certificates of testing for rigging components and assemblies.

Site safety

- Follow up on all points identified during the risk assessment.
- Provide fall prevention and protection.
- Do a complete site cleanup.
- Remove any loose, unsecured material.
- Secure temporary structures.
- Make sure that roof structures are secure as well as cladding, decking, etc.
- Where necessary, wet down the staging area to minimize dust.

Security and notification

- Notify workplace parties of where and when helicopter lifts will be conducted.
- Prohibit access to non-essential personnel.

- Notify public safety and local authorities, Ministry of Labour, and local air traffic control.
- Confirm insurance coverage (certificate of insurance on aircraft).
- Obtain Transport Canada approvals (under Canadian Aircraft Regulations the licence holder must apply for a waiver—special operations permit—to operate below 1,000 feet; site inspection and approval of flight plans are required).



Ground crew

- Determine crew size.
- Plan crew cycling or rotation.
- Assign individual assignments and responsibilities.
- Provide training in personal protective equipment, fall hazards and safeguards, pinch points, etc.

Hoisting communications

Arrange for radio, hand signals, emergency signals, and warning signals. Air horns can be useful when signallers/marshalls need to alert ground crew.

Emergency preparedness

- Arrange and communicate designated emergency telephone contacts.
- Prepare and communicate an emergency plan in case of accidents, including signals in case of emergency, exits, and escape routes for ground crews.
- Determine whether helicopter is equipped with warning siren and advise ground crew accordingly.

5. Construction Regulation: Helicopters

- 1) The pilot of a helicopter that is hoisting materials shall be competent to fly an externally-loaded helicopter.
- 2) The pilot shall be in charge of the hoisting operation and shall determine the size and weight of loads to be hoisted and the method by which they are attached to the helicopter.
- 3) Ground personnel including signallers for a helicopter being used to hoist materials shall be competent workers.
- 4) The constructor shall take precautions against hazards caused by helicopter rotor downwash.

6. Responsibilities of Workplace Parties

Owner/constructor

- Clearly identify and define needs, tasks, and schedule.
- Work with the lifting subcontractor to locate and size an appropriate staging area, develop lift and flight plans, and make lift and laydown arrangements.
- Cooperate with other workplace parties to make safety a priority in planning and carrying out helicopter lifts.
- Comply with other requirements such as security along flight path and limiting access of non-essential personnel.

Trade contractor

- Work with the lifting subcontractor and owner/general to plan and schedule moves.
- Make sure that accurate information about load weight, size, and shape has been provided and approved.
- Make sure that rigging equipment is selected and approved and plans are prepared and approved.
- Coordinate risk assessment activities, including site visits at staging area, along flight path, and at laydown area.
- Make sure that necessary local, provincial, and federal authorities have been notified.
- Designate crew members for all tasks.
- Make sure that ground crew is trained and receives pre-job briefing.
- Take direction from the lifting subcontractor. Don't pressure pilots to push limits or take chances.
- Provide required personal protective and other equipment for ground crew.

Lifting Subcontractor (helicopter company)**General**

- Provide proper equipment, competent pilot(s), and crew for the job.
- Conduct site visits and risk assessment in advance of the job.
- Select/approve staging area, flight plan, refuelling area, and emergency landing location.
- Identify load and lift information required.
- Specify ground crew identification needed from contractor such as coloured hard hats, vests, or coveralls.
- Provide ground crew training and pre-lift briefing.
- Support actions and judgments of air crew.
- Explain weather limitations and plan for alternate days.

Pilot

- Confirm any changes in load specifications.
- Conduct and review risk assessment.
- Make sure all parties are well briefed.
- Be well-rested before job.
- Don't put yourself or others at unnecessary risk.
- Inspect all equipment before job—rigging, hooks (electric and manual release).
- Confirm communication methods, signals, and equipment.
- Confirm load sequence and orientation markings.
- Prepare and communicate emergency plans.

Ground crew—loadmasters, signallers

- Know and check out communication equipment and signalling methods.
- Know the procedures for emergency preparedness.
- Know the loads and all lift requirements.
- Brief the ground crew at your location and make sure they know their tasks.

Ground crew—contractor employees

- Be sure there is a briefing on load rigging, load sequence, and flight plan (direction of approach).
- Know and follow load-handling procedures.
- Know the load orientation requirements and markings.
- Know the procedures for emergency preparedness.
- Wear appropriate protective clothing and safety equipment.

7. Contractor Ground Crew Procedures**1) Personal Protective Equipment (PPE) and Clothing**

PPE must be appropriate to very high wind and noise conditions:

- hard hats with secure chin straps
- goggles—not glasses—that fully cover the eyes and can be strapped on
- protective work gloves
- hearing protection.

Fall protection includes

- permanent or temporary guardrails
- when required, fall-arrest system consisting of full body harness, lanyard, shock absorber, rope grab, lifeline, and lifeline anchor
- appropriate anchor or tie-off locations.

Clothing is important for protection and identification.

- Clothing should be appropriate to weather—in cold conditions, for instance, balaclava and snowsuit.
- The signaller should wear apparel distinctive in colour—vest, coveralls, hard hat—which can be identified from the aircraft.
- Other ground crew involved in the lifts should be distinctively dressed but be readily distinguishable from the signallers.

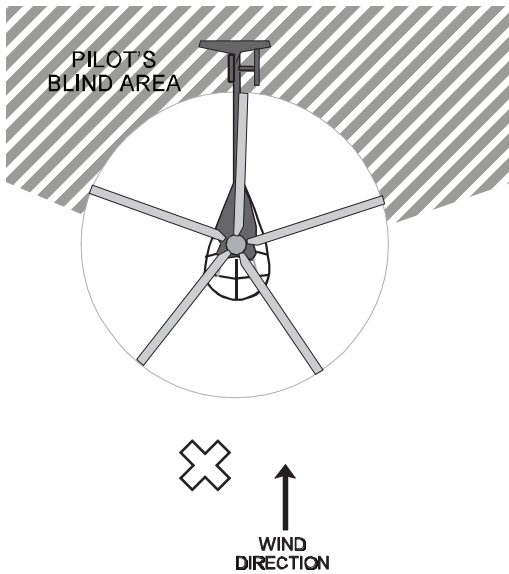
2) Signalling

- Signalling is the job of lifting contractor personnel because of their experience in working with the aircraft and its crew.
- Helicopter signals are different from the international hand signals used in hoisting operations with cranes.
- Emergency signals must be confirmed in the pre-flight briefing.

3) Hooking up

The procedures to be used for hooking up must be confirmed during the pre-flight briefing.

- There must be no loose wrapping, packing, or objects on the load.
- The hook-up person stands with back to the wind while the aircraft approaches into the wind.
- The hook-up person stays with the load.
- The aircraft will approach and hover over the hook-up person.
- If the downwash is too strong, or the load is large and flat, or catches the wind, it can be blown around dangerously and the aircraft will be harder to control. The load line may have to be lengthened. Load lines will have to be longer for larger aircraft.



- Keep the angle of load rigging greater than 45° to the horizontal.
- Place the pear ring onto the hook and have the signaller contact the pilot to start lifting.

When attaching tag lines to loads, keep the following points in mind.

- Keep tag lines shorter than the load line so they can't blow into the rotors.
- Use synthetic fibre rope.
- Make sure tag lines don't get tangled with load lines.
- Weighting tag lines at one end, with shackles for instance, can be a hazard to the ground crew if the lines are blown about.



Before the load clears the ground:

- Stay with the load and guide the cables to ensure they don't get snagged as the helicopter climbs to take up slack.
- **Don't turn your back on the load.**
- Double-check to make sure that the load's centre of gravity is below the rigging attachment points.
- Look again at the load shape for trapping downwash or chances of "flying" when travelling.
- A large, light load may have to be weighted so as not to "fly".

Lift-off

- When satisfied that load, rigging, or tag lines won't get snagged, the hook-up person will have the marshaller contact the pilot to HOLD position while the hook-up person walks out from beneath the helicopter to the marshaller.
- Once the hook-up person joins the marshaller, the signaller can give the signal for the helicopter to

continue lifting until the load is clear.

- The helicopter is now free to deliver the load.

4) Receiving the load

- Stay with the signaller until given the go-ahead to approach the load.
- Approach the load when it's at eye level and face the load at all times.
- Control the load by using tag lines.

Don't pull down on tag lines when you grab them. This effectively adds weight to the load. For an aircraft near maximum load, especially a lighter aircraft, the extra load can make control difficult.

- Keep your arms outstretched while guiding the load into position. Don't get under the load. At all times, for safety, behave as if the load is going to fall.
- Large and heavy loads are harder to control from the ground.
- Remember that precise control of loads is not possible from a hovering aircraft.
- Before the load is lifted, check for, and make sure you understand, any markings, lugs, tabs, or rat tail holes to be used for orientation.

Various methods can be used to orient and place loads in their final position. The methods depend on load type, shape, size, and can include:

Rat tails

Rat tails are typically made from 1/4" or 3/8" wire rope 3 to 6 feet long with a button or nut attached at the top end to keep them from sliding through the flange holes. Rat tails can be used for the final alignment of mating flanges. Once the flanged load is over and close to its final location, rat tails can be slotted through the marked holes in the mating flange and pulled tight as the load is lowered into position.

Drift pins

Drift pins can be used to locate and match load flange holes to base flange holes. Drift pins, or spud wrenches, can also be used to lever parts into place.

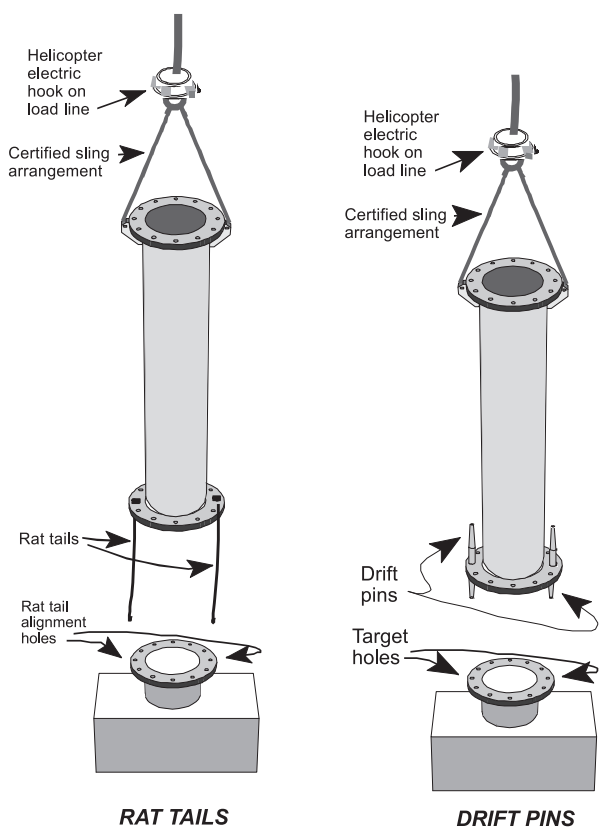
Tabs and lugs

Locating tabs or lugs can be fastened to the bottom of the load to fit over and align it with the mating base or support. Tabs or lugs installed in pairs to frame a corner of the load can be mated with the matching corner of the base. This corner can then be used as a locating and pivot point to assist the pilot or ground crew in aligning the rest of the load.

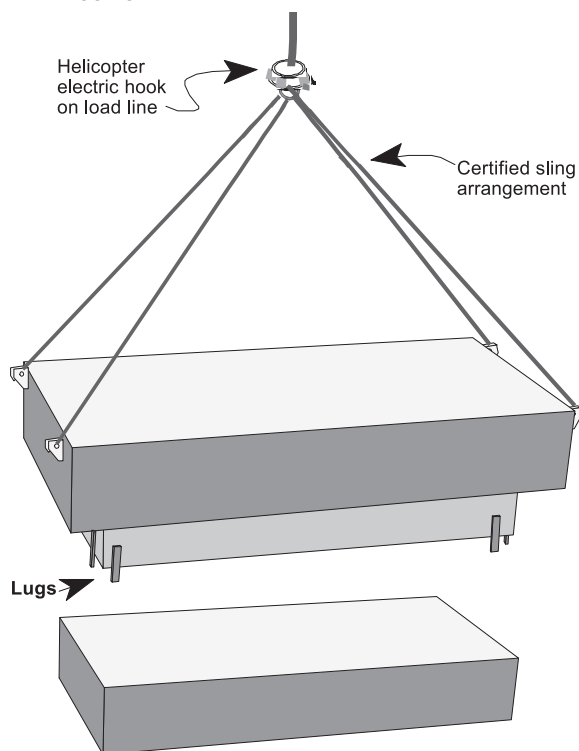
Collars

Collars on loads can sometimes be used to align and mate slung loads with their bases.

- Locate load orientation marks, rat tail locations, or lugs or tabs used for load orientation before final placement.



- If rat tails are being used, insert them through the correct holes and pull them through.
- Make the final alignment according to the agreed procedure—spud wrenches, clamps, etc.
- Keep hands and feet away from areas where they may be pinched, wedged, or crushed by the load or the rigging.



- Wear a fall-arrest system where required. Always look for possible trip hazards with lifelines.
- Plan escape routes in case of an emergency.
- When the load is in place and secured, only the signaller can give the pilot the go-ahead to release the load.
- Disengage the load hooks and make sure they don't snag.
- Only the signaller can signal the pilot to leave and pick up the next load.

8. Staging Area Requirements

The staging area must be

- level and firm
- large enough to spread out loads for organized sequential pickup and to avoid blowing adjacent material around—a problem with short load lines and an increasing problem as helicopter type gets bigger
- large enough for aircraft to climb out safely (a helicopter near its capacity can only climb at a gradual rate and needs clear space to do this safely)
- located to avoid lifting loads over occupied areas or buildings
- free of debris, demolition waste, stored materials, light equipment
- free of obstacles—powerlines, vehicles, stacks, towers, cranes, etc.
- clear of excessive dust (if necessary, water down the area to suppress dust)
- free of spectators and unnecessary personnel
- posted with warning signs and cordoned off with barricades (signs and barricades should be secured against downwash).

9. Placement Area Requirements

The placement area must have

- no loose debris or unsecured materials, equipment, signs, or barricades
- unsecured roof covers securely tied down
- a crew the appropriate size for the job
- crew members aware of assigned responsibilities, protected by guardrails or fall-arrest systems where necessary, and familiar with placement area hazards—usually fall hazards on a roof.

10. Pre-flight Briefing and Inspection

A pre-flight briefing should be held immediately prior to the lift commencing. By this time the ground crew and the lifting contractor should have had training and received final information for the lift as well as confirmation that all inspections have been carried out.

PROCEDURES CHECKLIST

- weather and wind check, corresponding actions required
- flight pattern to follow—approach and departure directions, etc.
- briefing by air crew on operational and emergency procedures and signals for ground crew
- review of rigging, loading, and unloading procedures for ground crew
- review and test of communication system(s)—radio, warning air horns, etc.
- confirmation of loading sequence and load orientations
- markings and methods to convey correct load orientation from staging to placement areas
- review of emergency disconnect procedure for hook(s)
- confirmation that fall prevention and protection measures are in place

INSPECTION CHECKLIST

- personal fall protection equipment
- loads as specified
- loads within aircraft’s safe lifting capacity
- loads inspected by lifting contractor and pilot
- pilot/marshaller’s confirmation that slings, lanyards, swivels, cables, tethers, and other rigging arrangements are correct
- pilot/marshaller’s confirmation of methods and markings used to indicate load orientation
- loose debris, plastic bags, wrapping, and other packaging removed or secured in staging and placement areas
- loose material and temporary structures secured in staging and placement areas
- pilot’s confirmation that cargo hook(s) are appropriate and in good working order
- confirmation that large light loads, loads with rotating components, or loads with wind-trapping features will be kept from rotating in downwash (light loads may need to be weighed down for stability in flight)

11. Hazardous Loads

Some loads or load conditions are dangerous and need to be treated with extreme care. All workplace parties—owner, constructor, contractor, ground crew, lifting contractor—must be warned accordingly.

Loads with a moving centre of gravity

One example is a tank filled, or partially filled, with liquid. Liquid moving around or surging in the tank as it’s lifted and carried in flight will change the load’s centre of gravity. The pilot must always be informed of such a load. If it can be carried at all, a single-point suspension should be used. Even a relatively small amount of liquid can have an effect on load stability.

Loose materials in containers

Downwash and turbulence can cause spillage and danger on the ground. Make sure sheet coverings such as shrinkwraps or tarpaulins are securely lashed down or—better—removed altogether.

Large loads

Very large loads carried flat or loads that trap downwash can increase their effective weight and create problems. They are also prone to oscillation and aerodynamic effects.

Environmental effects

- Under cold conditions, loads can freeze to the ground and require unpredictable force to break them free.

- Snow can enter or ice can form in a container or hollow fabricated piece, adding unexpected weight or changing the centre of gravity.
- When lifting loads from water, remember that the submerged weight is less than the free weight.
- Objects in water or a flooded area for any time can acquire unexpected weight from silt or mud.

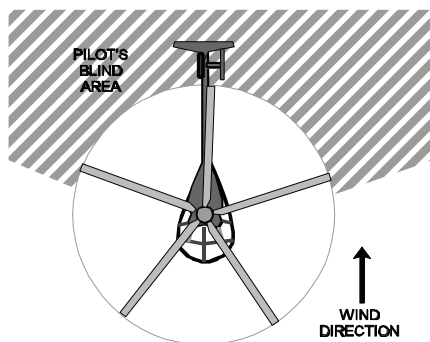
Containers of flammable or harmful liquids

Take care with containers holding fuel, solvent, or other flammable liquids. Static discharge can cause fire or explosion. Discharge static buildup by using a weighted chain or other conductor reaching to ground. Fuel containers must be vented. For harmful or toxic liquids check the *Transportation of Dangerous Goods Act*. All workplace parties must be advised when such loads are to be handled.

12. General Precautions around Helicopters

Approaching

- Rotors can kill.
- Pilot's blind area is anywhere around the rear of the aircraft.
- Stay in view of pilot and keep your back to the wind.

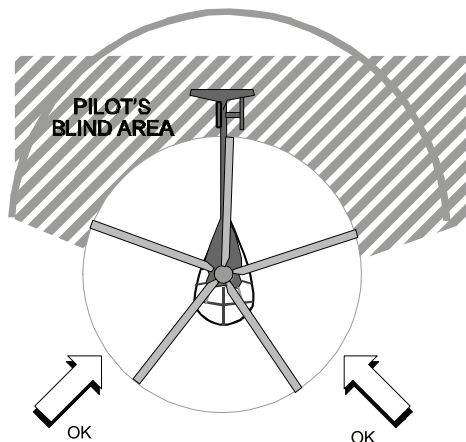


Boarding

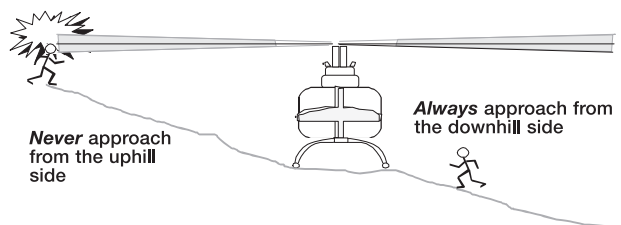
- Note if engine will be running.
- Note location of door(s).
- Approach aircraft from the side—never from the rear.
- Crouch low under main rotor.
- Don't carry objects extending above body height.
- Remove loose headgear.



NO APPROACH FROM ANYWHERE TOWARD THE REAR

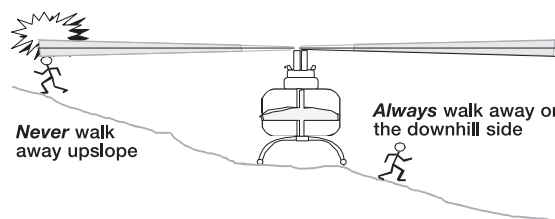


- Never approach downslope—the main rotor can kill you.



Leaving

- Exit straight out the door. Don't change direction until well clear of the helicopter.
- Stay away from rear of aircraft.
- Crouch low under main rotors.
- Don't carry objects extending above body height.
- Never walk away upslope—the main rotor can kill you.



13. Exercises

1. Which two workers must control load-handling activities during helicopter lifting?

2. When a loaded helicopter is hovering over a pickup or laydown location, the pilot needs direction from the ground signaller because

- the signaller has a clear view of the load and its position
- the signaller has a clear view of personnel and the ground situation, and
- the pilot generally cannot see the _____ and the _____ location.

3. What special features are required for head protection and eye protection during helicopter lifting?

hard hat with _____

eye protection consisting of _____

4. Why are these features required?

5. What is the one safe practice activity which must be carried out at both the staging and laydown areas before any helicopter lift and to which all site personnel can contribute?

6. In helicopter lifting, why do long tag lines present a hazard?

7. During a helicopter lift, static electricity can build up and discharge through the load line to a rigger on the ground. What two precautions can be taken against this hazard?

8. Identify two purposes served by rat tails in helicopter lifting.

9. Identify at least four points to know about a load to be lifted by helicopter.

10. What documentation must be available for all rigging equipment?

11. Which workplace party generally has primary responsibility for providing accurate load weights and rigging plans?

12. As the helicopter approaches to pick up the load, how should ground crew stand in relation to the wind?

13. When working with a load suspended from a helicopter, never turn your _____ to the load.

14. When a load is being picked up from the staging area, where should the hookup person stand after hooking up the load and before the signal is given for the load to clear the ground?

15. Cross out the item of PPE which is NOT adequate for use by ground personnel during a helicopter lift?

- protective work gloves
- safety glasses
- green-patch workboots
- hard hat with chin strap

For answers, see next page.

Answers

1. pilot; signaller/marshaller
2. load hook; pickup or laydown location
3. chin straps; goggles
4. high winds generated by rotor downwash
5. site hazard assessment
6. tag lines may drift or blow into rotors
7. install a non-conductive element in load line; follow a static discharge procedure to prevent shocks to ground crew touching load or load line
8. orienting load in relation to base; aligning load on base
9. accurate weight; size; location of centre of gravity; pickup points; shape
10. certificate of test
11. trade contractor
12. with backs to the wind
13. back
14. out from under the helicopter
15. safety glasses