

## Externally loaded helicopters in construction work

**T**here has been a continuing increase in helicopter use in all phases of the construction industry. This increase has created a need for information directed to contractors who are using or are anticipating using helicopters, especially external load applications within their organizations. This data sheet provides information on the safe use of these machines in construction situations.

**2.** The material contained in this data sheet is based on discussions and written information derived from many sources. The material is not all-inclusive, and does not supersede or cancel any regulations of the Federal Aviation Administration or of any state, provincial or local agencies.

**3.** This data sheet was developed primarily for external (sling load) applications, and it may not be specifically applicable to electrical utility construction (Figure 1).

### Helicopter registration

**4.** All non-military commercial helicopters used in the United States for external load operations must be duly registered and licensed by the FAA under Federal Aviation Regulations. Pilots of such helicopters, in addition to holding a current commercial or airline-type rating, shall hold a current-type rating for that specific helicopter. Foreign operations must be conducted in accordance with the regulations appropriate to the area.

### Operational planning

**5.** In the United States, a plan of operations must be submitted to, and approved by, the appropriate FAA district office. Any other local, state, provincial or federal agency having jurisdiction must be informed

and approvals obtained, if necessary. (The owner(s) of the property may choose not to participate in gaining approvals.)

**6.** Prior to using a helicopter for any job, an on-site survey and inspection of the operational area should be made by the personnel who will conduct the operation. The person for whom the operation will be performed should participate in the inspection and be duly informed concerning the needs of the operation, including the need for site cleanliness.

**7.** When helicopters are used during construction to perform heavy and complex lifts, there is a possibility of increased hazards. Careful planning is critical and coordination of participating elements is necessary for a safe lift.

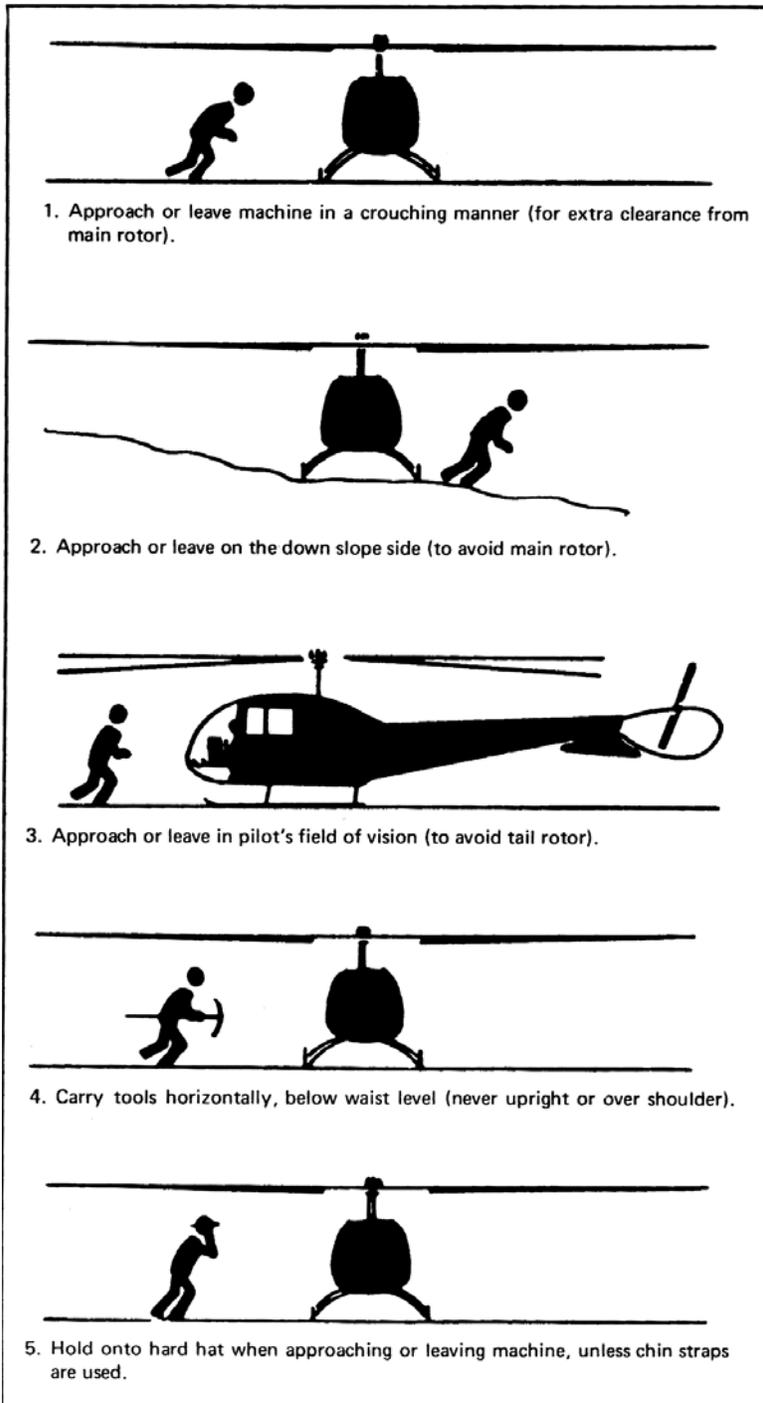


**Figure 1** shows one of the more spectacular uses of helicopters in high-rise building construction. (Courtesy Midwest Helicopter Airways Inc.)



8. The area of intended operation should be investigated by the helicopter operator, the pilot and others in the work crew for:
- Layout of the landing and loading area and the access routing. The area should be flat and level to pre-

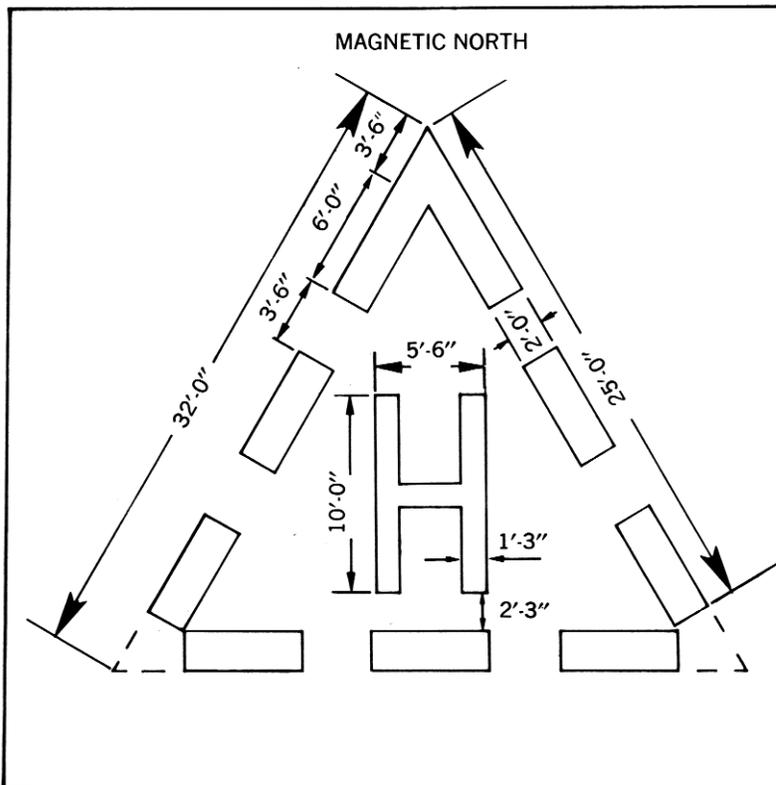
vent any possibility of ground personnel coming into contact with rotors. If the area is not flat, procedures must be developed to permit safe operations under such unusual conditions (Figure 2).



**Figure 2** provides some general rules covering the more common situations that occur when working with a helicopter.



- b. Area(s) to be used in event of an unprogrammed emergency, including escape route(s) for ground crew personnel in case of emergency.
  - c. Location of power lines where they could present a hazard to the operation. Bridges and other obstructions also must be considered.
  - d. Height and proximity of adjacent structures, allowing for clearance of 100 feet or several times the rotor diameter.
  - e. Prevailing winds in the area and possible turbulent airflow that can be generated by interference, such as trees.
  - f. Height above sea level at which operations will take place, the humidity and temperature ranges and the pattern of fog, frost or dust.
  - g. Areas that will allow for clear approaches to the loading and unloading areas.
  - h. Debris, such as dust, loose materials, gravel and stones, that can be thrown by the rotor downwash. Clear vision is need.
  - i. Areas that are large enough to allow loads to be separated upon lifting or letting down.
9. Factors to be taken into consideration when making plans for the operation:
- a. All loads must be within the weight and size limitations of the aircraft for the altitude and temperature conditions that will be encountered, as prescribed in the approved FAA rotorcraft flight manual for the aircraft type. Because helicopters are limited, the precise weight and size must be known before lifting.
  - b. All loads must be structurally sound and contain attachment points for



Elevated Platform 40 ft. by 40 ft. minimum  
 Ground Level 75 ft. by 40 ft. minimum

**Figure 3.** The required FAA heliport day markings for helicopters up to 6,000 pounds must point to the magnetic north. (Reflectorized paint may be used.) Ground level heliports have a larger minimum area than elevated heliports (which include rooftop ones) and must have a 3-foot fence around them as a minimum.



slinging and rigging. (Figure 3)

- c. The pilot must have continuous communication with weather data. Some remote areas may present hazards from sudden weather changes.
  - d. What refueling method will be used and where refueling will be done.
  - e. Means of electrically grounding the helicopter during loading and refueling operations must be decided.
- 10.** If external load operations are to be continued during a period of time longer than several days, it may be desirable to establish a heliport. (Figure 3)
- 11.** Conditions requiring concentrated, sensitive control of the helicopter for periods in excess of one hour may dictate the use of two pilots in the craft to change off and provide rest breaks so excessive fatigue is avoided. Single pilot operations should be limited.
- 12.** If more than one helicopter is in use, a definite flight pattern should be established. Flight should be avoided, if at all possible, over areas where ground personnel are at work.
- 13.** If helicopter operations are to be conducted over water or close to where employees are exposed to water dangers, special consideration must be given to any FAR governing over-water flights and to U.S. Department of Labor's Occupational Safety and Health Regulations, Section 1926.106.
- 14.** Helicopters should never be used in construction operations at night. One hour before sunrise and one hour after sunset are accepted limits.

### **The load**

- 15.** For all external loads, the following should be considered:
- a. Helicopter load-limit rating that has been adjusted for temperatures and altitude should not be exceeded. Humidity, fuel load and crew are other

important factors.

- b. Load should not have high airfoil qualities. In flight such loads tend to fly, causing erratic behavior.
  - c. All loose material such as nuts, bolts or nails must be handled in closed containers designed to ensure against spillage in flight.
  - d. Cargo nets used for handling loads must be designed and tested to ensure a proper safety factor. They should be of four-point suspension design and should be attached to the helicopter hoist cargo hook assembly by only a single attachment. More than one attachment increases the hazard of fouling the load at the point of the hook.
- 16.** All loads should be kept as compact as possible. When numerous small items are to be transported, an appropriate container should be used.
- 17.** Never use any loose material, such as canvas or plastic sheets, around the helicopter. These may be blown about, if left loose, and drawn into the rotor blades or ingested into engine's air intakes. Fasten all coverings securely both on loads and other items in the area.
- 18.** Before loading the material, an inspection should be made by the pilot as to the sizes, shapes and weights of the loads to be handled. The increase in weight due to start-up inertia must be considered.
- 19.** The sling attaching points should be carefully determined, considering the center of gravity of the load and in-flight load stability. The breaking strength of the sling must provide for minimum load safety factors of 4-to-1.
- 20.** External load slings should be kept to a length that will not allow the load to oscillate or swing. Lengths of 15-20 feet below the helicopter have been found to be most practical for most typical applications. However,

the length of sling must be determined for each load and site of operation. Whenever long loads are handled the external load slings should be long enough so, in case of sling leg failure or sling slippage, the load will not be capable of striking the helicopter.

### **Magnetic north**

**21.** Load slings should not be allowed to hang free on the hook when flying without a load. Load slings should be connected with lifting rings and shackles. Pressed sleeves, swedged eyes or equivalent means should be used on splices for all freely suspended loads to prevent hand splices from spinning open or wire rope clamps from loosening.

**22.** Only wire ropes should be used for slings and load lines. Natural fiber rope should never be used.

**23.** Care should be taken so the rigging is not on top of the landing gear. This would result in insufficient control in keeping the helicopter level during pick-up of the sling load.

**24.** The use of hoists should be avoided, if possible. When hoists are used, effective stops or fail-safe devices should be used in the event of a power source failure to prevent the rope from running out of the drum.

**25.** All slings should have non-spin hooks. However, if using a simple sling, it may be desirable to allow it to spin by using a swivel attachment (dependent on flight characteristics of the load). Swivels, if used, should be checked periodically. Should a swivel bind and the rope wrap up, damage to the aircraft may result if the swivel suddenly becomes free again.

**26.** The hook assembly on the helicopter, however, should be fixed and have safety latches. Doubling of slings will assist in controlling spinning of compact loads, such as pallets or reels.

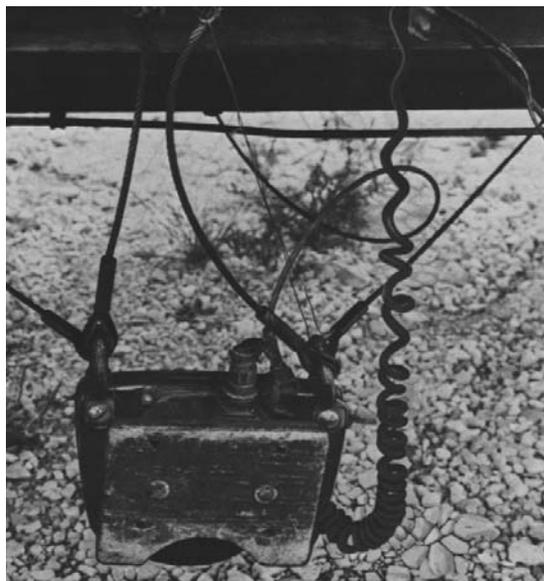
**27.** The use of positive action, combined

electrical and mechanical release mechanism is recommended (Figure 4). The hook assembly should have a positive visual indicator to show when it is completely locked in, and should be so designed and installed so as to prevent inadvertent operation.

**28.** Cargo hooks should be equipped with an emergency mechanical control for releasing the load. The hook should be tested prior to each day's operation.

**29.** As they may become fouled in some operations, tag lines should be used only with the knowledge and consent of the pilot. For most normal loads, tag lines should be between 5 and 10 feet in length - longer lines may foul the rotor. The length of the tag line will be dictated by the job requirements, the size of the load and the aircraft assembly.

**30.** Ground crews should be instructed not to wear loose, ill-fitting clothing, which is likely to be caught on hoist lines



**Figure 4** shows an electrical "hook" used in some external load operations. This type of hook has the advantage that, in case of emergency, the pilot can jettison the load with controls located in the cockpit. (Courtesy Midwest Helicopter Airways Inc.)



or slings. Personnel must not ride on the load or the sling, nor on any other attachment, at any time during operation. Only personnel essential to the job may ride in the aircraft.

### **Personal safety**

**31.** Helicopters have many exposed, dangerous moving parts. Among them are the tail rotor, tail rotor drive, many engine parts and hot radiators. Turbine-powered aircraft have hot exhausts and high velocity air intakes. Because of these hazards, only trained personnel familiar with helicopter operations should be allowed to approach a helicopter while it is on the ground. Whether or not the engine is running, the number of persons permitted should be limited to the absolute minimum number required.

**32.** The following protective equipment is recommended for all employees assigned to work in close proximity to helicopter operations:

- Safety hats with chin straps must be provided and used.
- Safety goggles (not glasses) of a closed type with baffled vents must be worn. Goggles provide adequate protection against particle damage and convection drying of the eyes.
- If physically, chemically, or microbially active dust will be present, self-contained breathing apparatus or respirators should be provided for ground personnel. These will provide respiratory protection and some skin protection.
- Hearing protection for all ground personnel should be provided because helicopters, especially large ones, produce high sound levels that can cause both temporary and permanent hearing loss. Turbine-powered helicopters also produce high frequency sounds.
- Gloves should be worn by ground per-

sonnel at all times.

- During cold-weather operation, proper clothing must be worn to combat the increased chill factor caused by rotor downwash.

**33.** Employees exposed to possible falling from precarious positions, such as those who must attach or detach loads in steel erection, must use proper personal protective equipment and lifelines.

**34.** All employees engaged in loading or unloading operations must be carefully briefed regarding their duties, and informed of the location of a predetermined safety zone. Employees and crew members should be thoroughly briefed on the overhead danger of the rotor blades before any rotorcraft is to be landed for hookup or removal of loads. It is vitally important to warn all personnel about the dangers of walking into the tail rotor. Tail rotors are virtually invisible when operating.

**35.** Whenever personnel are approaching or leaving a helicopter, they should remain in full view of the pilot and keep in a crouched position (Figure 2). Personnel should avoid the area from the cockpit or cabin rearward, unless authorized to work there.

### **Landing site operations**

**36.** An emergency landing area and a ground personnel safety zone should be designated before the operation. All personnel should be briefed of the action they would take in event of a helicopter power failure. They should be instructed to listen to the engine because power failure can be recognized instantly.

**37.** Loading, landing and unloading area(s), including the area within 100 feet and the flight pattern for helicopter operations, must be kept clear of loose material to prevent danger to exposed ground personnel and the helicopter itself.

**38.** Communications and signal systems

should be agreed upon between the pilot and signalman and clearly understood before the beginning of the operation. When visual signals are to be used, the signalman should be readily distinguishable from other employees by special high-visibility clothing. Only one person should serve as signalman at any one time (Figure 5). Hand signals should be as shown in Figure 6.

**39.** Special precautions should be observed if visibility becomes obscured by dust or other conditions. (The area should be wet down to prevent dust, if possible.) Operation with snow cover presents a serious operational problem. All areas of landing and take-off must be completely cleared.

**40.** The helicopter will build up a powerful static charge while in flight, and the charge should be dissipated through an electrical grounding device before the suspended load is touched by the ground crew. (If the load is landed by the helicopter, this may not be necessary, depending on either the nature of the landing pad or whether grounding strips are built into the landing pad.)

**41.** When necessary to hook up loads to a hovering craft, a safe, clear means of access should be provided to reach suspended hooks or slings.

**42.** Hoist wire or slings should not be attached to any fixed object or structure, nor be allowed to foul any fixed structure.

**43.** No operation should be attempted that will require any part of the load, tag lines or load lines to be within 15 feet of power lines. Rotor downwash will cause additional stress on these lines, and could cause breakage and possible contact with electrical lines. Operation next to any energized power source is highly undesirable and should be avoided unless absolutely necessary. All adjacent power lines should be marked with high visibility markings by FAA-



**Figure 5** shows a signalman at a worksite who is directing the operation of a helicopter carrying a portable field storage tank on skids.

*(Courtesy Bell Helicopter Co.)*

approved methods. (Rotor diameter also must be considered.)

**44.** Open fires should not be permitted in an area where rotor downwash could spread such fires.

### **Concrete buckets**

**45.** A simple, positive mechanical method of braking the bucket should be designed. It is essential to prevent workers from becoming entangled with the brake and gate mechanism while the bucket is being lowered from the helicopter.

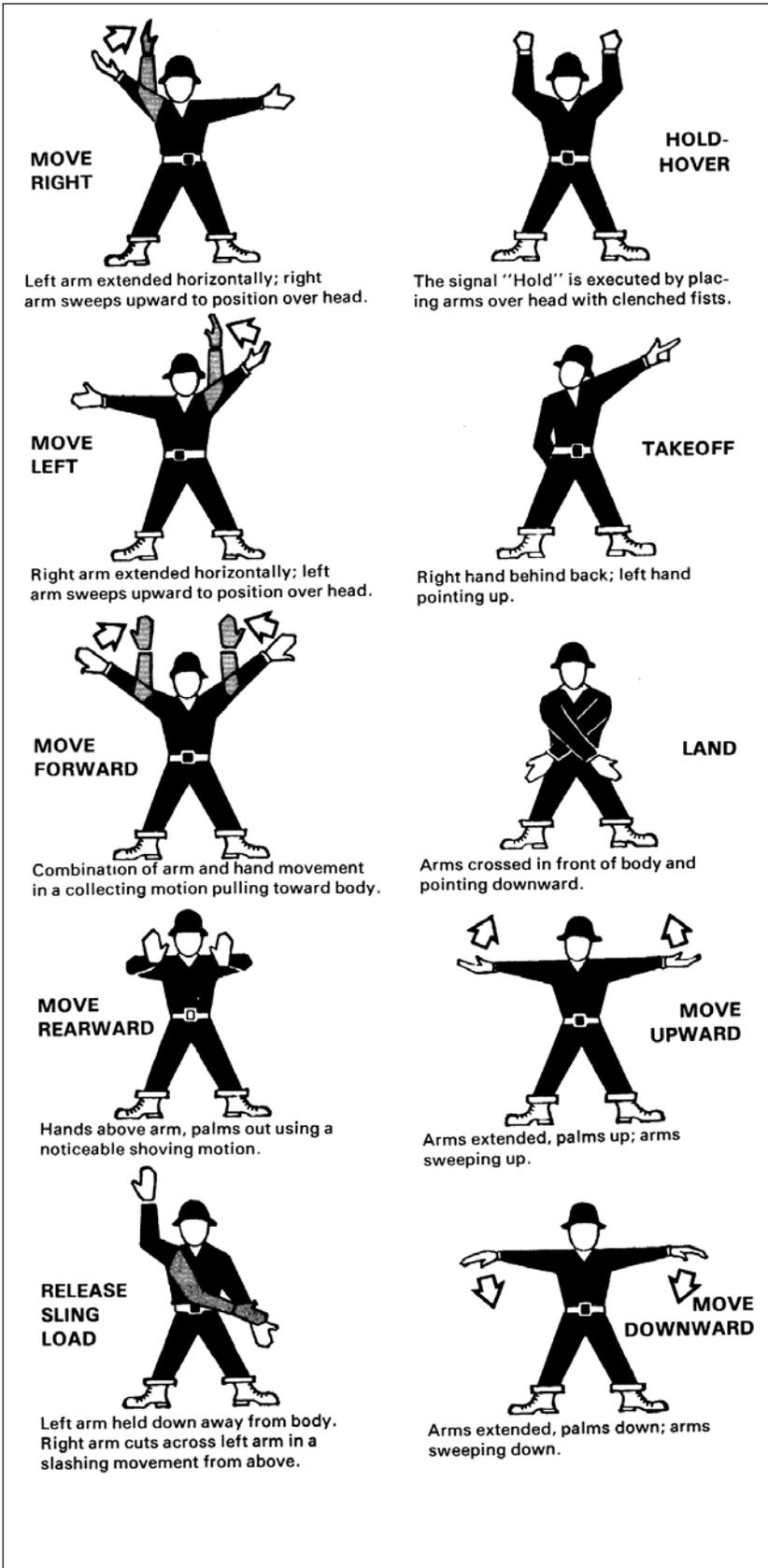
**46.** The gate and closing mechanism must be automatic. A bucket that remains open during flight, after being emptied, presents a definite hazard to all ground personnel from hardened material falling from the bucket.

**47.** It is generally good practice to use two concrete buckets alternately. This allows ground personnel to wash, clean and fill one while the other is in use.

### **Transportation of explosives**

**48.** High explosives are not acceptable for air shipment under the provisions of

Figure 6





the Department of Transportation or the FAR. However, they may be transported externally by helicopter, provided the operator has obtained the necessary FAA regulation waiver authority from the proper FAA field office. The provisions for obtaining a waiver are contained in Section 103.5 of the FAR2.

**49.** The same conditions and limitations apply for internal carriage, the procedures for permitting the air shipment of high explosives being listed in Section 103.5 of the FAR3.

**50.** For intrastate and interstate commerce, the application for authority to deviate from the regulation is FAA Form 400. The documentation is contained in Section 103.5 of the FAR3 and the shipping label requirements are contained in Title 49, Code of Federal Regulations, Section 173.404. (These forms, as well as any instructions or requirements, may be obtained from any FAA field office.)

### **Helicopter maintenance**

**51.** Reliable maintenance is the key to safe operation of all aircraft, and particularly so with helicopters that fall rather than glide if the power should fail.

**52.** Maintenance on all helicopters and the attachment of any certified special duty equipment shall be performed only by qualified and certified personnel, in accordance with FAR Part 133.

**53.** Adequate facilities and time must be scheduled into an operation so a high standard of maintenance by qualified personnel is allowed.

### **Helicopter refueling**

**54.** Helicopter operations should be planned so that fueling at the jobsite is avoided. When fueling must be done at the jobsite, procedures should be as follows:

a. Helicopters should be thoroughly grou-

nded and the engine shut off before refueling is attempted.

b. Ground the fueling vehicle to a suitable ground.

c. When fueling from a truck, the truck should be bonded to the helicopter by a separate wire before the fuel tank filler cap is opened (Figures 7 and 8). This may be accomplished by a separate bonding wire long enough to allow the nozzle to reach all fuel tanks while the wire is attached to the nozzle and the helicopter.

d. The fuel hose should be of a static-dissipating type, and be bonded to the nozzle and tank trucks. If this cannot be done, the fueling nozzle should be touched to the tank filler before the tank is opened.

e. The fueling nozzle should be in contact with the tank filler during the entire fueling operation.

f. When refueling from cans, the can should first be bonded against the airframe, and then brought into contact with the tank. Only metallic cans and funnels should be used.

g. Bond should not be broken at the tank until refueling is complete.

h. Disconnect in reverse order on completion of fuel service.

i. The use of an approved fuel-filtering system is absolutely essential whether fueling from a vehicle, drums or cans.

**55.** No smoking or open flames should be permitted within 100 feet of any refueling operation. Due to static electricity, nylon clothing is a severe hazard if worn by personnel in refueling operations. The use of nylon clothing should be prohibited.

**56.** A standby fire watch should be provided during refueling operations. The person charged with this responsibility should be 10- 5 feet from refueling operations, armed with an extinguisher of size and



**Figure 7** shows a typical helicopter refueling takes two workers, one to handle the refueling and one to stand by in case of fire. Note the bonding between the truck, from which the fuel is pumped, and the helicopter. The helicopter is grounded with a metal stake driven into the earth.  
(Courtesy Midwest Helicopter Airways Inc.)



**Figure 8** shows a close up of both the bonding wire and the ground wire connections to the helicopter.  
(Courtesy Midwest Helicopter Airways Inc.)

type suitable for the operation. (CO, ABC, or foam generator equipment may be applicable, depending upon condition and availability). The minimum extinguishing rating should be 20B.

**57.** Extreme caution should be exercised in refueling because the external parts of a helicopter engine will be quite hot, even after a cooling run-out. Any spills on a reciprocating craft where the engine is located below the tanks would be subject to flash. Use only the recommended fuel couplings and nozzle.

**58.** If the fuel truck is to be on standby during operations, an area so designated should be established with "No Smoking" signs posted at a radius of 100 feet from the vehicles. All other construction activities, especially welding, should be curtailed in the helicopter landing and refueling area.

### Acknowledgment

This data sheet was prepared by the Construction Division, National Safety

Council, 1121 Spring Lake Drive, Itasca, IL 60143.

### Sources of information

U.S. Department of Transportation, Federal Aviation Administration, *Code of Federal Regulations*, Title 14, Subchapter 6, Part 133, Rotorcraft External Load Operations.

U.S. Department of Labor, OSHA, *Code of Federal Regulations*, Title 29, Subpart E, Section 1926.106, Working Over or Near Water.

U.S. Department of Transportation, FAA, *Code of Federal Regulations*, Title 14, Subchapter F, Part 103, Transportation of Dangerous Articles and Magnetized Materials; Section 103.5, Authority to Deviate.

U.S. Department of Transportation, Hazardous Materials Regulations Board, *Code of Federal Regulations*, Title 49, Subpart H, Section 173.404, Labels.

U.S. Department of Labor, OSHA, *Code of Federal Regulations*, Title 29, Subpart N, Section 1926.551, Helicopters.

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