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SECTION 2

2.4. MOUNTAIN COUNTRY OPERATION

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2.4 MOUNTAIN COUNTRY OPERATION

2.4.1 General

With a turbine engine, power fall off with altitude is slower than with a piston engine. Furthermore, as we will see later on, there is a convenient means of ensuring that the limit load condition is not exceeded and, at limit load, the available power reserve is considerable.

With any helicopter, flying in mountain-country presents some special aspects which derive from the following :

- presence of vertical air currents (updrafts and downdrafts of dynamic or thermal origin).
- disappearance of visible horizon, when the helicopter flies lower than the crests facing the pilot.
- lower air density.

As regards the first two points, there is nothing special to say on the Alouette (except that with its fast climb capabilities, it is well preserved against downdrafts) and the considerations briefly outlined hereafter are applicable to all type helicopters.

However, the lower air density is the source of some special aspects in regard of a turbine-powered helicopter.

A. Presence of vertical air currents

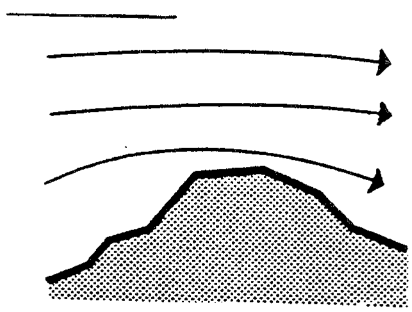
Vertical air velocities in mountain-country, even out of the clouds, can attain considerable levels (15 m/sec. and more) quite imposible to offset by the vertical speed of the aircraft itself. Hence, it is essential to know how they should be anticipated and what action should be taken.

B. Dynamic air currents

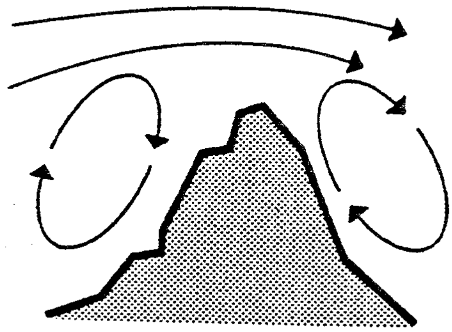
Winds are disturbed by topographical features since they are compelled to get around them.

- If the topography is relatively flat, and the wind is slight, the mass of air will flow over the mountains in laminar fashion (i.e. no turbulence) : rising current or updraft on the near side relative to the wind direction and a downward current or downdraft on the far side (view A).

2.4.1 General (continued)



A



B

- When the topography is abrupt, and in strong wind conditions, the air flow is no longer laminar : turbulence occurs on both the near side and the far side relative to the wind direction and as a result, there is a downdraft close to the near side of the mountain and an updraft close to the far side (view B).

C. Thermal air currents

In low or zero wind conditions, and in sunny weather (anticyclones in the summer), the air masses are unevenly heated on the spot and, as a result, thermal vertical air currents are set up :

- updrafts above the mountain sides exposed to the sun and, in the evening, updrafts above the forests in which is stored the heat generated during the day.

- downdrafts above the mountain sides in the shade and above the glaciers.

2.4.2 Disappearance of visible horizon

The pilot who is deprived of visible horizon, has no visual reference in regard to aircraft attitude. Instead of flying at constant attitude he will have a tendency to maintain the crests at a constant height relative to the fuselage center line, hence, to lift the nose of the helicopter when approaching the mountain side.

In view of the above, the airspeed indicator must be read very frequently.

2.4.3 Effect of decrease in air density

When hovering in ground effect, the decrease in air density, for a given weight, has the following effects :

- higher collective-pitch requirements
- higher tail rotor blade angle entailing smaller rudder pedal margin
- less reserve power

2.4.3 Effect of decrease in air density (continued)

As a result, the maximum operating weight (taken as the maximum weight sustainable in hovering flight with ground effect) is reached when any one of the following limits is attained :

- maximum collective-pitch
- maximum rudder pedal position (allowing for a minimum margin)
- maximum engine power

In the particular case of the Alouette, the limit collective-pitch angle is always reached before attaining the rudder pedal limit and, in most cases, before attaining the maximum tail pipe temperature, which, in fact is never reached before the limit collective-pitch angle unless the prevailing O.A.T. is extremely high, namely 55° C at S.L, 32° C at 2000 m (6,500 ft) and 8° C at 4000 m (13,000 ft) (see figs. 3-7 and 3-8).

Maximum hovering weight in zero wind conditions, which is shown on fig. 3-6, enables to predetermine limit landing or take off weight in relation to altitude and temperature.

In practice, the pilot who wishes to take-off at altitude with a given load is permitted to load the aircraft until the hovering collective-pitch angle attains one of the values shown on the chart in para. 1.6. (without, however, exceeding maximum permissible gross weight).

This rule is an extremely convenient one : the collective-pitch indicator actually serves the same purpose as a spring balance, the pilot no longer has to worry about weight estimation errors, which cannot be ruled out, and the wind, a favourable factor, can be taken into consideration. In addition, this collective-pitch limitation always leaves a considerable power reserve, which, in itself, is an important safety factor.

In the case of an altitude take-off, the pilot will be well advised to accomplish a preliminary trial with a gross weight slightly below the limit shown in the hovering take-off weight charts (fig. 3-6).

By hovering in ground effect prior to landing, he will know from the collective-pitch angle, the load he can add on at the next journey. A difference of 0.05 in collective-pitch angle corresponds to :

- 150 kg (330 lb) at 0 m (0 ft), density altitude
- 120 kg (265 lb) at 2000 m (6,000 ft), density altitude
- 100 kg (220 lb) at 4000 m (13,000 ft), density altitude

2.4.4 Flight path requirements

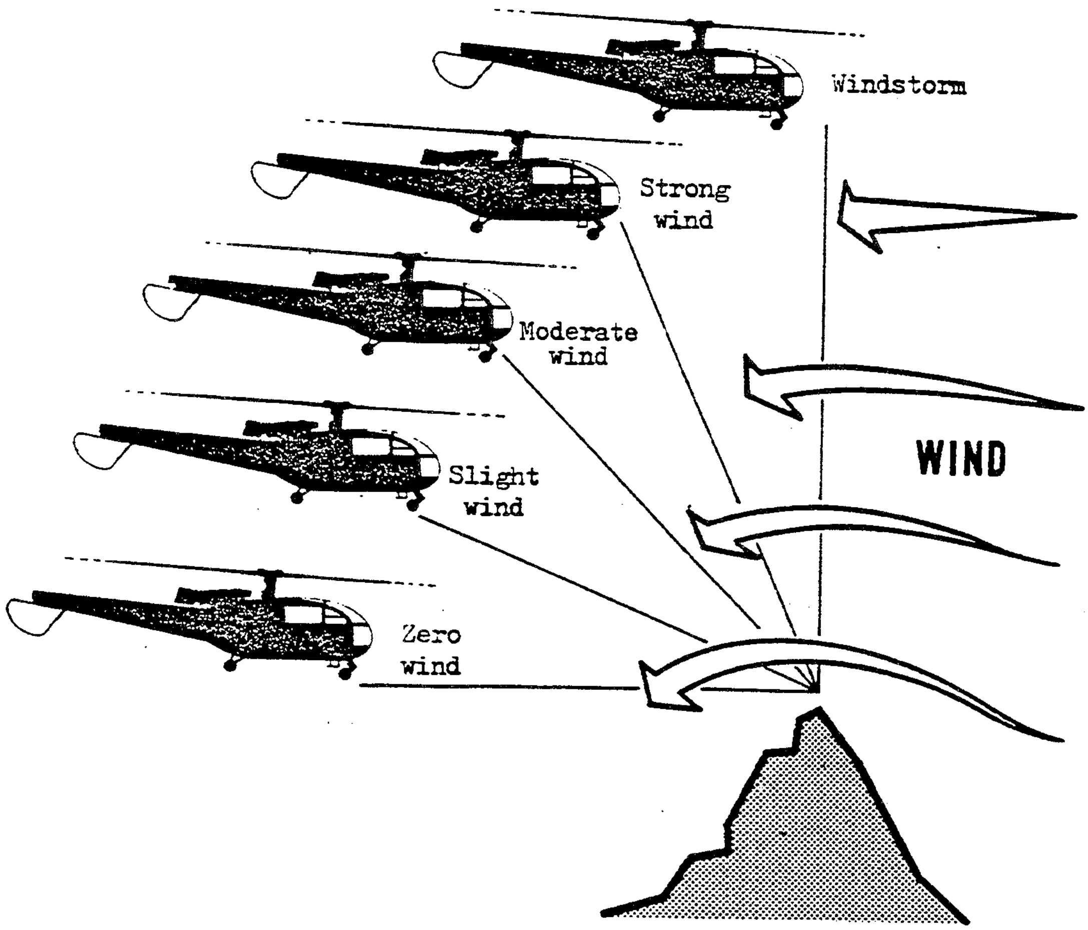
A. Landing approach or post take-off flight path

The weight limitation being determined, the pilot must choose an approach flight path or a post take-off flight path that he will be able to follow without having to exceed operating limitations, due consideration being given to the downdrafts liable to be encountered. Optimum flight paths, therefore, are those requiring the smallest collective-pitch angle during the manoeuver.

2.4.4 Flight path requirements (continued)

Whenever possible, the pilot should elect to land on a bump or crest, so as to be able to choose any approach axis in azimuth and elevation, depending on the wind. Furthermore, this will enable him to easily accomplish another circuit in the event of a faulty approach. Finally, he will also be able to reduce engine power immediately the helicopter is airborne.

The golden rule of mountain-country flying is to select an approach angle all the more steep that the wind is stronger, up to vertical approach in a windstorm.



When there are no downdrafts to be feared, flat approach is the form which authorizes minimum collective-pitch to establish hovering flight, as there is no vertical speed to be cushioned. In windy conditions this advantage is offset by the presence of downdrafts behind the crest, a factor which grows in importance as the wind increases.

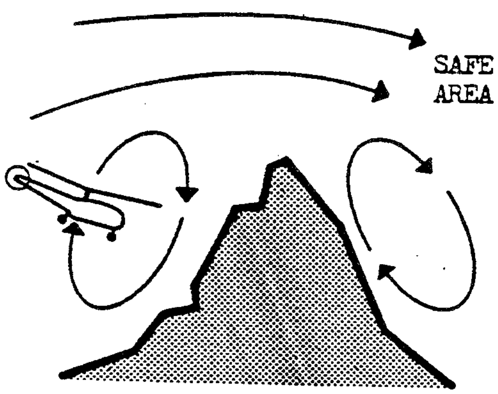
2.4.4 Flight path requirements (continued)

Gathering of speed after take-off should, of course, be accomplished into wind ; so should deceleration prior to landing but the slow down must be very gradual. During final approach, the airspeed indicator should be watched very carefully, especially in slight or zero wind conditions, in order to make sure that the airspeed does not fall off completely before the helicopter is over an area possible to land on.

To determine wind direction, in the absence of a flag, smoke or other such means, proceed as follows : make a run at low I.A.S. with no side-slip, at about 50 m (160 ft) above the landing point, and then another run at the same I.A.S. in the opposite direction. Drift, on the one hand, and the difference in ground speed between the two runs, on the other, will give a fairly accurate idea of the wind direction. If the wind is only slight, the first two-way run may not be sufficient to establish its direction ; in that case, accomplish a second two-way run at a lower altitude (a few feet above the ground).

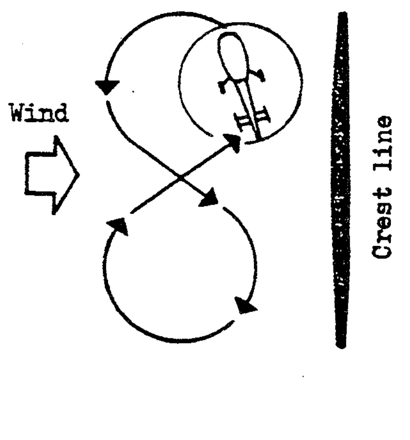
These runs will also permit checking the condition of the ground on the selected landing area.

Should the aircraft be caught in a downdraft which forces it below the desired flight path, the pilot should immediately turn the helicopter in the downwind direction and allow it to be carried by the downdraft, while maintaining the airspeed along the slope. He should move out of the downdraft before attempting to regain altitude.



B. Climb

In order to reduce climb time, the pilot should attempt to take advantage of atmosphere updrafts (flight on the near side relative to the wind or, in slight wind conditions, flight above the mountain sides exposed to the sun).



The pilot who gains altitude on the near side relative to the wind should always beware of the downdraft close to the mountain side. If he approaches the mountain side in search of the maximum updraft, he should not do so by facing the mountain side, but by placing the aircraft almost parallel to the latter so as to be ready at all times to move away from it and re-enter the rising current.

2.4.4 **Flight path requirements** (continued)

If he wishes to gain altitude in a given zone, he should accomplish a series of 8's, always turning in the downwind direction, and not a spiral climb.

Never attempt to take advantage of the updraft on the leeward side of a mountain, for the turbulence on that side can be very dangerous.

The chart, figure 3-9, gives the rate of climb of the Alouette III, in relation to pressure-altitude and outside air temperature. This chart gives an idea of climb time in the absence of vertical currents.

2.4.5 **Winter operations in mountain-country**

Winter operations in mountain-country should be performed only by highly experienced pilots, in view of the following considerations :

1. On landing in flaky snow, the pilot is liable to be deprived of visibility by snow dust thrown up by rotor downwash.

2. In dull weather it is difficult to estimate distances and speeds on snow covered surfaces.

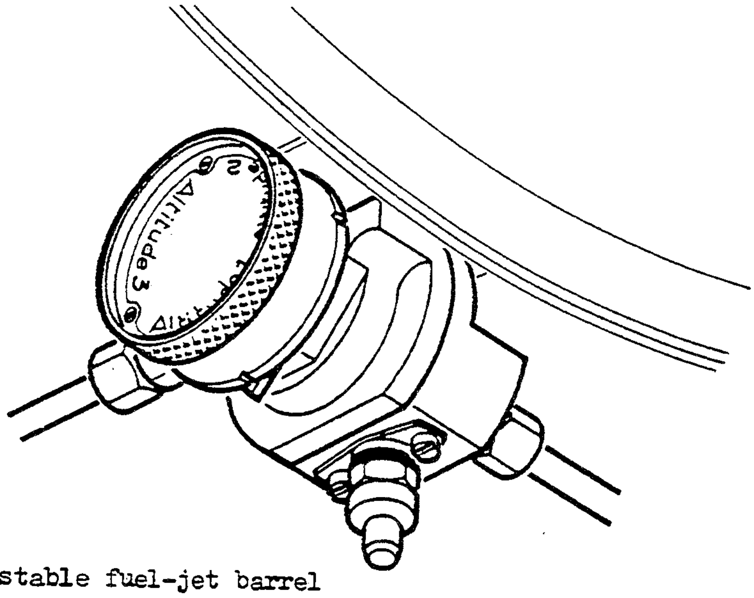
3. It is essential to assume flight paths that will not compell the pilot to exceed specified collective-pitch limitation nor cause him to apply full right rudder (during turns on the spot or very low speed flight, always turn in the direction of rotor rotation, in view of the fact that much power is absorbed in resuming straight flight on completion of a left hand turn).

2.4.6 **Engine starting at altitude**

- The engine is normally provided with a barostatic cock which automatically adjusts fuel mixture during the starting cycle for the altitude of operation.
- Some engines are provided with a fuel-jet barrel, adjustable on the ground, for starting at the following altitudes :
  - n° 1 for engine starting up to Zp = 1500m. (5000 ft)
  - n° 2 for engine starting from 1500 to 3000m. (5000 to 10 000 ft)
  - n° 3 for engine starting from 3000 to 5000 m. (10 000 to 16 500 ft)
- For these two types of cock, and for engine starting between 5000 and 5800m (16 500 to 19 000 ft) a slow-running check must be performed before stopping the engine : Engine idling speed should be 20 000 rpm.

  Correct, if necessary, by re-setting the idling adjustment screw.

SGAC Approved
July 26, 1968



Adjustable fuel-jet barrel

2.4.7. Landing on a slope

Before landing, apply the parking brake.

After a final approach head into wind, turn the aircraft during the hover so that the steepest gradient, in the upward direction, lies between 9 o'clock and 12 o'clock relative to the helicopter. Allowing for the slope of the plane containing the three wheels during the hover (aft and starboard) this will produce the smallest tilt when the aircraft first touches down.

As the helicopter starts to tilt when the first wheel touches down, counteract rotor tilt by moving the stick towards the top of the slope. When all three wheels have touched down, fully reduce collective pitch while returning the stick to neutral.

The maximum permissible gradient is 10 degrees.
In case of necessity, the aircraft may be landed in a direction outside the limits defined above provided that the slope does not exceed 6 degrees.