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PARACHUTE ESCAPE FROM HELICOPTERS

BY

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August 1973

U. S. ARMY AEROMEDICAL RESEARCH LABORATORY

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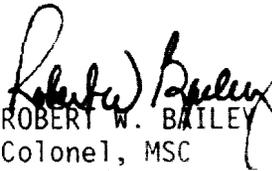
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ABSTRACT

Experimental evidence shows that a parachutist experiences no major difficulty in achieving vertical and horizontal separation from an auto-rotating helicopter.

At high rates of descent, there is a 0.5 - 0.75 second delay after exit before expected separation begins.

APPROVED:


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PARACHUTE ESCAPE FROM HELICOPTERS

INTRODUCTION

In spite of scattered reports to the contrary,^{1 2 3 4} legend among helicopter pilots has it that if a crewmember were to bail out of a disabled helicopter he would be struck by the rotating blades. Logic does not support this contention. There are several pieces of background information upon which deduction may be based: (1) Although the maximum rate of descent of a helicopter without main rotor blades is estimated to be about 38,100 feet per minute, the maximum rate of descent in autorotation for most helicopters is somewhere between 3,000 and 3,500 feet per minute, although some helicopters (e.g., AH-1G) can be forced to a rate of descent of as high as 6,000 feet per minute with accelerated dives; (2) The average stable free-fall parachutist falls at a rate of about 12,000 feet per minute. By presenting minimal surface area to the relative wind, this rate can be increased to as much as 21,000 feet per minute; and (3) When the escaping crewmember leaves the disabled helicopter he will begin his acceleration to his eventual equilibrium velocity from a baseline velocity equal to the rate of descent of the helicopter at his moment of exit, since, in fact, at the instant he departs the helicopter his velocity vector should be equal to that of the helicopter. The train of logic then suggests that since the jumper has an ultimate equilibrium velocity greater than the worst possible case of a flying helicopter, the jumper should always be able to fall away from such a helicopter, provided the main rotor blades are still turning and providing some lift.

METHOD

To test this hypothesis a series of jumps were made from an autorotating helicopter. The exit and separation of the parachutist from the helicopter were documented by 16mm motion pictures taken at 32 frames per second with an Arriflex motion picture camera and by 35mm slides taken four frames per second by a motorized Nikon camera. The photo platform was a chase helicopter flying precise formation with the jump helicopter. Data were obtained with frame by frame analysis of the motion pictures measuring the distance separating the parachutist from a reference point on the helicopter. The distance from the most anterior portion of the nose to the most posterior portion of the tail boom of the jump helicopter was used as a reference length. Approximate rates of descent of the jump helicopter during test were established using the vertical speed indicator

aboard the jump helicopter. Precise rate of descent at the moment of parachutist exit was determined using a recording radar altimeter which provides precise altitude information above ground level. This recording radar altimeter continuously plotted the position of the aircraft above ground level. The moment of parachutist exit was marked on this plot, and the helicopter's rate of descent at the moment of parachutist exit was determined by establishing the slope of the radar altimeter plot at the moment of the parachutist's exit.

A total of eight parachute jumps were made at progressively increasing rates of descent of the helicopter. These are summarized in Table I.

TABLE I

Jump	Approximate Vertical Speed Ft/Min	Measured Vertical Speed Ft/Min	Exit Altitude Ft AGL
1	0	0	4400
2	500	650	4900
3	1000	1500	4800
4	1500	1840	4100
5	2500	2700	3700
6	3000	2880	4400
7	3500	3240	5100
8	3500	3080	3800

RESULTS

The results of test are summarized in Table II. The numbers in each cell represent the distance in feet between the reference point on the aircraft and the reference point on the jumper at the indicated second or fraction thereof after exit of the parachutist from the aircraft. No data are available in jump number seven because the motion picture camera malfunctioned at the time of exit. In jumps one through six, exit was stable and free-fall was uneventful. In jumps seven and eight, the parachutist was uncontrollably rolled 180° clockwise onto his back immediately after separation from the helicopter. Stability was regained without difficulty and the remainder of the free-fall was uneventful.

TABLE II

Jump	Measured Vertical Speed Ft/Min	Time in Seconds Exit = Time 0												
		0	1/2	1	3/2	2	5/2	3						
1	0	2.4	4.0	8.4	15.8	24.1	34.8	47.9	61.6	77.2	92.3	111.6	132.8	150.6
2	650	4.0	7.8	11.7	17.7	27.1	38.4	49.7	62.7	88.1	98.7	118.3	138.9	166.0
3	1500	6.9	7.6	9.9	18.2	29.9	40.7	56.6	69.4	98.9	117.7	141.8	164.0	199.0
4	1840	3.1	3.8	3.5	3.7	6.3	12.4	20.4	30.8	43.8	47.8	75.2	88.2	110.6
5	2700	1.9	2.7	2.4	4.7	8.6	14.4	21.1	29.0	37.6	47.6	58.8	71.9	86.0
6	2880	3.4	3.5	2.4	2.0	6.3	13.0	21.9	31.8	43.6	58.9	74.4	92.5	112.7
7	3240													
8	3080	2.9	3.1	3.2	4.3	8.0	13.5	20.6	29.5	39.6	51.8	66.2	82.5	99.8

ω

DISCUSSION

It is clear from the data the parachutist experienced no major difficulty in achieving vertical separation from the helicopter even at rates of descent which approach the limit of safety for the aircraft. Motion pictures also show adequate horizontal separation from the rotor system by 1.5 seconds after exit. Based upon these data, we can confirm the initial premise that the main rotor system poses no threat to a parachutist leaving a UH-1H helicopter even at rates of descent which approach the limit of safety.

The vertical velocity plot of a stable parachutist during his acceleration phase from an initial vertical velocity of zero is shown in Figure 1. Preliminary consideration suggested that as the rate of descent of the helicopter increases, the major modification in the parachutist's acceleration curve would merely be that he would enter the velocity curve at a point equal to the vertical velocity of the helicopter at the moment of his exit. Data from jumps one, two, and three tend to substantiate this premise. However, in jumps four, five, six, and eight, an unusual observation was made. There appears to be a delay in the neighborhood of 0.75 seconds during which time the parachutist falls in close proximity to the descending helicopter before he begins to show the expected rapid separation from the helicopter.

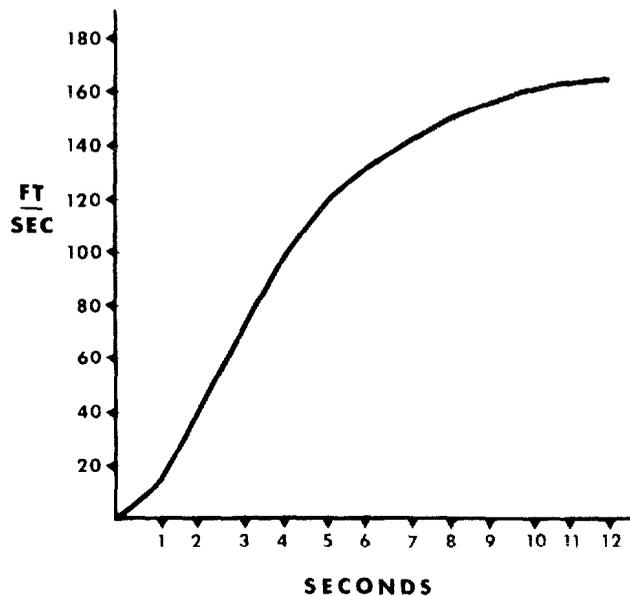


FIGURE 1

It is known that peculiar airflow patterns may occur around helicopter fuselages, and this occurs especially during unusual flight maneuvers. It is possible, for example, to read as much as ten knots difference in the indicated airspeed merely by changing the position of the dynamic port of the pitot static airspeed indicator system. Also, it has been determined that the cargo viewing mirror, which can be mounted on the nose of a UH-1 helicopter to view sling cargo loads, causes about twice the drag as would be calculated from its geometry alone.

The data we obtained suggest that there is an area close to the skin of the aircraft which provides greater than the expected buoyancy when the helicopter is in steep autorotational glide slopes. When the parachutist escapes from this area of high buoyancy, he then begins an expected acceleration away from the descending helicopter. The uncontrolled rolling of 180° experienced by the parachutist when rates of descent were above 3,000 feet per minute suggests that the parachutist was experiencing differential buoyancy with higher buoyancy on his inboard shoulder and lesser buoyancy on his outboard shoulder which, for an exit from the right door, caused him to rotate clockwise. Eventually, however, after this initial delay of about .75 seconds, the parachutist rapidly fell away from the descending helicopter and experienced no further difficulty in separation.

Studies are presently underway at the US Army Aviation Systems Test Activity, Edwards Air Force Base, California, which may help to more clearly define airstream characteristics close to the skin of a flying and auto-rotating UH-1 type helicopter.

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