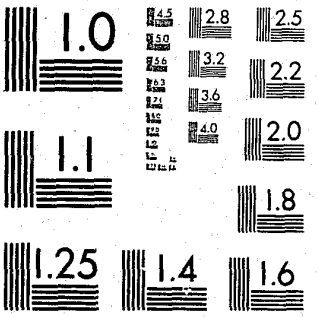
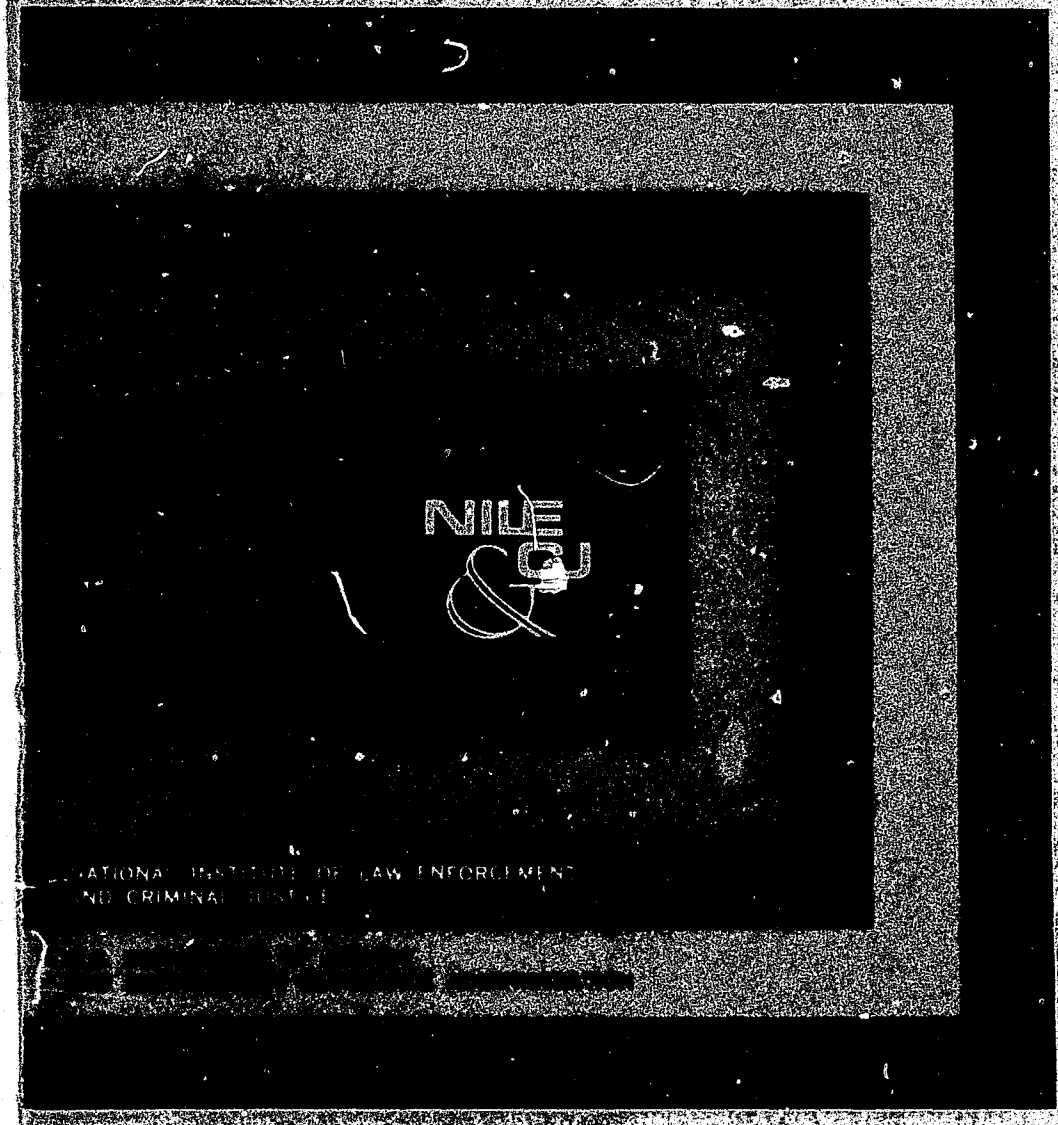


Police - Helicopters

The Utilization of Helicopters for Police Air Mobility



The Utilization of Helicopters for Police Air Mobility

ICR 71-2
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A Survey Prepared by

The Center for Criminal Justice
Operations and Management

NATIONAL INSTITUTE OF LAW ENFORCEMENT
AND CRIMINAL JUSTICE

U.S. DEPARTMENT OF JUSTICE
LAW ENFORCEMENT ASSISTANCE ADMINISTRATION

Foreword

This report has been prepared by the Center for Criminal Justice Operations and Management (CCJOM) of the National Institute for Law Enforcement and Criminal Justice, with Cornell Aeronautical Laboratory, INC. (CAL) acting as consultant. It is part of a program which will ultimately provide cost and effectiveness guidelines in the use of aircraft for police use. These guidelines will aid in evaluating applications for procurement of aircraft and in assisting law enforcement agencies in determining their aircraft requirements, so as to achieve the maximum effectiveness in their employment of air mobility. The establishment of these guidelines is both timely and necessary, since in the past few years a significant growth in the use of helicopters by civil government agencies has occurred. In the period from 1967 to 1969 alone, the number of civil government agencies that operate helicopters in the United States and Canada grew from 74 to 94, an increase of 27 percent. The total helicopter fleet of these agencies grew from 187 to 273 during the same period, or an increase of 46 percent in 2 years.

With consulting assistance from CAL, CCJOM is conducting a limited flight test program in conjunction with the Dade County Public Safety Department (DCPSD), Florida. The study is designed to evaluate police use of helicopters and short takeoff and landing (STOL) aircraft, and will include those factors which contribute to effectiveness in a law enforcement operation: surveillance, rapid response time, preventive patrol, deterrence, as well as any new operational procedures and factors made possible by the use of aircraft. Also included in the study will be cost, multiuse, maintenance, and other factors which are essential to a realistic evaluation.

In order to identify those factors which should be included in the test and evaluation program, CCJOM conducted a field survey and study of the air mobility elements, design features and activi-

ties of typical police jurisdictions. Data for this study were gathered both from existing literature and from visits by CCJOM and CAL personnel to several of the major police users of helicopters and fixed wing aircraft. These major police forces included those of the cities of Memphis, Kansas City, Los Angeles, New York, Fort Worth, Indianapolis, and the States of Illinois and New York.

During this survey activity, it was discovered that considerable data had been accumulated which would be useful to local law enforcement agencies which either have or contemplate having air operations. For this reason, it was decided to summarize this survey data in report form so that the information could be disseminated. The information collected as of March 1970 is summarized in this report.

Much of the data is presented in the form in which it was compiled by the various law enforcement agencies. This has been necessary because of the difficulties in reconciling data between organizations which vary so greatly with respect to organizational structure, activity emphasis, and demographic characteristics of the jurisdictional area. Therefore, this survey is not so much oriented towards comparisons between helicopter user agencies as it is towards presenting the entire scope of helicopter utilization in law enforcement activities.

IRVING SLOTT,
Acting Director,
National Institute of Law Enforcement
and Criminal Justice

Summary

This report describes how helicopters are currently being used in the United States in support of law enforcement activities. Many law enforcement agencies which use helicopters were surveyed to ascertain the types of activities for which the helicopters are used. While the main emphasis continues to be on traffic surveillance, speed law enforcement, traffic control, and search and rescue activities, other types of activities are becoming increasingly evident. These growing activity areas include air evacuation (i.e., air ambulance), air and water pollution control, emergency cargo transportation (blood, transplant organs, food, special equipment), riot control, narcotics detection (i.e., detection of narcotics smuggling and distribution activities), fire fighting, night patrols for crime prevention (using high intensity lights), and covert surveillance.

Also included in the survey were the types and numbers of helicopters employed, their annual utilization rates, and the types of special law enforcement-related equipment installed. The aerial vehicles most widely used for law enforcement activities are the three place reciprocating-engined helicopters typified by the Bell 47G series, the Hughes 300C and the Enstrom F–28A. Turbine helicopters (Fairchild Hiller FH–1000 and Bell 206A Jet Ranger) are becoming popular in law enforcement activities, but their high initial costs ($98,000 and $105,000, basic price respectively) put them out of reach for many agencies. Average annual utilization of helicopters ranges from 600 to 1,200 hours for various law enforcement agencies. Specialized equipment which is useful for law enforcement work has been installed on these helicopters to accommodate individual department needs. Police radios are widely used in addition to normal VHF aircraft communication and navigation radios. High intensity lights are being used not only for night patrols to prevent crime in industrial, commercial and residential areas, but also for riot control, search and rescue, and il-

lumination in criminal apprehensions and at accident scenes. Combination public address and siren systems are finding wide application in criminal apprehension, motorist assistance, disaster warning (fires and floods), and crowd control. In regions with significant bodies of water, floats are installed on helicopters both for rescue work and to insure crew safety during overwater flights.

Other utilization factors examined include utilization by mission type, time distribution of the demand for helicopter services, preplanned vs. emergency missions, availability, sortie length, patrol altitudes, night operations and weather minima.

Law enforcement agencies using helicopters have measured helicopter effectiveness in terms of decreased crime rates, numbers of criminals apprehended and number of rescues accomplished. The most often cited example of helicopter patrol effectiveness is "Project Sky Knight" in Lakewood, Calif. (*29*). The Memphis Police Department, the Kansas City (Missouri) Police Department, the Los Angeles Police Department, the New York State Police, and the Illinois State Toll Highway Authority report significant numbers of criminal apprehensions attributed to their air operations. However, it is not known to what extent helicopter patrols reduced total crime, to what extent these patrols merely forced a shift in the location of criminal activities, or to what extent other factors played a part in crime reduction.

Many lives have also been saved by the use of helicopters. The Chicago Fire Department, for example, has made 1,000 rescues within a 4-year period. Helicopters from the New York City Police are used extensively for search and rescue and respond to literally hundreds of such calls each year.

An important factor contributing to the success of the helicopter in criminal apprehensions, rescues, and air ambulance activities is its rapid reaction time. In the Los Angeles Police Department "ASTRO" program, average time for airborne craft to reach the scene was found to be 1.5 minutes. During the "Sky Knight" program response was usually within 2 minutes. It was not clear, however, how many incidents were not responded to at all by the helicopters because it would have taken too long to respond or because they were otherwise occupied.

Helicopter performance data was also reviewed for those vehicles which either are or could be used for police work. Performance parameters depicted include useful load, speed, range, endurance, hover ceilings, service ceilings, and rates of climb.

Helicopter procurement and operating costs were also presented in this survey. Procurement costs range from $33,630 to $55,950, basic price, for reciprocating-engined helicopters, and start at approximately $95,000 for those with turbine engines. To these

prices approximately $5,000 to $20,000 must be added to equip the helicopter for law enforcement activities. This range depends upon the type of equipment desired and the type of helicopter. Operating costs, based on 1,000 hours of operation per year and excluding crew costs, begin at $23.01 per hour for reciprocating-engined helicopters, and $52.50 per hour for turbine-powered helicopters.

Helicopter ownership alternatives (single agency owner—single agency user, single agency owner—multiple user agencies, and leasing) and maintenance and servicing arrangements were also surveyed.

Personnel and organizational factors inspected included pilot selection criteria, pilot training programs, and flight crew costs. Pilot selection criteria were found to vary widely, with requirements ranging from 1,000 helicopter hours and no police experience stipulation, to no flying experience and 5 years with the police force. Probably most common were requirements stipulating 2 to 5 years police experience and a fixed wing commercial pilot's license. Many of the jurisdictions feel that it is preferable to train a policeman to fly rather than attempt to teach a pilot to be a policeman. The prime reason cited for this viewpoint is training time: Learning to fly takes 5 months; learning to be a competent police officer may take 5 years. On the other hand, experienced helicopter pilots argue that safety may be compromised by using inexperienced pilots. These pilots suggest that perhaps a two-pilot crew is best; one pilot should be an experienced pilot without an extensive police background, the other pilot an experienced police officer without an extensive flying background.

The pilot training programs appeared to vary considerably. Some programs utilize instructor-pilots who are members of the force, other programs use the training services of commercial operators, while still others extensively rely on pilot schools operated by the helicopter manufacturers.

Little information was immediately available regarding "skill pay" differentials for pilots and observers. It is known, however, that the Los Angeles County Sheriff provides an 11-percent differential for pilots but none for observers. The Los Angeles Police Department provides a $250 per month differential for both pilots and observers.

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Chapter 1

LAW ENFORCEMENT AND RELATED MISSIONS PERFORMED BY HELICOPTERS

In table 1-1, the law enforcement missions performed by helicopters for selected law enforcement or related agencies are listed. It should be noted that the list of missions for any particular city may be incomplete, because of limited data obtained from the survey and the existing literature.[1] Variation in the types of missions performed by different agencies are the result of many factors. These include population density, physical limitations (i.e., high rise buildings as in New York City), the existence of large bodies of water (water area patrol, water pollution control), the proximity of national boundaries (border patrol, narcotics detection), existence of considerable organized crime (covert surveillance missions) and the primary purpose of the agency (e.g., fire departments' missions have only limited commonality with those of agencies which are primarily law enforcement oriented). What is perhaps more significant than comparisons of missions performed by different agencies is the total list of missions. Such a list is useful not only in developing a test plan for helicopter STOL evaluations, but also serves to inform user agencies of other potential uses of their aircraft.

1.1 Mission Type vs. Hours Flown

Examining data regarding hours flown vs. mission type gives considerable insight into how law enforcement helicopters are employed. Although there is a great deal of similarity in the missions performed by helicopters of different agencies, and the percentage of flying hours devoted to law enforcement related activities

[1] See References, pages 56 to 57.

Table 1–1

LAW ENFORCEMENT AND RELATED MISSIONS PERFORMED BY HELICOPTERS FOR SELECTED AGENCIES

	CHICAGO FIRE DEPT.	CHICAGO P.D.	DENVER P.D.	FORT WORTH, CITY OF	HONOLULU, CITY & COUNTY OF	HENNEPIN COUNTY SHERIFF, MINNESOTA	ILLINOIS STATE TOLL HIGHWAY AUTH.	INDIANAPOLIS AIRPORT AUTHORITY	KANSAS CITY P.D.	L.A. CITY F.D.	L.A. COUNTY F.D.	L.A. COUNTY SHERIFF	L.A. P.D.	HOME OFFICE POLICE, LONDON	MEMPHIS P.D.	NASSAU COUNTY P.D., NEW YORK	NEBRASKAS' AIR AMBULANCE & HWY. ASST. PROG.	NEW JERSEY STATE POLICE	NEW YORK CITY P.D.	N.Y. STATE POLICE	PENNA. STATE POLICE	PEORIA	POMONA, CAL., CITY OF	ROYAL CANADIAN MOUNTED POLICE
COMMAND POST			•						•	•	•		•	•				•	•	•	•	•	•	
CRIMINAL APPREHENSION																								
HIGH SPEED CHASE				•	•	•	•	•				•		•		•	•				•			
PATROL - RURAL OR VACANT AREAS				•			•	•				•						•	•		•			
PATROL - SEASONAL AREAS IN OFF SEASONS				•				•				•	•					•			•			
PROVIDING INTERCEPT DIRECTION/CONTROL TO SURFACE VEHICLES &/ FOOT PERSONAL				•		•	•	•						•				•			•			
RESPONSE TO ALARMS					•		•	•				•		•	•						•		•	
ROAD BLOCK - SETUP														•				•			•			
SEARCH - FUGITIVES				•		•	•	•				•	•	•				•	•		•	•		•
SEARCH - VEHICLES			•			•	•	•				•		•			•	•			•			
STAKE OUT					•	•		•					•					•			•			•

LAW ENFORCEMENT	SURVEILLANCE - COVERT		●	●		●	●	●		●			●	●	●		●					●	●		
	SURVEILLANCE - GENERAL		●	●	●	●	●	●	●	●		●	●	●	●	●		●	●	●	●	●		●	●
	SURVEILLANCE - ROOFTOP				●			●		●				●		●			●						
	TRACKING FLEEING SUSPECTS				●			●		●					●	●			●			●			●
	FAA REGULATION ENFORCEMENT								●			●	●						●			●			
	NARCOTICS DETECTION							●					●						●			●			
	OBSERVATION POST				●				●						●			●	●			●			
	OFFICER SAFETY				●			●	●				●		●										
	POLLUTION CONTROL																								
	AIR POLLUTION				●			●										●	●			●			
	PATROL - ILLEGAL DUMPING, PREVENTION OR DETECTION				●			●				●			●				●						
	WATER POLLUTION		●		●													●	●						
	PREVENTATIVE NIGHT PATROLS WITH LIGHTS		●	●			●		●			●			●				●					●	
	RIOT CONTROL	●	●	●				●			●	●	●		●			●	●			●	●		
	SECURITY - VALUABLE SURFACE MOVEMENTS													●											●
	TRANSPORT PRISONERS													●	●										●
	TRANSPORT SPECIALISTS TO CRIME SCENE		●	●	●							●			●			●	●	●	●				
	VIP SECURITY				●								●						●			●	●		
	VOICE CONTROL OF GROUND EVENTS						●		●	●		●	●	●	●			●	●	●	●		●	●
PUBLIC SAFETY	AERIAL PHOTOGRAPHY			●	●			●	●				●	●	●	●	●	●	●	●	●		●	●
	AIR EVACUATION (AMBULANCE)	●		●				●	●		●	●	●		●	●	●	●	●		●	●			
	AMBULANCE ESCORT					●	●		●												●				
	DISASTER WARNING				●				●				●		●				●						
	EMERGENCY CARGO TRANSPORT	●						●					●	●				●	●	●	●	●	●	●	●
	FIRE DETECTION AND FIGHTING	●			●	●			●	●	●		●		●		●	●	●					●	
	RESCUE	●			●	●	●	●	●			●	●	●	●	●		●	●	●	●	●	●	●	●
	SEARCH - PEOPLE LOST				●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●		●	●
	TRAFFIC																								
	ACCIDENT INVESTIGATION				●		●	●	●				●		●		●	●	●	●	●				
	ACCIDENT PREVENTION							●										●	●	●	●				
	DEBRIS AND OTHER SAFETY HAZARD REMOVAL ASSISTANCE				●			●	●									●	●						
	MOTORIST ASSISTANCE				●		●	●	●				●		●		●	●	●	●	●				
	SPEED CONTROL				●			●					●				●	●		●	●		●		
	TRAFFIC CONTROL - EMERGENCY							●					●	●	●	●	●	●	●		●				●
	TRAFFIC CONTROL - FREEWAY AND HIGHWAY				●			●	●						●	●	●	●	●		●				
	TRAFFIC MONITERING				●	●	●	●	●				●	●	●	●	●	●	●		●		●		●
	WATER AREA PATROL		●		●	●								●		●		●	●						●

Table 1–2

CITY OF FORT WORTH HELICOPTER UTILIZATION
(August 21, 1968–October 31, 1969)
(62-week period)

Department	HOURS		FLIGHTS		
	Total hours	Hours per week	Percent	No.	Percent
Police [1]	965.5	15.6	65.0	692	44.2
Health	136.0	2.2	9.2	127	8.1
Fire	27.4	4	1.9	32	2.1
Water	22.2	.4	1.5	21	1.3
Service flights	247.2	4.0	16.8	631	40.3
Sub-total	1,389.3	22.6	94.4	1,503	96.0
Other departments	83.1	1.3	5.6	62	4.0
Total	1,472.4	23.7	100.0	1,565	100.0

Source: Reference 7.

[1] As of April 1970, 50 percent of the police activities was devoted to night patrol, 25 percent to traffic and 25 percent to general surveillance.

Table 1–3

CITY AND COUNTY OF HONOLULU HELICOPTER UTILIZATION
(October 21–December 31, 1968)
(10-week period)

Mission	Total hours	Hours per week	Percent
Traffic watch	153.0	15.3	49.2
Fire department training	70.8	7.1	22.8
Search and rescue	32.2	3.2	10.4
Patrol and car search	29.7	3.0	9.5
Other	25.3	2.5	8.1
	311.0	31.1	100.0

Source: Reference 32.

are often similar, there is considerable variation between agencies as to which missions are emphasized. To some extent, this emphasis is structured by the type of organization. Helicopters which are shared among several other agencies or departments within a state or municipality may have slightly less direct police

Table 1–4

INDIANAPOLIS AIRPORT AUTHORITY HELICOPTER UTILIZATION
(November 8, 1968–September 30, 1969)
(48-week period)

Agency	Total hours	Hours per week	Percent
Sheriff	406.4	8.5	48.2
Police	283.9	5.9	33.7
Fire	46.2	1.0	5.5
Mass Transit Authority	38.1	.8	4.5
Airport	11.3	.2	1.3
Hospital	22.5	.5	2.7
All	34.9	.7	4.1
Total	848.3	17.6	100.0

Source: Reference 19.

department involvement in the overall activities. Multiuser agencies include the city of Fort Worth, the city and county of Honolulu, the Indianapolis Airport Authority and the Illinois State Toll Highway Authority. Utilization by type of mission (depending on data source) is depicted in tables 1–2 through 1–5. Direct police department participation accounts for from 60 percent to 80 percent of the total hours flown. Tables 1–6 and 1–7 show the fleet utilization for two single agency users, the Los Angeles Police Department and the Kansas City (Mo.) Police Department. Note that the percentage of time devoted to law enforcement activities is about 88 percent in both of these cases.

While law enforcement agencies which either own or lease helicopters (i.e., which are in a sense sole operators or users) may tend to have a slightly higher percent of the total hours employed for police work, there is nevertheless considerable similarity with the operations of multiagency helicopter operations. The reason is that many helicopter-equipped police departments operate these helicopters on missions to cooperate with and assist other government agencies. For example, the New York City Police Department helicopters are used to enforce water pollution regulations, whereas in the city of Fort Worth this activity falls under the jurisdiction of the Health Department. Similarly, the Denver Police Department, the Los Angeles County Sheriff, the Los Angeles Police Department, and the New York City Police Department perform air evacuation (i.e., helicopter ambulance) services whereas in Indianapolis this falls under the jurisdiction of one of the user agencies and the police and sheriff are theoretically not involved.

Table 1–5

THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY AIRCRAFT UTILIZATION
(May 1, 1968–April 30, 1969)
(52-week period)

Department	Bell Jet Ranger	Cessna 182	Cessna 337	Cessna 182	Department total	Hours per week
AVIATION	66.3 hrs 16%	13.0 hrs 3%	82.3 hrs 26%	6.6 hrs 1%	168.2 hrs 9%	3.2
COMMUNICATIONS	143.0 hrs 36%	37.3 hrs 8%	71.5 hrs 23%	17.6 hrs 2%	270.3 hrs 14%	5.2
ENGINEERING	58.1 hrs 15%	.8 hrs 1%	00.0 hrs	00.0 hrs	58.9 hrs 3%	1.1
EXECUTIVE	47.2 hrs 12%	34.0 hrs 7%	114.4 hrs 36%	2.2 hrs 1%	197.8 hrs 10%	3.8
POLICE [1]	73.4 hrs 18%	332.6 hrs 71%	38.3 hrs 12%	717.7 hrs 95%	1,162.0 hrs 60%	22.3
OTHER DEPTS	12.9 hrs 3%	46.0 hrs 10%	10.5 hrs 3%	9.7 hrs 1%	79.1 hrs 4%	1.5
	400.9	463.7	317.0	753.8	1,935.4	37.2

[1] The tabulated hours for the Police Department primarily consist of air speed-checks. In addition the Police hours include aerial observation of special high density traffic conditions, such as holiday traffic, and major accident traffic build-ups. Police hours also include aerial search for lost children, escaped prisoners, stolen vehicles, and aerial criminal stake-outs of areas encompassing the Toll Road.

Source: Illinois State Toll Highway Authority, Aircraft Mission Report Summary, May 1, 1968 through April 30, 1969.

Table 1–6

LOS ANGELES POLICE DEPARTMENT HELICOPTER UTILIZATION
(January–June 1969)
(26-week period)

	Total hours	Hours per week	Percent
Patrol	2,713.9	104.8	70.0
Traffic	384.6	14.8	10.0
Investigation	208.1	8.0	5.8
Training	333.6	12.8	8.6
Unusual occurrence	119.8	4.6	3.2
Other (mech)	52.4	2.0	1.7
Survey	10.3	.4	.2
Transportation	17.2	.7	.4
Executive transportation	4.7	.2	.7
Total	3,842.1	147.8	100.0

Source: Reference 30.

Table 1–7

KANSAS CITY, MISSOURI, POLICE DEPARTMENT HELICOPTER UTILIZATION
(July–September 1969)
(13-week period)

	Total hours	Hours per week	Percent of total hours
Time on patrol	661.3	50.9	74.3
Called for services	103.4	8.0	11.6
Training	25.6	2.0	2.9
Special assignment	19.7	1.5	2.2
Other	79.6	6.1	8.9
Total	889.6	68.4	100.0

Sources: References 22 and 23.

As was mentioned before, there is considerable variation with respect to those missions which are emphasized. For example, in Honolulu traffic watch activities account for almost 50 percent of the total flying time, whereas the Los Angeles Police Department (table 1–6) spends approximately 10 percent of its total flying time for similar duty. However, it turns out that both LAPD and

Table 1–8

INDIANAPOLIS AIRPORT ACTIVITY SUMMARY
(December 3, 1968–November 7, 1969)
(48-week period)

Public safety activity:		
Accident reporting	23	
Aircraft accident investigation/assistance	4	
Ambulance run—actual	49	
Ambulance run—false (unable to locate or erroneous)	5	
Ambulance run—first aid only	5	
Ambulance run—not needed (minor or no injuries)	145	
Animal check	3	
Drowning search	2	
Flood patrol	2	
Ice patrol	2	
Missing person search	17	
Railroad assistance	4	
	261	(39.2%)
Law enforcement and crime-related activity:		
Bank alarm	83	
Car search—moving	17	
Car search—stolen/abandoned	33	
Criminal search	31	
Crowd control	21	
Holdup/burgular alarm—false	48	
Vandalism control	2	
	235	(35.3%)
Traffic-related activity:		
Speeding chase	6	
Traffic control	35	
Traffic survey	12	
	53	(8.0%)
Fire-related activity:		
Fire alarm	14	
Fire survey/check	24	
	38	(5.7%)
Other government activity:		
Park survey	8	
Photo	21	
Planning survey	5	
Road/street survey	16	
Smoke pollution survey	1	
Snow survey	2	
Trash control	3	
	56	(8.4%)

Table 1–8 (continued

INDIANAPOLIS AIRPORT ACTIVITY SUMMARY
(December 3, 1968–November 7, 1969)
(48-week period)

Training activity:		
Ambulance demonstration and training	6	
Flight training	4	
Police/sheriff training	6	
	16	(2.4%)
Miscellaneous	7	(1.0%)
Total	666	

Source: Reference 19.

Honolulu average roughly 15 hours per week for traffic patrol; but since Honolulu has fewer helicopters (one compared with seven), its traffic watch represents a much greater portion of the overall activity.

1.2 Mission Type vs. Number of Calls

Utilization of helicopters may also be examined in terms of number of calls or number of sorties performed vs. mission type. Data is presented for five agencies: City of Fort Worth, table 1–2; Indianapolis Airport Authority, table 1–8; Memphis Police Department, table 1–9; New York City Police Department, table 1–10; and the Home Office Police, London, England, table 1–11.[2] The Home Office Police operation is rather unique. It is an experimental program using military helicopters (four Sioux helicopters, military versions of the Bell Model 47G) operated by military pilots and using police officers as observers. A similar organizational arrangement has been tested in the United States. Nebraska's Air Ambulance and Highway Assistance Program uses Nebraska Army National Guard Sikorsky H–19C helicopters operated by National Guard pilots. Other crewmen typically include a police officer and a physician (*11*).

[2] These tables are presented individually rather than in summary form because they do not all contain similar information. It is recommended that a standard aircraft utilization form be developed for police users of aircraft.

Table 1–9

MEMPHIS POLICE DEPARTMENT SUMMARY
(October–December 1969)
(13-week period)

Public safety activity:		
Lost persons	8	
Calls for police	17	
Search and rescue	6	
	31	(8.0%)
Law enforcement and crime-related activity:		
Robbery	60	
Burglary	19	
Shootings	49	
Criminal assault	5	
ADT (American District Telegraph) alarm system	29	
Money snatch	14	
Prowlers	61	
Calls for assistance by police	16	
Stolen cars	18	
Larceny	14	
Disturbance	21	
Hit and run	5	
Check rooftops for officers	11	
Suicides	2	
Assist sheriff's officers	1	
Suspicious persons	4	
	329	(85.0%)
Fires	14	(3.6%)
Other:		
Photography	5	
Public relations	4	(2.3%)
	9	
Total	383	

Source: Captain Glenn Moore, Helicopter Patrol Division, Memphis Police Department.

Table 1–10

NEW YORK CITY POLICE DEPARTMENT ACTIVITY SUMMARY
(January–December 1967)
(52-week period)

Public safety activity		
Boats in distress	142	
Persons on rafts, in water, etc.	110	
Searches for missing persons, planes, boats, etc.	273	
Investigating low flying complaints	42	
Fire patrols, rooftop surveys, escorts, salutes	1,004	
	1,571	(29.6%)
Law enforcement and crime-related activity:		
Stolen cars recovered	45	(0.8%)

Table 1–10 (continued)

NEW YORK CITY POLICE DEPARTMENT ACTIVITY SUMMARY
(January–December 1967)
(52-week period)

Traffic-related activity:		
Aerial traffic surveys	507	
Disabled car on highway obstructing traffic	1,169	
Radio calls concerning traffic	2,028	
	3,704	(69.6%)
Total	5,319	

Source: Captain Robert P. Oberle, New York Police Department.

Table 1–11

HOME OFFICE POLICE (LONDON, ENGLAND) ACTIVITY SUMMARY
(March–August 1967)
(26-week period)

Public safety activity:		
Missing persons	74	
Incidents at sea	37	
Air/sea rescue	15	
	126	(15.2%)
Law enforcement and crime-related activity:		
Routine patrol	75	
Prison escapes	45	
Suspect searches	160	
Prisoner escort	21	
Surveillance	36	
Escort of valuable surface movements	63	
Crowd control	33	
Crime, etc.	33	
	466	(56.0%)
Traffic-related activity:		
Traffic control	38	
Traffic observation	116	
	154	(18.5%)
Other activity:		
Transportation	16	
Photography	21	
Experimental missions	19	
Reconnaissance	8	
Miscellaneous	22	
	86	(10.3%)
Total	832	

Source: Reference 35.

Chapter 2

HELICOPTER OPERATION FACTORS

The preceding section tabulated the spectrum of law enforcement related missions for which helicopters are employed as found in the survey. Chapter 2 examines the extent to which helicopters are employed in these missions. Factors examined include fleet composition, annual utilization, the demand for helicopter services, availability, sortie lengths, patrol altitudes, night operations, and weather minima.

2.1 Fleet Composition

Table 2–1 depicts the aircraft fleet composition for selected agencies. As shown in the table, the majority of the equipment consists of two- and three-place piston-engined helicopters. Many agencies are equipping or re-equipping with the turbine powered helicopters (Bell Jet Ranger and Fairchild-Hiller 1100) because of their higher performance (high speed and large useful load) and greater reliability. However, many agencies continue to order piston-engined helicopters because of their significantly lower initial acquisition and operating costs. The fixed-wing aircraft listed are used primarily for highway patrol, for speed checks and for executive transportation. In the case of the Royal Canadian Mounted Police, the aircraft are used to transport officers and supplies to remote or inaccessible areas and to transport witnesses to and from trials. The RCMP has essentially a "bush" type of flying operation.

In table 2–2, the equipment which has been installed in the aircraft of selected agencies is listed. Note that floats are used in aircraft which do extensive flying over water. Sirens, public address systems, and high-intensity lights are utilized in several law enforcement agency aircraft. Other installed equipment in police

Table 2–1

AIRCRAFT FLEET COMPOSITION BY AIRCRAFT TYPE FOR SELECTED LAW ENFORCEMENT AND RELATED AGENCIES

Agency	Bell 47G	Bell Jetranger	Fairchild Hiller 1100	Hughes 200/300	Other helicopters	Fixed wing
California Highway Patrol			3			
Chicago Fire Department	5	1				
Chicago Police Department	2					
Costa Mesa Police Department				2		
Dade County Public Safety Department	1					
Dallas Police Department	1			2		
Denver Police Department	[1] 2					
Fort Worth, City of	1					
Hennepin County Sheriff, Minn.	1					
Honolulu, City and County of	1					
Houston Police Department				3		
Huntington Beach Police Department				2		
Indiana State Police		3				
Indianapolis Airport Authority		1				
Illinois State Police						3 Cessna 182; 1 Cessna 310
Illinois State Toll Highway Authority		1				2 Cessna 182; 1 Cessna 337
Kansas City Police Department				2		
Los Angeles City Fire Department	2	2				
Los Angeles County Fire Department	2	1			1 Bell 204B	
Los Angeles County Sheriff	5			9		

[1] Plus one on order.

Table 2–1 (continued)

Agency	Bell 47G	Bell Jetranger	Fairchild Hiller 1100	Hughes 200/300	Other helicopters	Fixed wing
Los Angeles Police Department	6	1				
Louisiana Highway Patrol			3			
London Home Office Police	4					
Long Beach Police Department				3		
Maryland Marine Police					1 Brantly 305	
Maryland State Police		2				
Massachusetts State Police		1				
Memphis Police Department	1					
Michigan State Police			1			
Mississippi Highway Patrol	1		3			
Missouri State Highway Patrol	1					
Nassau County Police Department, New York			1			
Nebraska's Air Ambulance and Highway Assistance Program					2 Nat. Guard H–19	
New Jersey State Police			1		3 Enstrom F–28A	
New York City Police Department	1	3			2 Bell 47J	
New York State Police	1	3				1 Cessna 172
State of Ohio, Department of Highways					1 Bell 47J2A	
Ohio State Highway Patrol		2				
Oakland County Sheriff					1 Enstrom F–28A	
Pasadena Police Department					2 Enstrom F–28A	
Pennsylvania State Police	2					

Table 2–1 (continued)

Agency	Bell 47G	Bell Jetranger	Fairchild Hiller 1100	Hughes 200/300	Other Helicopters	Fixed wing
Peoria [a]		1				
Pittsburgh Police Department	1					
Pomona, Calif., city of	2					
Puerto Rico Police Department			2			
Royal Canadian Mounted Police						8 Beavers, 1 PT6 Turbo Beaver, 7 Others, 1 Beechcraft 18, 1 Grumman Goose, 1 Kingair A90 and 1 DHC 6 Twin Otter.
San Francisco Police Department	1					
Santa Mon. a, city of				2		
Seattle Police Department		1				
Suffolk County Police Department					1 Alouette II	
Tampa Police Department				2		
Tennessee Highway Patrol	2					
Texas Department of Public Safety	4	3				
Wichita Police Department				1		

[a] Privately owned, but used occasionally by law enforcement agencies.

Table 2–2

EQUIPMENT INSTALLED IN AIRCRAFT OF SELECTED LAW ENFORCEMENT AND RELATED AGENCIES

Department	Floats	Siren	P.A. system	High intensity light	Type radio(s)	Litters	Other equipment
Denver Police Department		x	x	x	(*)	x	TV camera, film camera.
Fort Worth (city of)				x	(*)		
Honolulu, city and county of	x	x	x	x	(*)	x	Water tank, life raft, cargo net, rope.
Chicago Fire Department					(*)		Life raft.
Chicago Police Department		x	x	x	9 ch police		
Hennepin County Sheriff, Minn.		x	x	x	4 ch police		Riot gun, first-aid kit.
Indianapolis (Airport Authority)					6 ch police		
Illinois State Toll Highway			x		(*)		
Kansas City Police Department	x			x	1 VHF A/C and 5 ch police	x	
Los Angeles City Fire Department					(*)		Water tank.
Los Angeles County Fire Department					(*)		
Los Angeles County Sheriff	x	x	x	x	4 ch police radio	x	
Los Angeles Police Department		x	x	x	MK 12–360 A/C and 2–4 ch police		
Memphis Police Department		x	x	x	VHF A/C and police radio		
Nassau County Police Department, New York	x				VHF A/C	x	Radar, life jackets, life raft.

* Data not available.

Table 2–2 (continued)

Department	Floats	Siren	P.A. system	High intensity light	Type radio(s)	Litters	Other equipment
Nebraska's Air Ambulance and Highway Assistance Program					(*)	4 per A/C	Body splint mattress, traffic flares, canes, and flags.
New York City Police Department	x		x	x	VHF A/C and 1–1 ch police		TV cameras, winch, special tools, armor plate, M–15 semiautomatic rifle.
New Jersey State Police	x	x	x	x	360 ch VHF A/C and 4 ch police (*)	x	16mm movie camera, first-aid equipment.
New York State Police Peoria **		x	x	Landing lights	1–ch FM police 360–ch VHF A/C		
Pennsylvania State Police				x	MK 12 A/C and 2 ch police	x	
Pomona California, city of		x	x	x	KY 95 A/C and 4 ch police	x	TV camera, water tank.
RCMP Royal Canadian Mounted Police	Installed on Beaver and Otter only				(*)		

* Data not available.
** Privately owned, but used occasionally by law enforcement agencies.

Table 2–3

ANNUAL HELICOPTER UTILIZATION FOR SELECTED AGENCIES

	Annual hours/A/C	Annual hours/fleet
Dade County Public Safety Department, Fla.	600	600
City of Fort Worth	1,240	1,240
Hennepin County Sheriff, Minn.	248 hrs/3 mo	248 hrs/3 mo
City and county of Honolulu	1,200	1,200
Indianapolis Airport Authority	960	960
Illinois State Toll Highway Authority	Jet Ranger 401 182 464 337 317 182 754	1,936
Kansas City (Mo.) Police Department	1,154	[1] 3,462
Los Angeles County Sheriff	940–1,030	13,200–14,400
Los Angeles Police Department	549/1st 6 mo. 1969	3842/1st 6 mo. 1969
Memphis Police Department	1,200	1,200
Nassau County Police Department	1,000	1,000
Nebraska's air ambulance and highway assistance program	192	384
New York City Police Department	600	3,600
Pennsylvania State Police	1,050	2,100
City of Pomona, Calif.	1,200	1,200
Home Office Police, London, England	N.A.	991/6 mo.

[1] Kansas City Police Department had three helicopters in 1969. As of February 1970, two were in service.
N.A.—Not available.

helicopters are the TV cameras used by Denver, New York City and Pomona; the radar used by Nassau County to monitor shipping and to locate boats in emergencies; and the armor plate used by the New York City Police Department.

2.2 Annual Utilization

The annual utilization of helicopters is examined in terms of annual hours per aircraft and annual hours per fleet.

Table 2–3 presents the annual hours per aircraft and annual hours per fleet for several agencies. Note that annual utilizations of 1,200 hours or more have been achieved. According to the Bell Helicopter Corp., the average helicopter in the United States flies

Table 2–4

PEAK PATROL[1] TIMES FOR SELECTED LAW ENFORCEMENT RELATED AGENCIES

Agency	Peak patrol time
City of Fort Worth	700 p.m.–11:00 p.m.
City and County of Honolulu	6:30 a.m.–8:00 a.m., 3:30 p.m.–5:30 p.m.
Indianapolis Airport Authority	8:00 a.m.–10:00 a.m., 4:00 p.m.–6:00 p.m.
Kansas City (Mo.) Police Department	6:00 p.m.–2:00 a.m.
Los Angeles City Fire Department	10:00 a.m.–5:00 p.m.
Los Angeles County Sheriff	11:00 a.m.–3:00 a.m.
Nassau County Police Department, New York	6:00 a.m.–9:00 p.m.
Nebraska [illegible] Ambulance and Highway Assistance Program	Weekends
New York City Police Department	6:30 a.m.–9:00 p.m.
Home Office Police, London, England	8:00 a.m.–10:00 a.m., 5:00 p.m.–7:00 p.m.

[1] Two types of patrol activities are included. Traffic patrol (Honolulu, Indianapolis, and Nebraska) is concentrated during rush hours or other peak traffic periods while general patrol activities are emphasized during periods of peak criminal occurrences.

approximately 720 hours per year. In examining the data in table 2–3, however, one must remember that high aircraft utilization will be difficult to achieve in some locations due to poor flying weather (low clouds, poor visibility, and icing) during significant portions of the year.

2.3 Peak Patrol Periods

Table 2–4 shows the peak patrol periods for several law enforcement agencies employing helicopters for law enforcement related activities. It will be noted that some law enforcement agencies emphasize using their helicopters for patrol work during periods of peak traffic congestion. These include the city and county of Honolulu, and the Indianapolis Airport Authority. Other agencies, such as the Los Angeles County Sheriff and the Kansas City (Mo.) Police Department, concentrate on providing patrols during peak daily periods of certain types of criminal activity (e.g., burglary, robbery, rape, and vandalism). In fact, the Kansas City Police Department uses a computer to predict times and locations of probable criminal activity and assigns helicopter patrols on that basis.

2.4 Home Office Police Experiment

Figure 2–1 depicts the hourly distribution of requests for emer-

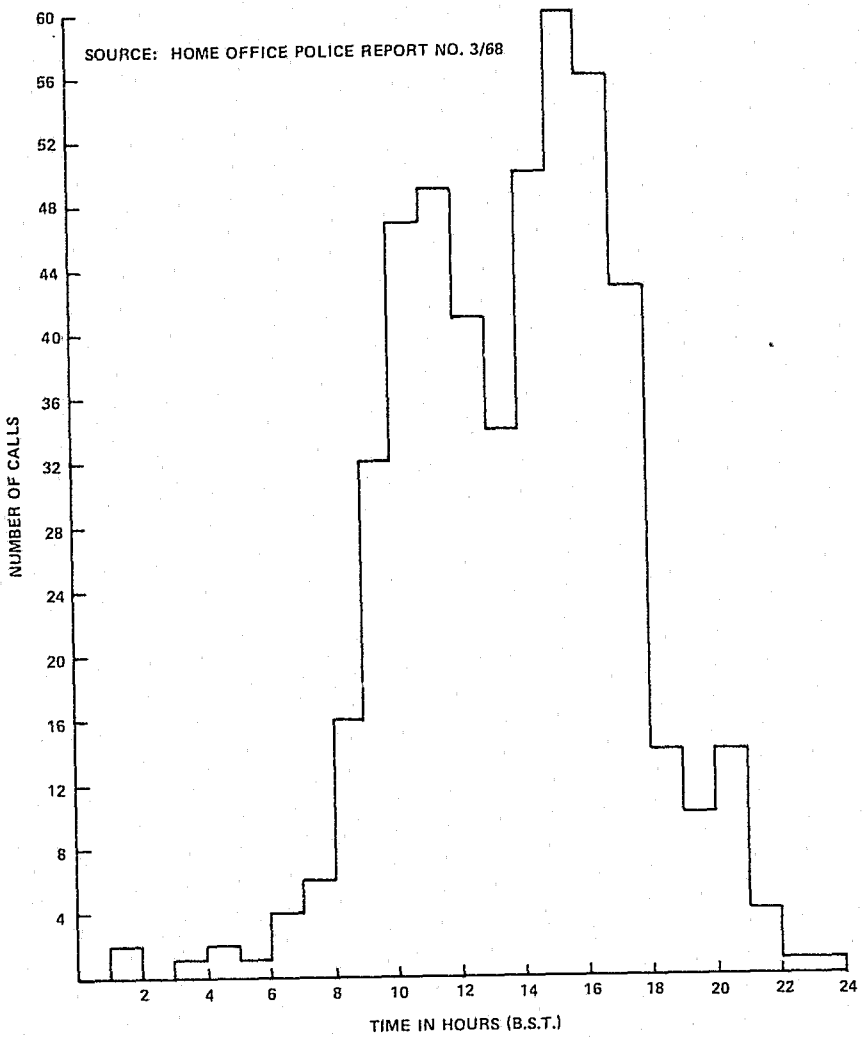

Figure 2–1 Hourly Distribution of Calls in the Emergency Mode Home Office Police March – August 1967

Source: Reference 35.

gency assistance for March through August for the Home Office Police, London. Unfortunately, comparable data is not readily available for U.S. police air mobility operations. Collection of this type of data is important because of its relevance in scheduling air operations in an effective manner. It should be noted that different missions (e.g., traffic vs. crime) will create different time patterns of usage.

Table 2–5

HELICOPTER UNAVAILABILITY SUMMARY
HOME OFFICE POLICE
(March–August 1967)

More helicopters required:	160	
Helicopters fully committed	50	
Helicopters under maintenance	210	(14.1%)
Poor flight conditions:	23	
Bad weather at base	1	
Bad weather at scene of incident	8	
Could not respond due to darkness	32	(8.2%)
Equipment limitations:	6	
Helicopter not large enough	35	
Response time too great	41	(10.6%)
Other reasons:	15	
Requires flying in restricted area	44	
Call cancelled before take-off	15	
Air/sea helicopter used	31	
Miscellaneous	105	(27.1%)

Source: Reference 35.

2.5 Helicopter Availability

The ability of a law enforcement agency to dispatch a helicopter to answer an emergency request for assistance may be expressed in terms of availability. During the six-month test carried out by the Home Office Police, the helicopter was able to respond to 444 of the 832 requests for its service (54%). Table 2–5 lists the reasons why the helicopter did not answer calls for assistance.

The Home Office Police experiment was conducted over 178 days using four helicopters, providing a commitment of 712 helicopter days. A total of 202 helicopter days was lost due to maintenance problems. The down time rate is therefore 202/712 or 28.3 percent; i.e., 28.3 percent of the time the helicopter was disabled (*35*).

The Kansas City Police Department cites maintenance and weather as two prime factors associated with helicopter unavailability for scheduled patrols. During the period July–December 1969, a total of 510 hours, or 20.3 percent of the assigned patrol time, were lost to weather and/or maintenance (*24*).

2.6 Average Time Airborne or Away From Base

Two types of statistics may be used to describe the average time used by the helicopter in the performance of various missions. One way these time histories may be described is in terms of the average time aloft per flight or mission; another is in terms of average time away from base in the event that the aircraft lands before completing the activity (e.g., to refuel or brief a crew on the ground). For both the city of Fort Worth (*7*) and the Kansas City Police Department, the average time aloft for all flights is approximately 54 minutes. For the Los Angeles County Sheriff, scheduled patrols average 1 hour, 36 minutes. In the Home Office Police experiment, the average duration for all flights was 2 hours, 14 minutes. The average time spent away from base (i.e., including time on the ground) for any one incident was 2 hours, 22 minutes.

The maximum continuous time aloft is constrained by two factors—helicopter endurance and pilot fatigue. As is shown in chapter 5, the 3-seat piston-engined helicopters have *maximum* endurances ranging from 3.0 to 3.7 hours. Of these times, at least 30 minutes must be treated as reserve fuel. Pilot fatigue is also a critically limiting factor, even more than in airplanes, because of the higher pilot workload, and higher noise and vibration levels. As an example, the Pennsylvania State Police limits the maximum continuous flight time to 3 hours (*26*).

2.7 Patrol Altitudes Employed

Patrol altitudes are chosen on the basis of several factors which include FAA regulations and restrictions imposed by air traffic control facilities, type of mission, height of obstructions which may present hazards to the helicopter (tall buildings, radio and TV towers, high tension lines, bridges, water towers, hills, etc.), availability of landing areas, weather conditions, helicopter noise level, and whether the patrol is conducted in daylight or at night. Table 2–6 lists representative patrol altitudes employed by several law enforcement agencies.

The problems associated with low altitude patrol experienced by the Los Angeles County Sheriff (Project Sky Knight) are worthy of note. When Project Sky Knight was initiated in Lakewood, California in 1966, the helicopter patrolled at 750 feet. However, the high noise level so annoyed sleeping residents that City Hall was bombarded with complaints. In response to the noise complaints, the helicopter was then operated at 1,500 feet. However, it was found that this altitude was considerably less effective for surveillance. The manufacturer of the helicopter then undertook a modification program to quiet the helicopter. The primary

Table 2–6

AVERAGE PATROL ALTITUDES EMPLOYED BY SELECTED LAW ENFORCEMENT AGENCIES

Agency	Altitude
Hennepin County Sheriff, Minn.	400 to 600 feet.
City and County of Honolulu	1,500 feet.
Illinois State Toll Highway Authority	1,000 to 1,500 feet for highway patrol. 1,000 feet or lower for manhunts.
Los Angeles County Sheriff	500 to 600 feet during daylight. 700 to 800 feet at night.
Pennsylvania State Police	300 feet or more.
City of Pomona, Calif.	500 to 1000 feet.

source of noise was found to be the tail rotor. Corrective modifications consisted of increasing the tail rotor diameter and gearing it to turn more slowly. Additionally, partial mufflers were installed. Upon resuming the night patrols, the pilots found that they could patrol as low as 500 feet without disturbing sleeping residents (*19*).

2.8 Night Operations

A limited number of law enforcement agencies employ helicopters extensively for night patrol activities using high intensity searchlights for crime deterrence and crime detection. The Los Angeles County Sheriff (Project Sky Knight) pioneered the use of intensive helicopter night patrol and operates routinely until 3 a.m. Agencies which employ night patrols extensively are the Kansas City Police Department, with routine patrols lasting until 2 a.m., the City of Denver, the Memphis Police Department, which conducts 50 percent of its operations at night, the city of Fort Worth, the Los Angeles Police Department, and the Hennepin County Sheriff's Office, Minn. Other agencies which conduct some night operations include the New York City Police Department, Nassau County Police Department, city and county of Honolulu, Chicago Police Department, and the city of Pomona, Calif.

2.9 Weather Minima

Weather minima applied by agencies using helicopters are based upon several factors which include: FAA regulations, FAA control zones, possible obstructions to the flight, possible landing areas en route, urgency of the mission, helicopter capabilities and installed equipment, and pilot qualifications. The Peoria Journal

Star, which makes its privately owned Jet Ranger available to law enforcement agencies for special missions, flies in weather down to 500 foot ceilings and 1-mile visibility. The Illinois State Toll Highway Authority uses its Jet Ranger in weather down to three-fourth-mile visibility and 150 to 200 foot ceilings depending upon the route of flight and the nature of the emergency. On the other hand, the fixed-wing aircraft used by the Authority for speed checks are operated only when the ceiling is 1,500 feet or more and the visibility is greater than 4 miles.

Chapter 3

HELICOPTER EFFECTIVENESS

To gauge the effectiveness of helicopters in law enforcement roles, police departments have used the following measures: Changes in crime rates, number of criminals apprehended, and number of rescues. Another measure of helicopter effectiveness that is used (and which may be ultimately reflected in the number of apprehensions and rescues) is the reaction time following calls for assistance. Other effectiveness measures can be developed as the knowledge of the law enforcement role of aircraft improves.

3.1 Crime Rates

Decreases in crime rates may be cited for several cities to demonstrate the crime deterrent capability of helicopter patrols.

The illustration most often used is Project Sky Knight. In this 18-month study, sharp contrasts were seen between the crime rate trends in the city of Lakewood (which received intensive day and night patrols by 3 helicopters) and those of the entire Los Angeles County. During the fiscal year 1966–67, actual major crimes decreased in the city of Lakewood by 8 percent, while they increased by 9 percent in Los Angeles County as a whole. The crime rate per 100,000 population decreased 11 percent in the City of Lakewood while rising 8 percent in the entire Los Angeles County area. Robberies fell by 6 percent for Lakewood while they rose 22 percent in Los Angeles County. Similarly, burglaries decreased 7 percent in Lakewood while increasing 9 percent in Los Angeles County (*29*).

Other cities have experienced similar results. During the first 9 months of 1969, Kansas City, Mo., had increases each month in the number of robberies, burglaries, and auto thefts committed. In those selected areas of Kansas City which were designated for heli-

copter patrol, the total number of crimes per month (in the aforementioned categories) decreased. The patrol areas selected were those with the highest number of criminal occurrences within the entire city. *Within the patrol areas,* the number of crimes in June showed a decrease of 13.7 percent from the previous 5-month average of 159 crimes per month. The number of crimes in July (38), showed a 7.4 percent decrease from the previous 6-month average of 149. In August the patrol area was changed. August, with 154 crimes had a 3 percent decrease as compared to the previous 7-month average of 159. In September, the patrol areas were again revised and the 151 crimes which occurred in those areas represented a 7.6 percent decrease from the 163.5 crimes per month average of the first 6 months of 1969. During the last 6 months of 1969, the number of crimes in the patrol areas decreased 13.5 percent as compared with those crimes which occurred in the first 6 months.

Hennepin County, Minn., also experienced reductions in crime rates coinciding with the inauguration of helicopter patrols by the County Sheriff's office. Minneapolis is excluded from the county data since patrols were not conducted within the city limits. The total crime rate for January 1969 was 19 percent lower than that of January 1968. The total crime rate decrease between February 1968 and February 1969 was about one-half percent. January figures for burglary show a 14 percent decrease between 1968 and 1969 and an 11 percent reduction occurred between February 1968 and 1969.[1]

The crime rate reductions which appear to have been achieved are very encouraging. However, it must be pointed out that it is difficult to prove that a helicopter patrol *caused* a decrease in the crime rate; one can only demonstrate correlations and try to account for other possible reasons for the decrease. Similarly, in comparing crime rates of patrolled and adjoining unpatrolled areas, one is in fact comparing two areas whose crime rates may not have been similar even if both areas were unpatrolled. Helicopter patrols concentrated in one area may decrease the crime rate within the patrol area while at the same time causing increases in the crime rates in the surrounding unpatrolled areas. Furthermore, it may be that the helicopter was not the only major change instituted that had an effect on crime. Despite these questions, it can be said that the helicopter has had a beneficial effect in reducing or deterring certain types of crimes in certain cities.[2]

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[1] Letter to Sheriff Omott from E. W. Phillips, President of Executive Helicopters, Inc., Apr. 21, 1969.

[2] Note that the New York City Police Department has had helicopters for over 20 years but does not use them primarily for preventive patrol, because of the vertical nature of much of the city's construction.

Table 3–1

FELONY ARRESTS ACCOUNTED FOR
BY HELICOPTER—MEMPHIS POLICE DEPARTMENT
(October–December 1969)

Type of felony	Number arrested	Percent
Burglary	5	10.4
Robbery	5	10.4
Auto theft	12	25.0
Shootings	6	12.5
Larceny	13	27.1
Armed person	1	2.1
Prowlers	6	12.5
	48	100.0

Source: Captain Glenn Moore, Helicopter Patrol Division, Memphis Police Department

3.2 Criminal Apprehensions

The number of apprehensions of criminals attributed to helicopter use can be cited as a measure of the usefulness of helicopters in police work.

The Memphis Police Department, for example, credits its single helicopter with 48 felony arrests for the period October–December 1969 (see table 3–1). The Kansas City Police Department helicopters have also contributed to many arrests. During March 1969 their helicopter unit was "able to directly assist in 16 arrests for burglary, auto theft, minors in possession of alcoholic beverages and public disturbances." In April, the unit "directly assisted in 21 arrests relating to robberies, burglary, auto theft, public disturbances and prowlers." In May and June, the unit was able to "directly assist in 34 arrests for burglary, auto thefts, public disturbances, robberies, assault, mental patient, tresspassers, school truants . . . and was also instrumental in two high-speed auto chases" (*21*). During the entire year of 1969 the helicopter unit assisted in 362 arrests (table 3–2).

The Los Angeles County Sheriff's Office found that in the first 12 months of Project Sky Knight the air patrol was instrumental in the arrests of five robbery suspects, five theft suspects, six major traffic offenders, seven criminal assault suspects, eight auto theft suspects and 20 burglary suspects.

In the Los Angeles Police Department's ASTRO program, arrests accounted for by the use of helicopters in the first 6 months of the program were significant. In the West Valley Division, the helicopter was credited with 37.6 percent of the apprehensions on day

Table 3–2

AIR ACTIVITIES SUMMARY, KANSAS CITY POLICE DEPARTMENT
(January–December 1969)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Patrol flight hours	209.0	127.5	264.6	333.2	273.5	256.1	208.5	301.2	306.2	248 5	239.9	278.6	2976.8
Calls for service, flight hours	2.2	14.7	35.8	48.7	31.9	33.0	39.1	30.0	34.3	36 0	18 0	11.8	335.5
Training flight, hours	48.5	32.8	17.7	7.6	5.5	11.3	18.2	2.7	13.8	2.8	.5	3.9	150 0
Arrests [1]	5	17	31	27	32	30	48	45	35	25	45	22	362
Car checks [1]	2	16	25	17	17	31	24	38	38	33	30	18	289
Pedestrian checks [1]	—	—	5	11	10	17	4	22	42	21	6	6	144
Building checks [1]	—	—	5	11	10	17	4	22	42	21	6	6	144
Area illumination	—	14	11	9	20	8	10	12	13	13	19	3	132
Business building roof inspections	—	6	9	22	19	14	27	13	18	11	16	8	163
Stolen cars recovered [1]	1	5	21	18	20	22	14	19	—	15	15	4	154
Prowler calls [1]	5	31	26	40	30	49	29	43	51	33	31	51	419
Robbery calls [1]	3	16	20	19	14	17	20	13	22	11	9	14	178
Car chases [1]	2	2	4	2	8	5	3	8	4	0	7	2	56
Alarm calls [1]	3	8	4	15	11	15	14	8	39	11	11	8	147
Fires detected	—	2	5	1	—	1	1	3	2	—	4	2	21
Aerial searches and surveillances	—	29	44	39	66	79	59	85	20	47	30	10	508
Assistance to outside agencies	—	5	6	11	7	3	—	2	4	6	4	3	51
Traffic control	—	3	3	5	4	2	2	1	2	—	2	—	24

[1] Assist only.

Source: Captain Lester Harris, Planning and Research Unit, Kansas City Police Department.

watch and 35.2 percent on night watch for those cases in which the helicopter was called. Similarly in the University Division, helicopters accounted for 24.7 percent of the day watch arrests and 21.3 percent of those on night watch.

Both helicopters and fixed wing aircraft have been effectively employed in highway speed law enforcement. Two agencies making large numbers of traffic violation apprehensions are the New York State Police and the Illinois State Toll Highway Authority. The New York State Police aircraft made 876 speeding arrests in 1968 during 1,075 flying hours. Twenty-six percent of these apprehended were at speeds from 85 to 113 miles per hour. Between May 1, 1968, and April 30, 1969, the State Police attached to the Illinois State Toll Highway Authority issued 3,025 speeder citations and 202 warning citations. Of these, over 100 were exceeding 100 mph [5].

While using the number of criminal and traffic apprehensions as a measure of effectiveness does have some usefulness as an indicator, it also has some difficulties associated with it. First, it is probably almost universally true that the helicopter assists with or makes possible the arrest (i.e., acts as a command post to coordinate the apprehension and maintains surveillance of the suspect) rather than actually lands and makes the arrest. That is to say, most of the arrests would not be possible without the cars on the ground to physically make the arrest. (In fact, the State Police attached to the Illinois State Toll Highway Authority do not apprehend 50 percent of the speeders clocked by the air units because there are not enough cars to make the apprehensions.) Secondly, in cases where police respond to a call, there is virtually no data to indicate (and perhaps no way of ascertaining) the percentages of cases in which the arrest would not have been made without the helicopter's assistance.

No analysis has been performed to determine at what point money is better spent procuring aircraft instead of more cars. Preliminary analysis indicates that providing continuous helicopter patrol with one helicopter airborne at all times is at least as expensive as four patrol cars each patrolling 21 hours a day. The type of activity for which the patrol car cannot be substituted for the helicopter is the inspection of backyards, rooftops, and other areas not visible from the road, i.e., where a "birds-eye" view is required. Many incidents of this type have been cited in the Los Angeles Police Department "Helicopter Section Incident Log."

3.3 Rescues

Literally hundreds of rescues each year are effected by helicopters operated by law enforcement related agencies. Most, if not

all, of the police department, fire department and municipally-owned helicopters are used for some types of rescue work. Honolulu's helicopter, for example, is used to rescue surfers and swimmers. In 1967, the New York City Police Department responded to 142 calls for boats in distress, 110 calls for persons on cliffs, in water, etc., and 273 calls to search for missing persons, airplanes, and boats. Perhaps the most dramatic example of the potential of the helicopter for rescue work is the Chicago Fire Department. In the 1-year period since the inception of its helicopter unit in 1965, the Department's two helicopters have been used in over 1,000 rescues which have included removing an injured workman from the top of a building, rescuing the eight survivors of a plane crash in Lake Michigan, towing a capsized sailboat and its crew to shore, and retrieving a dog from an ice floe (20).

3.4 Response Times

One of the primary reasons for the effectiveness of the helicopter in criminal apprehensions, air ambulance and rescue activities is its rapid reaction time to emergency calls, particularly if the helicopter is already airborne.

In the ASTRO program of the Los Angeles Police Department for the period January–June 1968 the average travel time was found to be 1.5 minutes. "On almost every call, the helicopter unit was the first on the scene." In Project Sky Knight the response time for the Los Angeles County Sheriff's helicopters was similarly rapid, usually within 2 minutes (23).

The potential of the helicopter, in terms of travel time, is fully realized only when the helicopter is already airborne. This is because the delays in getting airborne (preflight inspection, starting, warmup, pretakeoff checks) may be lengthy enough so that for short distances, ground transportation may be faster. The problem is not as acute for turbine helicopters since, unlike reciprocating engined helicopters, they require no warm-up time.

However, helicopters which are not already airborne still may have faster travel times than patrol cars or ambulances, particularly in cases where significant distances or circuitous routes are involved and or traffic is congested (urban area, rush hours, holidays, etc.). For example, the helicopter ambulance study conducted in Pennsylvania (8) made comparisons between helicopters and conventional ground ambulance trip times. It was found that the helicopter reduced trip times by as little as 30 percent on short

Bell Model 47J-2A. This helicopter is a 4-place, piston-engined helicopter with a 91-mph cruising speed.

trips in light traffic and as much as 85 percent on longer trips during periods of heavy traffic. The time required to get airborne (i.e., the time between receiving the emergency call and liftoff) ranged from 1 to 5 minutes with an average of 2 minutes required. Flying time to the accident scene ranged from 1 to 35 minutes with an average of 7.5 minutes. Average one-way trip distance from the helicopter base to the accident scene was 8 miles. It is particularly significant that the helicopter response times were lower than those of conventional ambulances even though the average trip distances to the accident scene were shorter for the ground ambulances because 13 ambulance companies were involved in the tests.

Response time has much significance in medical evacuation as it does in criminal apprehension activities. According to the director of the trauma unit at Cook County Hospital (as quoted in Medical World News), "For every 30 minutes that elapse between the accident and the time that the patient gets definitive care, the mortality rate can be expected to increase threefold." Dr. James B. Mason, assistant director of the American College of Surgeons, states that, in his opinion, 25 percent of those permanently disabled in highway mishaps need not be crippled if proper care at the scene and rapid transportation to treatment centers were available.

In order to put these statements in proper perspective it should be noted that only a fraction of all ambulance calls are true emergencies,[4] in which response time is of critical importance. Furthermore, the greatest contribution to the delay in the delivery of emergency medical service frequently reflects a communications problem rather than a transportation problem. The proper officials may not be notified of the accident for a long time, either because of the lack of communications convenient to the highway or because of bystander apathy. Nevertheless, helicopter ambulances are useful in medical evacuation from accidents on major limited access highways where traffic blockage may hinder ground emergency vehicles.

With respect to helicopter ambulance operations, there is a divergence of opinion regarding the extent to which diagnosis and stabilization treatment should be performed at the scene and/or in-flight. Some argue that the patient should be delivered to the hospital as rapidly as possible, to be treated there. Others recognize the value of in-flight diagnosis and treatment, but feel that the added expensive equipment required may mean economic infeasibility and will detract from the multiuse potential of the vehicle.

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[4] See Table 1–8, Page 9.

It appears, however, that opinion is shifting towards providing increased training and providing additional emergency equipment so that the ambulance attendant can stabilize the patient's condition at the scene and en route to the hospital. These stabilization techniques include insertion of airways, control of bleeding, use of resuscitators, heart massage machines, heart monitors, and the administration of drugs and intravenous fluids.

Chapter 4

HELICOPTER CAPABILITIES AND LIMITATIONS

This section examines the performance characteristics of certain helicopters. The data presented here can be used to infer the capabilities of the vehicles in performing specific law enforcement tasks. Performance parameters presented include useful load (gross weight less empty weight), speed, range, payload, hover ceilings, and rates of climb.

4.1 General Considerations

Many aircraft types are ideally suited for some law enforcement tasks, but are inadequate for others. For example, small, economical three-place piston-engined helicopters have proven to be useful in night patrols using high intensity searchlights to illuminate residential, commercial and industrial areas. This same type of helicopter, however, has been left far behind during high speed auto chases. This usually occurred where the pursued vehicle escaped on a highway, traveling into a strong wind. Similarly, conventional fixed-wing aircraft have proven very effective in search operations, highway surveillance and speed control and are less expensive than helicopters or STOLs. However, there are many missions for which they are not well suited because they can neither hover nor land in a small area (e.g., crowd control, air evacuation, and rescue missions).

Aircraft performance also must be considered in the light of the climate and terrain in the area of intended operations. High temperatures and/or high altitudes (i.e., high "density altitude") seriously degrade aircraft performance to the extent that many helicopters cannot hover with meaningful payloads at high density altitudes. For example, Denver is above 5,000 feet and has summer

temperatures in the mid-seventies. For this reason, the Denver Police Department selected turbo-supercharged helicopters (which have excellent high altitude performance) to meet its specialized needs.

Table 4–1 presents helicopter performance data for several types of helicopters which either are or could be used for some aspects of law enforcement activities. All performance figures given pertain to flight at the gross weight listed (i.e., the helicopters will fly faster, higher, etc., with reduced fuel and payload).

4.2 Useful Load

Several of the performance parameters listed are of particular importance. Useful load, the difference between gross weight and empty weight, indirectly tells how many crewmen, passengers and/or how much special equipment may be carried. Useful load includes fuel, which requires a tradeoff between payload (passengers and equipment) and fuel (and hence range or endurance). Related to useful load is the number of seats. Table 4–2 shows the number of seats required vs. mission type as experienced by the Home Office Police, London, England.

4.3 Speed

Maximum speed and cruise speed are not important for patrol, observation, or command post activities. They are relevant, however, in responding to emergency calls (e.g., "burglar there now" or medical evacuation), high speed auto chases, and transportation over long distances.

4.4 Endurance

Endurance is often important in covert surveillance activities and is important in general patrol activities in that with greater endurance, a greater percentage of total flight time is spent "on station" rather than flying to and from the patrol area to refuel. However, pilot fatigue is often the limiting factor in aircraft endurance, particularly in helicopters. As was mentioned in chapter 2, at least one agency limits its pilots flying time to 3 hours of continuous flying and a maximum of 5 hours per day. The U.S. Army recommends that no single helicopter mission last longer than 2 hours without changing pilots.[1]

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[1] Personal communication from Col. Charles Drenz, U.S. Army Aviation Logistics Office.

Table 4–1

HELICOPTER PERFORMANCE

		VOUGHT HELICOPTER			
	Sud–Aviation SA 341	Alouette II	Alouette III	Brantly B2B	Brantly 305
Number of seats	5	5	7	2	5
Engine type	Turbine	Turbine	Turbine	Reciprocating	Reciprocating
Engine manufacturer and horsepower	Turbomeca, 600 shp	Turbomeca, 360 shp	Turbomeca 858 derated to 542 shp	Lycoming, 180 hp	Lycoming, 305 hp
Gross weight (lbs)	3,527	3,527	4,630	1,670	3,000
Empty weight (lbs)	1,742	1,975	2,435	1,020	1,800
Useful load (lbs)	1,785	1,552	2,195	650	1,200
Maximum speed (m.p.h.)	168	127	130	100	120
Cruise speed (m.p.h.)	152	105	118	90	110
Range (miles)	447	447	310	250 (with reserve)	200 (with reserve)
Endurance (hrs)	4	5.3 (max)	(*)	(*)	(*)
Rate of climb (fpm)	2,170	1,312	1,085	1,960	975
Hover ceiling, IGE [1] (ft)	12,800	4,985	6,550	6,700	4,080
Hover ceiling, OGE [2] (ft)	10,850	3,115	1,800	(*)	(*)
Service ceiling (ft)	18,750	10,800	13,950	(*)	(*)

[1] IGE—In ground effect or hovering with landing skids 2 to 3 feet above the ground.
[2] OGE—Out of ground effect or more than one rotor diameter (25 to 35 feet) above the ground.
[*] Information not readily available.

Table 4–1 (continued)

	Bell 47G–3	Bell, 47G–4	Bell 47G–5	Bell 206–A Jet Ranger	Enstrom F–28A
Number of seats	3	3	3	5	3
Engine type	Reciprocating Turbo supercharged	Reciprocating	Reciprocating	Turbine	Reciprocating
Engine manufacturer and horsepower	Lycoming, 280 shp	Lycoming, 305 shp derated to 280 shp	Lycoming, 220 shp (continuous)	Allison, 317 shp	Lycoming, 205 shp
Gross weight (lbs)	2,950	2,950	2,850	3,000	2,150
Empty weight (lbs)	1,915 †	1,856	1,672	1,460	1,450
Useful load (lbs)	1,035	1,094	1,178	1,540	700
Maximum speed (m.p.h.)	105	105	105	150	112
Cruise speed (m.p.h.)	88	85–90	81–86	122	100
Range (miles)	248	252	256 (no reserve)	392 (no reserve)	235 (no reserve)
Endurance (hrs)	3.7	3.7 hrs	3.7 hrs	4 hrs, 16 min	3.0
Rate of climb (fpm)	990	800	860	1,450	1,050
Hovering ceiling IGE (ft)	16,600	7,700	5,900	9,100	6,000
Hovering ceiling OGE (ft)	12,330	3,900	1,350	3,500	3,400
Service ceiling (ft)	18,400	11,200	10,500	17,700	12,000

† Standard configuration weight.

Table 4–1 (continued)

	Fairchild–Hiller FH–1100	Hughes 300C	Hughes 500	Scheutzow Model B
Number of seats	5	3	5	2
Engine type	Turbine	Reciprocating	Turbine	Reciprocating
Engine manufacturer and horsepower	Allison, 317 shp (torque limited to 274 shp)	Lycoming, 180 hp	Allison, 317 shp (torque limited to 278 shp for takeoff and 243 shp. max. continuous)	Lycoming, 165 shp
Gross weight (lbs)	2,750	1,900	2,550	1,550
Empty weight (lbs)	1,415	1,025	1,126	1,000
Useful load (lbs)	1,335	875	1,424	550
Maximum speed (m.p.h.)	127 (at sea level)	105	150	85
Cruise speed (m.p.h.)	125	90–100	144	80
Range (miles)	400 (no reserve)	255	377	175 (normal)
Endurance (hrs)	4.3	3.3	3.6	N.A.
Rate of climb (fpm)	1,600	1,140	1,700	1,250
Hovering ceiling, IGE (ft)	13,000	7,600	8,200	10,800
Hovering ceiling OGE (ft)	8,400	5,200	5,300	7,200
Service ceiling (ft)	14,100	13,200	14,450	14,000

Source: Manufacturers' data; Rotor and Wing, June 1969; and Jane's **All the World's Aircraft 1969–70.**

Table 4–2

SIZE OF HELICOPTER REQUIRED AGAINST TYPE OF OPERATION

Type of Mission	NUMBER OF SEATS REQUIRED				
	3 seats	4 seats	5 seats	6 seats	Percent requiring 3 seats
Routine patrol	70	1			99
Ecapes from prison	15				100
Searches for suspects	80	3	1		95
Maintaining surveillance	23				100
Escort of valuable surface movements	26				100
Traffic control	12				100
Traffic observation	63	1			98
Crowd control	11				100
Search for missing persons	27	2	1		90
Transportation	1	3	2	1	14
Photography	17	2			90
Prisoner escort	6			1	86
Incidents at sea	8	2	1		73
Air/Sea rescues	(None attended)				
Crime: Others	27	1			96
Experimental missions	12	2			86
Reconnaissance	5		1		83
Others	11		2	2	73

Source: Reference 35.

4.5 Service Ceiling

Service ceiling is an indicator of high altitude performance capability. It is a measure of the maximum altitude at which an aircraft can maintain a climb rate of 100 feet per minute on a standard day.

4.6 Hover Ceiling

The hover ceiling OGE (out of ground effect) is the maximum altitude (on a standard day) at which a helicopter can hover without being in close proximity (approximately one rotor diameter)[2] to the ground. Above this hover ceiling, the helicopter must maintain some forward speed merely to maintain altitude while not in close proximity with the ground. This occurs because the heli-

[2] For helicopters typically used for police work, one rotor diameter is 25 to 35 ft.

copter becomes power limited at high altitudes and because more power is required in the hover than for forward flight.

Hover ceiling IGE (in ground effect) is the maximum altitude at which a helicopter can hover. Above that altitude, the helicopter can neither hover nor takeoff vertically and must, in fact, make a running takeoff like fixed wing aircraft.

4.7 Height-Velocity Envelope

Another very important performance parameter for helicopters is the height-velocity envelope.[3] This envelope represents those combinations of airspeed and altitude from which a successful landing could not be made should the engine fail.

Figure 4–1 illustrates the height velocity curves for three representative 3-place helicopters. The shaded areas represent the dangerous flight regimes for these helicopters. Normally, helicopters do not operate within this area. Occasionally, however, the successful completion of certain types of missions will require operation within the "dead man's curve." These types of operations include lifting special equipment to the tops of towers or buildings and certain types of rescue operations.

Choosing a helicopter with a favorable height-velocity envelope (i.e., minimum area within the curves) generally implies a safer operation since there is greater leeway with which the helicopter may be operated without compromising safety. Twin-engine helicopters generally have more favorable height velocity curves than do single engined helicopters, but their high initial costs may put them out of reach for all but the very largest law enforcement agencies. Also, if operations are performed within the height-velocity envelope, the use of turbine powered helicopters is preferable because of their higher engine reliability.

4.8 Noise

Another parameter related to helicopter performance is noise. For certain missions, the amount of noise generated by a helicopter has a definite influence upon the effectiveness with which the helicopter can be used. As was mentioned earlier in chapter 2, complaints due to helicopter noise forced the Los Angeles County Sheriff's helicopters to patrol at higher (and less effective) altitudes until the helicopters were modified with quiet tail rotors and mufflers.

A quiet helicopter also is advantageous from the surprise aspect

[3] Often referred to as the "dead man's curve."

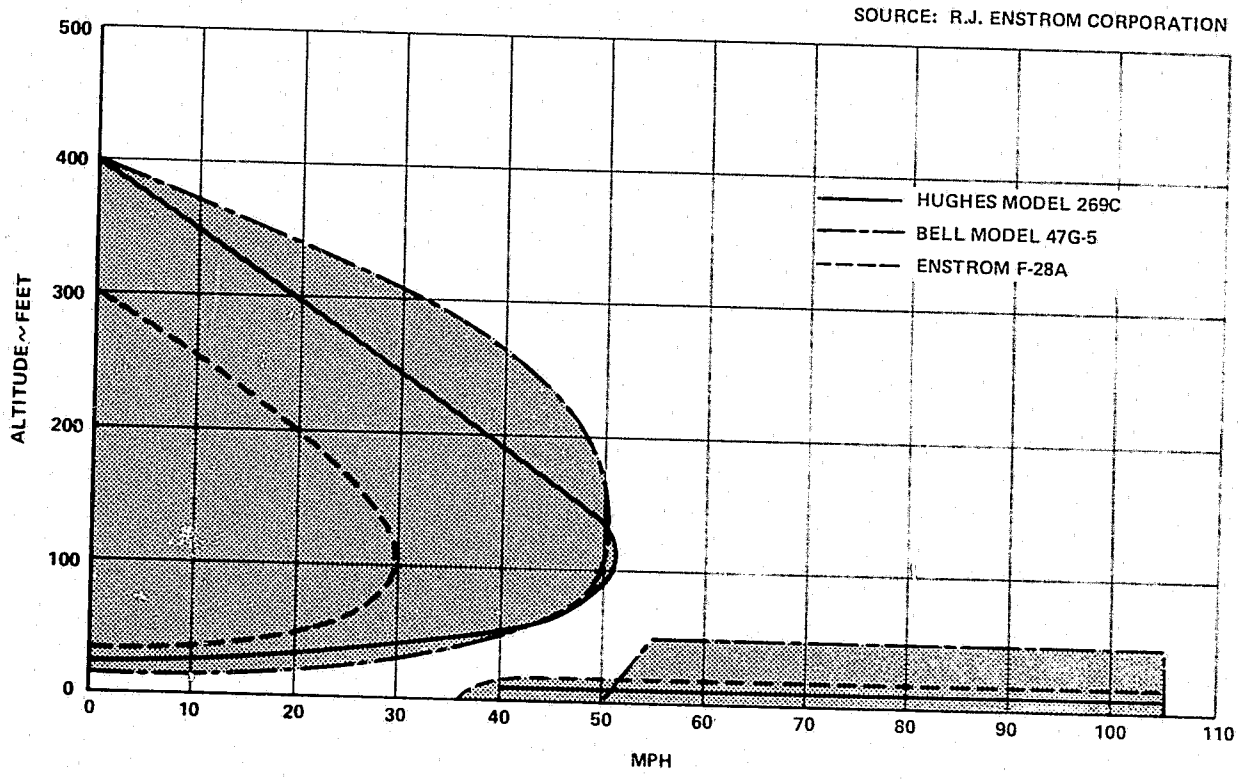

Figure 4–1 Height-Velocity Diagram

Table 4–3

HELICOPTER NOISE LEVELS
(Perceived Noise Level, PNdB)

	Bell 47G2A	Enstrom F–28A	Hughes 269B	Hughes 269B, special muffler and tail rotor
Flight condition I: (maximum lift off data taken 200 feet from aircraft)	106.6	91.4	101.5	93.6
Flight condition II: (maximum levels for 360° hovering turn approximately 6 feet in altitude. Data taken 200 feet from aircraft)	95.4	92.9	97.1	94.6
Flight condition III (60-m.p.h. fly-over at 500 feet)	87.7	83.6	83.3	84.0

Test Conditions: Temperature: 85°F
Weather: Clear
Wind: 5–10 m.p.h.

Discussion: The comparative data listed in the preceding table is presented in perceived-noise levels (units-PNdB). Perceived noise is derived with the criterion of annoyance being the determining factor. This is commonly used and accepted as being the preferred unit for judging acceptability of aircraft.

Source: Tests performed for R. J. Enstrom Corp., by Noise Unlimited, Inc.

in responding to certain types of emergency law enforcement missions (e.g., response to silent alarms or "burglar there now" calls). With a quiet helicopter, a criminal has less warning that the police are coming and is more likely to be apprehended.

Helicopter noise levels have been compared for various models in table 4–3. This data summarizes tests performed for the R. J. Enstrom Corp. by Noise Unlimited, Inc. These noise levels are presented in terms of decibels of perceived noise levels (PNdB), which are a measure of acoustic annoyance. The helicopter tests compared noise levels for flights at a near maximum gross weight for three different flight conditions: (1) Lift off, with data measured from 200 feet away; (2) maximum levels for 360 degree hovering turn at 6-foot altitude with data measured from 200 feet away; and (3) 60-miles per hour flyover at 500 feet. According to the test results, for the four helicopter types tested, the quietest was the Enstrom F–28A followed by the modified Hughes 269B with quiet tail rotor and special muffler, the Bell 47G2A and the standard Hughes 269B. These four models were the only ones examined in this test so it cannot be inferred that these helicopters are necessarily the quietest available.

Chapter 5

HELICOPTER PROCUREMENT AND OPERATING COSTS

5.1 Manufacturer's List Prices and Operating Costs

Tables 5-1 and 5-2 summarize procurement costs and operating costs for helicopters. Data in these tables are based upon costs provided by the manufacturers. List prices shown are for the basic aircraft and do not include accessories. Accessories which must be purchased in addition to the basic aircraft include: Aircraft radios, police radios, high intensity lights, rotor brake, heater, attitude instruments for night and instrument flying, floats, cargo hooks and hoists, instrument and external lights for night flying, litter kits, and combined siren and public address system. Accessories useful for police work can add anywhere from $5,000 to $20,000 to the basic helicopter price, depending upon the helicopter type and equipment desired.

Operating costs are shown for 600 and 1,000 hours of operation annually. These costs are all based on data provided by the manufacturers. Some adjustments have been made, however. In computing the cost of hull and liability insurance, manufacturers have used rates including 10 percent, 12 percent, and 15 percent of the basic helicopter list price to arrive at the annual premium. Therefore, to put the operating costs on a comparable basis, all of the helicopter insurance costs were computed using the 15 percent figure. Crew costs have not been considered in these comparisons.

Note that hangar costs are not included in the helicopter costs. The assumption made is that law enforcement agency helicopters will be hangared in existing heavy equipment garages. If the helicopters are stored in the hangar of a commercial operator, the annual fixed costs are increased by about $900. This represents an

Table 5–1

COMPARATIVE HELICOPTER COST DATA
(Annual basis)

Helicopters	ANNUAL COST @ 600 HRS/YR			ANNUAL COST @ 1,000 HRS/YR		
	Direct cost	Fixed cost	Total cost	Direct cost	Fixed cost	Total cost
Alouette II	$25,206	$34,365	$59,571	$42,010	$34,365	$76,375
Alouette III	37,506	57,130	94,636	62,510	57,130	119,640
Bell 47G-3B-2	12,498	16,226	28,724	20,830	16,226	37,056
Bell 47G-4A	11,412	15,936	27,348	19,020	15,936	34,956
Bell 47G-5	10,032	13,036	23,068	16,720	13,036	29,756
Bell 206A Jet Ranger	21,054	30,450	51,504	35,090	30,450	65,540
Enstrom F-28A	11,220	11,600	22,820	18,700	11,600	30,300
Fairchild Hiller FH-1100	23,226	27,720	50,946	38,710	27,720	66,430
Hughes 300	7,956	9,753	17,709	13,260	9,753	23,013
Hughes 500	15,150	27,250	42,400	25,250	27,250	52,500

Table 5–2

COMPARATIVE HELICOPTER COST DATA
(Per hour basis)

Helicopters	List price, basic aircraft	COST PER HR @ 600 HRS/YR			COST PER HR @ 1,000 HRS/YR		
		Direct cost	Fixed cost	Total cost	Direct cost	Fixed cost	Total cost
Alouette II	$118,500	$42.01	$57.28	$99.29	$42.01	$34.37	$76.38
Alouette III	197,000	62.51	95.22	157.73	62.51	57.13	119.64
Bell 47G–3B–2	55,950	20.83	27.04	47.87	20.83	16.23	37.06
Bell 47G–4A	54,950	19.02	26.56	45.58	19.02	15.94	34.96
Bell 47G–5	44,950	16.72	21.73	38.45	16.72	13.04	29.76
Bell 206A Jet Ranger	105,000	35.09	50.75	85.84	35.09	30.45	65.54
Enstrom F–28A	39,750	18.70	19.33	38.03	18.70	11.60	30.30
Fairchild-Hiller FH–1100	98,000	38.71	46.20	84.91	38.71	27.72	66.43
Hughes 300	33,630	13.26	16.25	29.51	13.26	9.75	23.01
Hughes 500	95,000	25.25	45.42	70.67	25.25	27.25	52.50

increase of $1.50 per hour for 600 hours of operation or $0.90 per hour for 1,000 hours of operation.

Tables A–1 through A–6 in appendix A show the cost breakdowns used in computing the comparative costs which are summarized in tables 5–1 and 5–2. It should be noted that the operating cost data was provided by the manufacturers and may tend to be optimistic.

5.2 Helicopter Ownership

Three types of helicopter ownership patterns prevail. These are: (1) Lease or lease-purchase; (2) single agency ownership-single agency use; and (3) single agency ownership-multiple agency use.

Lease arrangements are often used by law enforcement agencies and municipalities for evaluating helicopter operations. The advantages of lease programs are that the investment required is minimal and if the evaluation results prove negative, the agency is not faced with the costs involved in selling the helicopter. Where lease-purchase agreements are used, lease payments are applicable to the helicopter purchase price. Agencies which have used lease arrangements are the city of Fort Worth, city of Lakewood (Project Sky Knight), city of Pomona, Calif., and the Hennepin County Sheriff's Office, Minn.

In most cases the user agency owns the helicopter and operates it primarily for its own needs. Organizations which fall into this category include the Kansas City Police Department, the Los Angeles County Sheriff's Office, the Memphis Police Department, the Los Angeles Police Department, the Nassau County Police Department, the New Jersey State Police, the New York City Police Department, and the New York State Police.

The other arrangement which exists is that of the single agency owner-multiple agency users. This arrangement often occurs where the helicopter is owned by a municipality and is operated for several agencies within the municipality. For example, the City of Fort Worth's helicopter is used not only by the police, but also by the Health Department, Water Department, Fire Department, Research and Budget Planning Department, and the Department of Public Works. Similarly, the helicopter owned by the city Pomona, Calif., is used by the Police, Fire, Civil Defense, Water, Planning, Engineering, Traffic, Building and Safety, and Industrial Development Departments.

The helicopter acquisition made by the Indianapolis Airport Authority is a rather unique example of a joint effort by several agencies. These agencies all use this helicopter, but the Airport Authority purchased the helicopter to expedite the program commencement, since it had funds available. Other users include the

General and Community Hospitals, the Marion County Sheriff, Indianapolis Police and Fire Departments, the Mass Transportation Authority, and the Indiana University Medical Center.

Other examples of agencies which provide extensive helicopter services to other agencies include city and county of Honolulu and the Illinois State Toll Highway Authority.

The advantages of joint agency use are twofold. First, a greater number and a wider variety of services are performed by the helicopters. Secondly, since the annual utilization of the helicopter is increased by the demands incurred while supporting several agencies, the helicopter cost per hour decreases, and, through cost sharing, the helicopter becomes economically feasible. However, administration problems may be created by joint use agreements.

5.3 Helicopter Maintenance and Service

Basically, two types of helicopter servicing arrangements prevail in police organizations. Either the helicopters are maintained by men on the force, or they are maintained under contract with a local helicopter operator. Both arrangements are common.

The New York Police Department, the Nassau County Police Department, the Illinois State Toll Highway Authority, the Los Angeles County Sheriff's Office, and the Memphis Police Department have their helicopter maintenance performed by men on the force. Kansas City, on the other hand, has a fixed fee contract with a local firm to perform all maintenance and servicing. Fuel, oil, parts, and labor are all covered under a flat fee of $21.50 per flight hour for the Hughes 300 helicopters. Similarly, the Chicago Police Department, the Chicago Fire Department and the city of Fort Worth have their maintenance programs with a private firm.

Chapter 6

PERSONNEL AND ORGANIZATIONAL FACTORS

6.1 Pilot Selection

Criteria for pilot selection vary widely among law enforcement agencies. Some agencies have hired seasoned helicopter pilots with no police experience. This typically occurs in newly established programs to bring in personnel with technical expertise to manage the flying program (e.g., Illinois State Toll Highway Authority) and/or to expedite the commencement of aerial patrol activities. Examples of such programs are the operations of the city of Pomona, which requires 1,000 hours of flying time for applicants and the Hennepin County Sheriff, which confers the rank of special deputy sheriff on the pilots flying the leased helicopter.

Those who feel that helicopter flying experience is the most critical requirement argue on the grounds that safety is compromised with inexperienced pilots. A pilot's skill and judgment are products of his experience. It is argued that although a police helicopter pilot may start and end his mission at the same base of operation, the police mission itself may take him into a different environment each time he flies, such as landing in a parking lot, low flight among tall buildings where air turbulence and air cross currents are present, operation over high density population areas where he must have preplanned emergency landing areas. These areas which may be railroad yards, parking lots and the like will in all probability require a high degree of skill to negotiate a safe emergency or even a normal landing. In addition, insurance may be unobtainable or obtainable only at a prohibitive rate for newly-trained pilots.

Far more common, however, are those organizations which require extensive police experience (typically 2 to 5 years minimum service) but not necessarily an extensive flying background. Ex-

amples of experience requirements for pilot applicants range from no required flying experience (Kansas City Police Department, Chicago Police Department, and New Jersey State Police) to requiring a commercial license with 500 hours in fixed-wing aircraft (New York State Police).

Many agencies, however, require a commercial license for fixed-wing aircraft with no other stipulation on flying experience (although it is taken into consideration). Examples include the Royal Canadian Mounted Police, the Los Angeles Police Department, and the New York City Police Department.

Many reasons are given for making a police officer into a pilot, rather than attempting to make a skilled pilot into a competent police officer. Perhaps the most often cited factor is training time.

The Los Angeles County Sheriff's *Manual of Aerial Patrol* (*28*) states:

> "Pilots should first of all be competent police officers. It requires much *less* training to qualify as a pilot. The pilot's patrol experience should be extensive and he should know the patrol area from the ground, although this latter knowledge needn't be so extensive as in the case of the observer. He must be a competent pilot who has received special training in aerial enforcement and be temperamentally suited to the assignment."

Those police forces which draw pilot applicants only from within their own organizations often give preference to applicants with prior flying experience. This is primarily because it minimizes the training required to reach a given level of proficiency. The use of experienced pilots selected from the ranks has many advantages over other schemes. The Pennsylvania State Police have stated that the utilization of enlisted personnel (with flying experience) or pilots provide "a distinct advantage in the interest of economy, control, and necessity for the following reasons:

1. Recruiting qualified civilian helicopter pilots at current pay scales would be most difficult, if not impossible.
2. No need for primary flight training.
3. Pilots from the ranks would be able to perform other police duties when flight is not possible. Use of enlisted pilots would not detract from our patrol capabilities since this is the function to be performed by the helicopter.
4. The police power of arrest, if required, would be constantly available.
5. Departmental chain of command and esprit de corps would remain intact.
6. No contractual conflicts would be involved" (*33*).

Table 6–1

REQUIREMENTS FOR PILOT APPLICANTS FOR SELECTED LAW ENFORCEMENT AGENCIES

Agency	Years of service with force required	Flying experience and/or ratings required	Other requirements
Chicago Police Department	5 years, Rank of Sgt.	Not required	Age 30–40 years, married
City of Fort Worth	Not required	Commercial helicopter	
Illinois State Toll Highway Authority	State Police A/C-member Toll authority. Helo-not required	Commercial fixed–wing, commercial helicopter, instrument	
Kansas City Police Department	5 to 15 years	Not required	
Los Angeles County Sheriff	Member of force	Private, fixed–wing	
Los Angeles Police Department	5 years	Commercial, fixed–wing	
Memphis Police Department	Member of force	Private, fixed–wing	
Nassau County Police Department	Member of force	Private, fixed–wing	
New Jersey State Police	5 years	Not required	
New York City Police Department	Member of force	Commercial, fixed–wing	
New York State Police	Member of force	500 hours, commercial fixed–wing	Written exam, flight check
Pennsylvania State Police	Member of force	Licensed pilot	
City of Pomona, California	Not required	1,000 hours, commercial helicopter	
Royal Canadian Mounted Police	2 years	Commercial, fixed–wing	Age 20–28 years

The Royal Canadian Mounted Police requires, in addition to two years actual police experience, the possession of a valid Department of Transport Commercial License. Using these criteria not only minimizes the additional training required, but also aids in the selection process in another sense. J. H. Reid, C.O. "Air" Division, RCMP, states that

> "Since the member must obtain this license at his own expense, either before he joined the Force or on his own time while in the service, this provides us with an excellent method of selection. His having met this expense and time on his own is sufficient proof of his integrity and determination." [1]

Requirements for pilot applicants for certain law enforcement agencies are summarized in table 6–1.

The New York State Police has developed a program whereby extensive flying experience and extensive police experience are both employed. A commercial fixed base operator trained 10 New York State troopers as helicopter pilots in 1969. All of these pilots held FAA commercial pilot ratings, and in addition, one held an airline transport rating and two were flight instructors in light planes. The course given these trainees was 20 hours dual and 5 hours solo in a Bell 47G–4. When these pilots returned to Albany for assignment they were teamed with experienced pilots to perform their flight duties. In this way each member of each two-man team learned from the other.

6.2 Pilot Training

Helicopter pilot training programs are conducted either using instructor-pilots who are on the force or by using training services provided by commercial helicopter operators or by using the schools established by the manufacturers.

Civil government agencies using commercial establishments for helicopter training include Lakewood, Calif., Santa Monica, Calif., Huntington Beach, Calif., Long Beach, Calif., Kansas City, Mo., the Memphis Police Department and the New Jersey State Police. In the New Jersey State Police program, trainees receive 160 hours of ground school and 200 hours of flight instruction in the Enstrom and Fairchild-Hiller helicopters from a local commercial helicopter operator.

Operations using pilot-instructors within the force include the New York City Police Department, the Los Angeles Police Depart-

[1] Personal communication from J. H. Reid, Capt./Supt., C.O. "Air" Division, Royal Canadian Mounted Police, Dec. 18, 1969.

ment, the Memphis Police Department, the Illinois State Toll Highway Authority and the Royal Canadian Mounted Police.

In the Los Angeles Police Department,

> "Each trainee, even though he is a commercially-rated helicopter pilot, receives a minimum 200 hours of flying instruction under strict supervision of the chief pilot. Upon completion of the 200 hours, each trainee is given a proficiency check ride with the Senior FAA inspector in this area. Upon satisfactory completion of the proficiency check ride, he is designated as command pilot and is then eligible for the pilot skill bonus. The initial training period involves a minimum of four months.
>
> Training continues after the 200-hour minimum has been reached with each pilot having a training day at least once each month, in addition to a monthly proficiency check ride with the Chief Pilot." [2]

In the Royal Canadian Mounted Police (RCMP), which operates STOL and conventional fixed wing land planes, float planes and amphibians, the training program emphasizes on-the-job training by flying in the co-pilot position in all aircraft types and all of the regions.

> "After selection, a pilot is subject to an intense training in all phases of our type of flying. This initial training lasts for at least one year. First he is placed as co-pilot on one of the Beechcraft 18 or Twin Otter aircraft to gain general flight experience. Then commences a period of training at each Detachment throughout Canada on each type of aircraft, and over all areas. When he is considered competent to act as Captain of an aircraft he is qualified to fly any one of our aircraft in any area. After flying his own aircraft for a period not less than six months he is given an instrument training course and obtains his Instrument Flight Rating. A training schedule follows a pilot throughout his entire flying career as he is continually given Simulator Training courses, instrument refresher courses, and courses in new techniques, etc.
>
> Two check pilots are employed and each pilot is subject to semi-annual instrument flight checks and proficiency route checks.
>
> It will be seen that pilot training and supervision is emphasized and although it is a costly procedure it is most necessary

[2] "Tactical Operations Planning," Helicopter Section, Los Angeles Police Department.

to operate a safe and efficient service. Our own service exemplifies this as we have had but two serious accidents since 1937." [3]

Some agencies extensively use pilot schools operated by the manufacturer. Often this training is supplemented by training provided by pilot-instructors within the force. An example of such a program is that of the New York State Police. Deputy Chief Inspector, Warren B. Surdam of the New York State Police recently outlined the NYSP helicopter training program as follows:

"Presently, new pilots are assigned to our fixed-wing aircraft, and as vacancies occur in our rotary-wing aircraft, they receive the required training. Upon completion of the required 25 hours necessary for the securing of a Commercial Rotorcraft Rating, they are also trained at the Allison Engine School in Indianapolis and the Bell 206A School at Fort Worth, Texas. Our insurance carrier requires this schooling and 200 rotary-wing hours, 125 hours of which must be in the Bell 206A Jet Ranger before these pilots can fly solo. In addition, we are constantly conducting ground schools and flight proficiency checks, and encourage our pilots to obtain additional ratings." [4]

Helicopter pilot training for law enforcement activities involves much more than merely teaching a police officer how to fly. The pilot trainee must also receive specialized, intensive training in the techniques and skills which will enable him to most effectively use his aerial platform as a potent law enforcement tool. The police officer trainee must master the art of aerial observation, relearn patrol procedures, learn how to effectively coordinate with and assist his fellow officers on the ground, and learn many specialized techniques such as night illumination, rescue methods, and covert surveillance.

The skills involved in aerial observation and aerial patrol are required by virtually all law enforcement agencies. The need for specialized training in these skills has been recognized by many law enforcement agencies and incorporated into their training programs. With respect to aerial observation, the Los Angeles County Sheriff's *Manual of Aerial Patrol* states:

"It is difficult for a police officer to immediately master the

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[3] Personal communication from J. H. Reid, Capt./Supt., C.O., "Air" Division, R.C.M.P., Dec. 18, 1969.

[4] Personal communication from Warren B. Surdam, Deputy Chief Inspector, Planning and Research, New York State Police, Dec. 2, 1969.

art of aerial observation. It requires time and experience to be able to observe—from the air—those things of interest to law enforcement which can be easily identified from the ground. A comprehensive training program, which teaches the observer how to identify what he is looking for, from the air, is required."

This manual further stresses relearning patrol techniques.

"The pilot and observer must relearn a basic skill in law enforcement—how to patrol. The aerial policeman finds himself in a unique position. He is no longer limited to patrol patterns dictated by geography, terrain and natural obstacles such as rivers, railroads, dead end streets, traffic or fenced areas. He is literally above and beyond such restrictions and is thus faced with learning how to most effectively utilize his new found freedom.

"On the other hand, he no longer has the familiarity of prescribed procedures to guide him and must innovate methods for accomplishing as many of the old requirements of patrol as possible and to achieve the potential of the new medium."

Several law enforcement agencies have written rather comprehensive manuals to cover the training and operation phases of their air activities. References (*28*), (*30*) and (*36*) are representative of police air operations manuals.

6.3 Personnel Costs

As in the military service, some law enforcement agencies provide a pay differential for those officers who are on flight status. This pay differential is provided as "skill pay", i.e., compensation and recognition for skills achieved in addition to those required to function as an effective police officer. The pay increment for helicopter service is not treated as hazard pay, for experience indicates that the helicopter is nine times safer than ground units.

Law enforcement organizations which provide skill pay differentials include the Los Angeles County Sheriff, the Los Angeles Police Department and the Royal Canadian Mounted Police. The Los Angeles County Sheriff provides an 11 percent skill pay differential for pilots but provides no differential for observers. The Los Angeles Police Department pilots and observers both receive a $250 per month skill differential in addition to their regular police officer salaries. In the Royal Canadian Mounted Police, the pilots "are usually given the rank of senior N.C.O. and receive

extra flight pay for their flying duties. This extra pay brings them up to the pay of their civilian counterparts." [5]

Additionally, in the HALO Report (6) (a final report to the Pomona, California City Council regarding the helicopter program concept and operation recommended for the city), it was recommended that pilot pay "be established at the Sergeant level because of his responsibility and that a 15-percent differential be given for 'skill pay' as helicopter pilot."

[5] Personal communication from J. H. Reid, Capt. Supt., C.O. "Air" Division, RCMP, Dec. 18, 1969.

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Appendix A

HELICOPTER COST DATA

Table A–1

VOUGHT HELICOPTER COST DATA

	Alouette II	Alouette III
Basic price	$118,500	$197,000
Annual fixed costs		
Depreciation (5 years with 30 percent residual value)	16,590	27,580
Hull and liability insurance at 15 percent	17,775	29,550
Total fixed costs	34,365	57,130
Direct operating costs		
Fuel	7.50	12.50
Oil	.15	.18
Inspection and maintenance	2.15	2.75
Reserve for engine overhaul	9.40	8.31
Reserve for airframe spares	1.66	3.55
Reserve for engine spares	2.02	1.93
Reserve for retirement life items	4.85	6.50
Reserve for dynamic component overhaul	14.28	26.79
Total direct cost per hour	42.01	62.51

Total operating cost per hour	600 hours per year	1,000 hours per year	600 hours per year	1,000 hours per year
Direct costs, dollars per hour	$42.01	$42.01	$62.51	$62.51
Fixed costs, dollars per hour	57.28	34.37	95.22	57.13
Total costs, dollars per hour	99.29	76.38	157.73	119.64

Source: Ling-Temco-Vought, Inc., and Cornell Aeronautical Laboratory, Inc., estimates

Fig. A–1 VOUGHT Alouette II

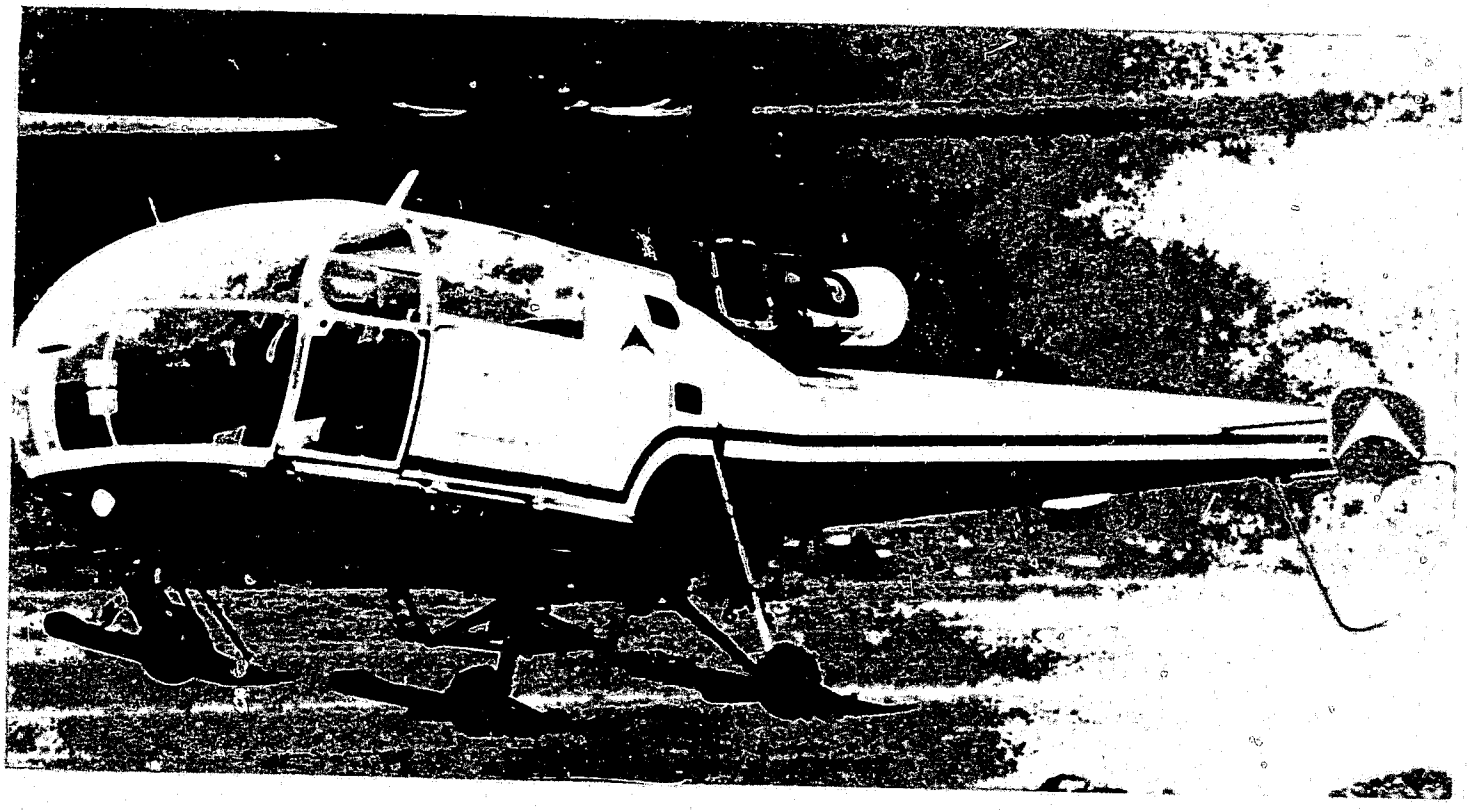

Fig. A–2 VOUGHT Alouette III

Table A–2

BELL HELICOPTER COST DATA

	Bell 47G–3B–2	Bell 47G–4A
Basic price	$55,950	$54,950
Annual fixed costs:		
Depreciation (5 years with 30 percent residual)	7,833	7,693
Hull and liability insurance at 15 percent	8,393	8,243
Total annual fixed costs	16,226	15,936
Direct operating costs, dollars per hour		
Fuel	7.60	6.80
Oil	.38	.38
Maintenance, including helicopter inspection at 1,200 hours	4.39	4.32
Reserve for engine overhaul	[1] 3.44	[2] 2.50
Reserve for spare parts, including 1,200-hour inspection	2.39	2.39
Retirement of life items	2.63	2.63
Total direct operating cost per hour	20.83	19.02

Total operating cost per hour:	600 hours per year	1,000 hours per year	600 hours per year	per year 1,000 hours
Direct costs per hour	$20.83	$20.83	$19.02	$19.02
Fixed costs per hour	27.04	16.23	26.56	15.94
Total costs per hour	47.87	37.06	45.58	34.96

[1] Engine overhaul at 900 hours.
[2] Engine overhaul at 1,000 hours.
Source: Bell Helicopter Co. and Cornell Aeronautical Laboratory, Inc., estimates.

Table A–3

BELL HELICOPTER COST DATA

	Bell 47G–5	Bell Jet Ranger
Basic price	$44,950	$105,000
Annual fixed costs:		
Depreciation (5 years with 30 percent residual)	6,293	14,700
Hull liability insurance at 15 percent	6,743	15,750
Total annual fixed costs	13,036	30,450
Direct operating costs, dollars per hour		
Fuel	6.00	6.25
Oil	.25	.18
Maintenance, including helicopter inspection at 1,200 hours	4.03	2.96
Reserve for engine overhaul	[1] 2.00	[2] 14.40
Reserve for spare parts, including 1,200-hour inspection	1.92	4.76
Retirement of life items	2.52	6.54
Total direct operating costs per hour	16.72	35.09

Total operating cost per hour:	600 hours per year	1,000 hours per year	600 hours per year	1,000 hours per year
Direct costs per hour	$16.72	$16.72	$35.09	$35.09
Fixed costs per hour	21.73	13.04	50.75	30.45
Total costs per hour	38.45	29.76	85.84	65.54

[1] Engine overhaul at 1,000 hours.
[2] Engine overhaul at 750 hours.
Source: Bell Helicopter Co. and Cornell Aeronautical Laboratory, Inc., estimates.

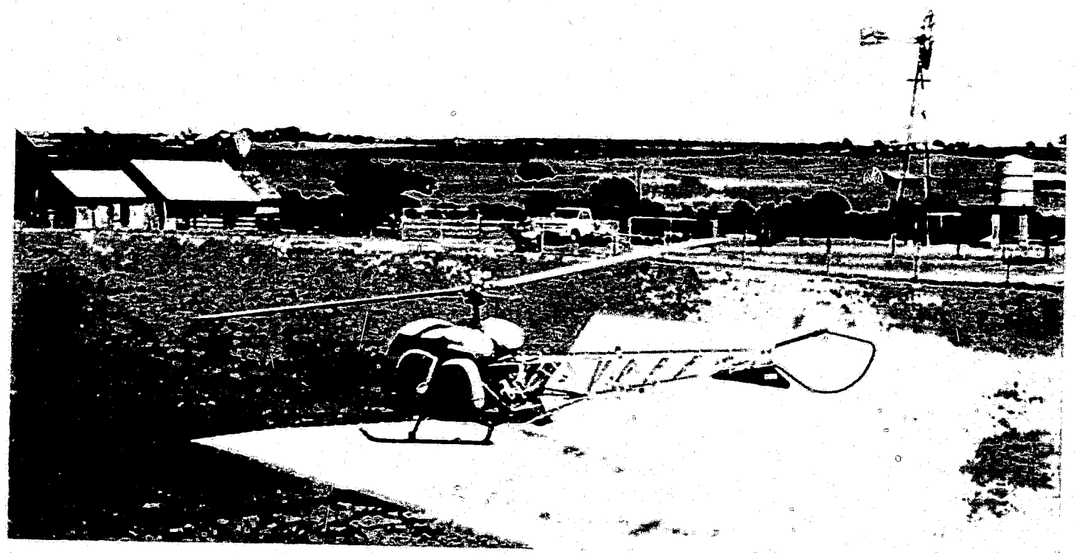

Fig. A–3 BELL 47G–5 (47G–3 and 47G–4 are externally similar)

Fig. A–4 BELL Jet Ranger

Table A–4

ENSTROM F–28A COST DATA

Basic price	$39,750
Annual fixed costs:	
Depreciation (5 years with 30 percent residual)	5,600
Hull and liability insurance at 15 percent	6,000
Total annual fixed costs	11,600
Direct operating costs, dollars per hour	
Fuel	5.85
Oil	.50
Maintenance through major overhaul labor	6.46
Reserve for engine overhaul	3.31
Reserve for airframe spare parts	1.10
Reserve for engine spare parts	.48
Reserve for retirement items	1.00
Total direct operating cost per hour	18.70

	600 hours per year	1,000 hours per year
Total operating cost per hour:		
Direct costs, dollars per hour	$18.70	$18.70
Fixed costs, dollars per hour	19.33	11.60
Total costs, dollars per hour	38.03	30.30

Source: R. J. Enstrom Corporation Civil Aeronautical Laboratory, Inc.

Fig. A-5 ENSTROM F-28 A

Table A–5

FAIRCHILD-HILLER FH–1100 HELICOPTER COST DATA

Basic price	$98,000
Annual fixed costs:	
Depreciation (5 years with 30 percent residual value)	13,720
Hull and liability insurance at 15 percent	14,000
Total annual fixed costs	27,720
Direct operating costs, dollars per hour	
Fuel	7.00
Oil	.10
Scheduled maintenance required: Including daily and 100-hour inspection up through and including 1,200 hour overhaul	3.00
Reserve for spare parts, including 1,200 hour overhaul	6.23
Reserve for retirement life items with 10,000 hours or less finite life	6.28
Reserve for engine overhaul (based on Allison T.B.O. of 750 hours)	14.00
Scheduled and unscheduled maintenance on engine (includes trouble shooting, removing, replacing, repairing and maintaining at $9/M.H. rate)	1.62
Reserve for engine parts	.48
Total direct operating cost per hour	38.71

	600 hours per year	1,000 hours per year
Total operating cost per hour	$38.71	$38.71
Direct cost per hour	46.20	27.72
Fixed cost per hour	84.91	66.43
Total cost per hour		

Source: Fairchild-Hiller Corp. and Corna Aeronautical Laboratory, Inc. estimates

Fig. A-6 FAIRCHILD-HILLER FH-1100

Table A–6

HUGHES HELICOPTER COST DATA

	Hughes 300	Hughes 500
Basic price	$33,630	$95,000
Annual fixed costs:		
Depreciation (5 years with 30 percent residual value)	4,708	13,000
Hull and liability insurance at 15 percent	5,045	14,250
Total fixed costs	9,753	27,250
Direct operating costs (dollars per hour		
Fuel	4.20	5.00
Oil	.25	.04
Reserve for limited life parts	3.50	7.91
Reserve for scheduled maintenance	1.61	1.94
Reserve for unscheduled maintenance, spares and engine overhaul	3.70	10.36
Total direct operating cost per hour	13.26	25.25

Total operating cost	600 hours per year	1,000 hours per year	600 hours per year	1,000 hours per year
Direct costs (dollars per hour	$13.26	$13.26	$25.25	$25.25
Fixed costs (dollars per hour	16.25	9.75	45.42	27.25
Total costs (dollars per hour	29.51	23.01	70.67	52.50

Source: Hughes Technical and Crime Aeronautical Laboratory (HCAL) estimates

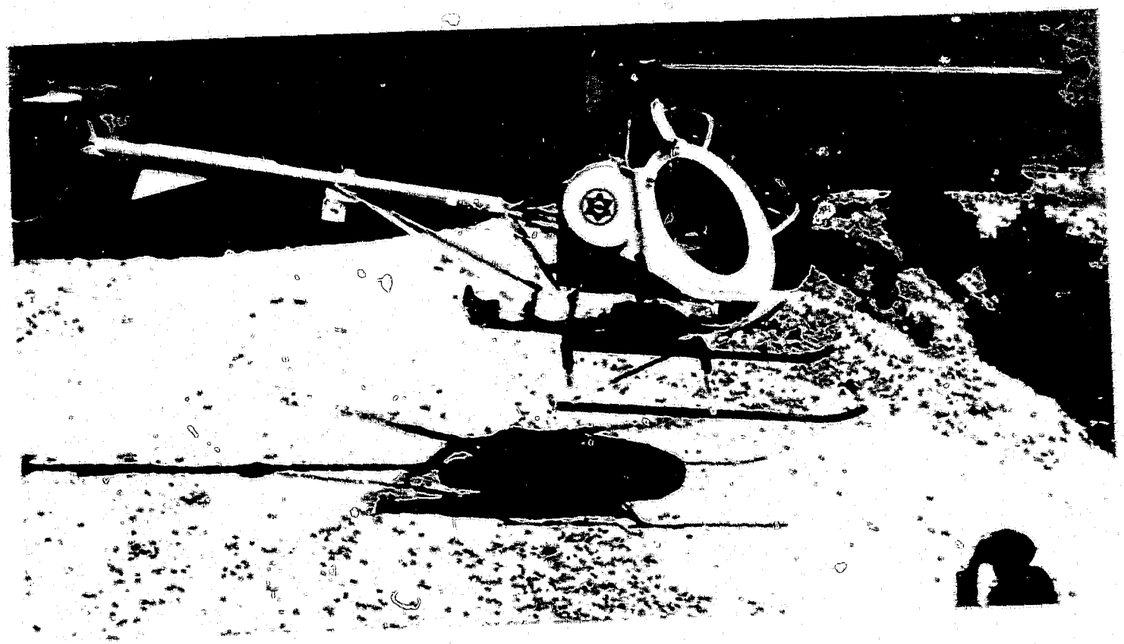

Fig. A–7 HUGHES 300

Fig. A-8 HUGHES 500

Appendix B

THE COST OF HELICOPTER PATROLS

During the course of the survey, sufficient data was accumulated to make possible the examination of varying amounts of helicopter patrol coverage. It is felt that this type of information would be of interest to prospective helicopter users.

This appendix examines the annual cost of providing helicopter patrol coverage for 8, 16, and 24 hours per day, 7 days per week. Table B-1 summarizes these costs for representative helicopter types. Breakdowns of these costs are shown in tables B-2 through B-4. While these cost estimates are based on helicopter cost data as in chapter 5, these costs differ from those in chapter 5 in that they represent costs of fleets of helicopters and include flight crew costs.

The basic assumptions used were:

1. Maximum annual helicopter utilization is 1,200 hours.
2. Flight crews consist of two pilots.
3. Pilots fly 4 hours per 8-hour shift and fly no more than 20 hours per week.
4. Pilots work average of 220 days per year considering vacation, sick leave, holidays, etc.
5. Pilots salaries average $11,000 per annum.

Using these assumptions, to achieve an 8-hour per day helicopter patrol coverage, an agency would require 3 helicopters, 8 pilots, and an annual budget of from $150,000 to $442,000, depending on the helicopter type. If continuous 24 hour patrol coverage was desired, 9 helicopters, 20 pilots, and an annual budget of $414,000 to $1,227,000 is required.[1]

[1] Observers salaries are not included in these estimates.

Table B–1

COMPARATIVE COSTS OF HELICOPTER PATROL
8, 16, and 24 hours per day
(Annual basis)

Helicopter type	8 hours per day patrol	16 hours per day patrol	24 hours per day patrol
Alouette II	$313,779	$571,188	$ 862,968
Alouette III	441,919	804,708	1,224,628
Bell 47G–3B–2	197,514	356,797	532,311
Bell 47G–4A	191,358	344,777	514,135
Bell 47G–5	175,942	316,845	470,787
Bell 206A Jet Ranger	281,813	511,176	770,988
Enstrom F–28A	177,404	321,208	476,612
Fairchild Hiller FH–1100	284,193	518,666	780,860
Hughes 300	155,969	280,188	414,158
Hughes 500	243,480	437,710	659,190

Source: Manufacturers' data and Cornell Aeronautical Laboratory, Inc., estimates.

Table B–2

COST OF HELICOPTER PATROL
8 hours per day
(Annual basis)

Helicopter type	Direct operating costs (2920 flying hours)	Fixed costs (3 helicopters)	Helicopter pilots (8 pilots)	Total cost
Alouette II	$122,669	$103,110	$88,000	$313 [illegible]
Alouette III	182,529	171,390	88,000	441 [illegible]9
Bell 47G–3B–2	60,823	48,690	88,000	197,514
Bell 47G–4A	55,538	47,820	88,000	191,3[illegible]8
Bell 47G–5	48,822	39,120	88,000	175,942
Bell 206A Jet Ranger	102,463	91,350	88,000	281,813
Enstrom F–28A	54,604	34,800	88,000	177,404
Fairchild Hiller FH–1100	113,033	83,160	88,000	284,193
Hughes 300	38,719	29,250	88,000	155,969
Hughes 500	73,730	81,750	88,000	243,480

Source: Manufacturers' data and Cornell Aeronautical Laboratory, Inc., estimates.

Table B–3

COST OF HELICOPTER PATROL
16 hours per day
(Annual basis)

Helicopter type	Direct operating costs (5,840 flying hours)	Fixed costs (5 helicopters)	Helicopter pilots (14 pilots)	Total costs
Alouette II	$245,338	$171,850	$154,000	$571,188
Alouette III	265,058	285,650	154,000	804,708
Bell 47G–3B2	121,647	81,150	154,000	356,797
Bell 47G–4A	111,077	79,700	154,000	344,777
Bell 47G–5	97,645	65,200	154,000	316,845
Bell 206A Jet Ranger	204,926	152,250	154,000	511,176
Enstrom F–28A	109,208	58,000	154,000	321,208
Fairchild Hiller FH–1100	226,066	138,600	154,000	518,666
Hughes 300	77,438	48,750	154,000	280,188
Hughes 500	147,460	136,250	154,000	437,710

Source: Manufacturers' data and Cornell Aeronautical Laboratory, Inc, estimates.

Table B–4

COST OF HELICOPTER PATROL
24 hours per day
(Annual basis)

Helicopter type	Direct operating costs (8,760 flying hours)	Fixed costs (8 helicopters)	Helicopter pilots (20 pilots)	Total cost
Alouette II	$368,008	$274,960	$220,000	$ 862,968
Alouette III	547,588	457,040	220,000	1,224,628
Bell 47G–3B–2	182,471	129,840	220,000	532,311
Bell 47G–4A	166,615	127,520	220,000	514,135
Bell 47G–5	146,467	104,320	220,000	470,787
Bell 206A Jet Ranger	307,388	243,600	220,000	770,988
Enstrom F–28A	163,812	92,800	220,000	476,612
Fairchild Hiller FH–1100	339,100	221,760	220,000	780,860
Hughes 300	116,158	78,000	220,000	414,158
Hughes 500	221,190	218,000	220,000	659,190

Source: Manufacturers' data and Cornell Aeronautical Laboratory, Inc., estimates

Appendix C

STOL AIRCRAFT PERFORMANCE AND COST DATA

STOL aircraft may represent a relatively inexpensive *partial* substitute for helicopters used in law enforcement operations. STOL aircraft cannot do all of the things that helicopters can do (take-off and land vertically and hover), but they can fly slowly and operate from a small strip (i.e., 600 ft.). In addition, STOL aircraft are much cheaper to operate than helicopters (one-third to one-half as much, excluding crew costs). Perhaps a mixed fleet of helicopters and STOL aircraft would be advantageous, whereby the inexpensive STOL would be used for those missions where unscheduled landings are rarely necessary, and the helicopters used for those activities where its unique capabilities are required.

STOL Aircraft Capabilities and Limitations

Performance data for eight STOL types, which could conceivably be used for law enforcement related missions, are presented in tables C-1 and C-2. As in the case of the helicopter data presented in chapter 4, all of the STOL performance data pertains to flight operations at the gross weight listed. It must be noted that for some of these aircraft (e.g., Fairchild Hiller Porter) the gross weight listed is not the maximum permissible gross weight. However, operation at higher gross weights is permissible only under the condition that the excess load be disposed of (through fuel burnoff, fuel dumping, or dropping cargo) prior to landing. Thus, operation at the higher weights is not relevant to law enforcement missions, particularly where the aircraft may be called upon to land without prior notice.

Table C–1

STOL AIRCRAFT PERFORMANCE

	Fairchild-Hiller Porter	Helio Courier H–250	Helio Super Courier H–295	Helio Stallion H–550A
Number of seats	6–10	6	6	8–12
Engine type	Turbine	Reciprocating	Reciprocating	Turbine
Engine manufacturer and horsepower	Garret, 575 SHP P & W, 550 SHP	Lycoming, 250 bhp	Lycoming, 295 bhp	Pratt & Whitney 680 shp
Gross weight (lbs)	4,850	3,400	3,400	5,100
Empty weight (lbs)	2,470	1,960	2,080	2,825
Useful load (lbs)	2,380	1,440	1,320	2,275
Maximum speed (m.p.h.)	174	160	N.A.	226
Cruise speed (m.p.h.)	136	152 (75% power) 133 (60% power)	165 (75% power) 150 (60% power)	217 (max) 160 (econ)
Minimum speed (m.p.h.)	67 (slow flight) 52 (stall)	31 (fully maneuverable)	30 (fully maneuverable)	42 (fully maneuverable)
Range (miles)	530	660—standard tanks 1,380—optional tanks	660—standard tanks 1,380—optional tanks	640—standard tanks 1,200—optional tanks
Rate of climb (fpm)	1,600	830	1,150	1,840
Service ceiling (ft)	29,000	15,200	20,500	28,000
Take-off distance, 50' obstable (ft)	560	750	610	695
Landing distance, 50' obstacle (ft)	550	520	520	504

Source: Rotor & Wing, June 1969, Fairchild Hiller Corp., the Helio Aircraft Corp., and Jane's All the World's Aircraft, 1969–70

Table C–2

STOL AIRCRAFT PERFORMANCE

	Robertson STOL 180	Robertson STOL 185	Robertson STOL 337	DeHavilland DHC–2 Turbo Beaver
Number of seats	4	4–6	4–6	8–10
Engine type	Reciprocating	Reciprocating	(2) Reciprocating	Turbine
Engine manufacturer and horsepower	Continental, 230 hp	Continental 300 hp	Continental, 210 hp (2)	Pratt & Whitney, 578 shp or 579 hp
Gross weight (lbs)	2,800	3,300	4,300	5,370
Empty weight (lbs)	1,536	1,580	2,635	2,760
Useful load (lbs)	1,264	1,720	1,665	2,610
Maximum speed (m.p.h.)	173	181	207	179
Cruise speed (m.p.h.)	165	172	199	157
Stall speed (m.p.h.)	34	38	39	60
Range (miles)	1,248 (max)	1,100 (max)	1,400 (max)	260
Rate of climb (fpm)	1,122	1,092	1,312	1,185
Service ceiling (ft)	19,900	17,800	21,000	20,500
Take-off distance, 50' obstable (ft)	635	648	678	920
Landing distance, 50' obstacle (ft)	558	612	697	870

Source: Rotor & Wing, June 1969 & Jane's All the World's Aircraft 1969–70.

Table C–3

COMPARATIVE COST DATA FOR STOL AIRCRAFT

	Fairchild Hiller Porter	Helio Courier H-250	Helio Super Courier H-295	Helio Stallion H-550A
List price, basic aircraft	$120 000	$88 400	$44 400	$138 900
Annual cost at 600 hours per year				
Direct operating cost	16 110	5 754	7 018	19 332
Fixed cost	20 320	7 383	8 193	21 555
Total cost	36 430	13 137	15 211	36 887
Annual cost at 1 000 hours per year				
Direct operating cost	26 850	9 590	11 680	32 220
Fixed cost	20 320	7 383	8 203	23 555
Total cost	47 170	16 973	19 883	45 775
Cost per hour at 600 hours per year				
Direct operating cost	26 85	9 59	11 68	32 22
Fixed cost	33 87	12 22	13 67	39 26
Total cost	60 72	21 81	25 35	61 48
Cost per hour at 1 000 hours per year				
Direct operating cost	26 85	9 59	11 68	32 22
Fixed cost	20 32	7 38	8 20	23 56
Total cost	47 17	16 92	19 88	45 78

Source: Manufacturers' data and Cornell Aeronautical Laboratory, Inc. estimates

STOL List Prices and Operating Costs

Table C–3 summarizes procurement and operating costs for the four single engine STOL aircraft types listed in table C–1. Data were not available for the other four STOLs listed in Table C–2. Data in this table are based upon costs provided by the manufacturers. Adjustments have been made on the operating costs to make them comparable with each other. Detailed cost breakdowns for these four aircraft are shown in Tables C–4 and C–5.

STOL aircraft insurance premiums were obtained from two sources. For the Helio Courier and Super Courier, factory quotes were used. In order to make the two turboprop STOL aircraft (Fairchild Hiller Porter and Helio Stallion) costs comparable with each other, estimates were obtained from an insurance underwriter. Hull rates are based on 5 percent of the initial cost. Public liability and property damage premiums are assessed at $100 per seat to provide single limit coverage of $1 million and a limit of $100,000 per seat. For costing purposes, both aircraft were assumed to have eight seat interior configurations.

Fig. C–1 FAIRCHILD-HILLER Porter

In chapter 5, annual helicopter depreciation costs were computed on the basis of a 30 percent residual value at the end of 5 years. This depreciation rate is standard among helicopter manufacturers. The STOL aircraft depreciation costs were derived on the basis of 50 percent at the end of 5 years. This rate is comparable to those provided by Helio and Fairchild Hiller. Helicopter depreciation rates are higher than those of fixed–wing

Fig. C–2 HELIO Super Courier H–295

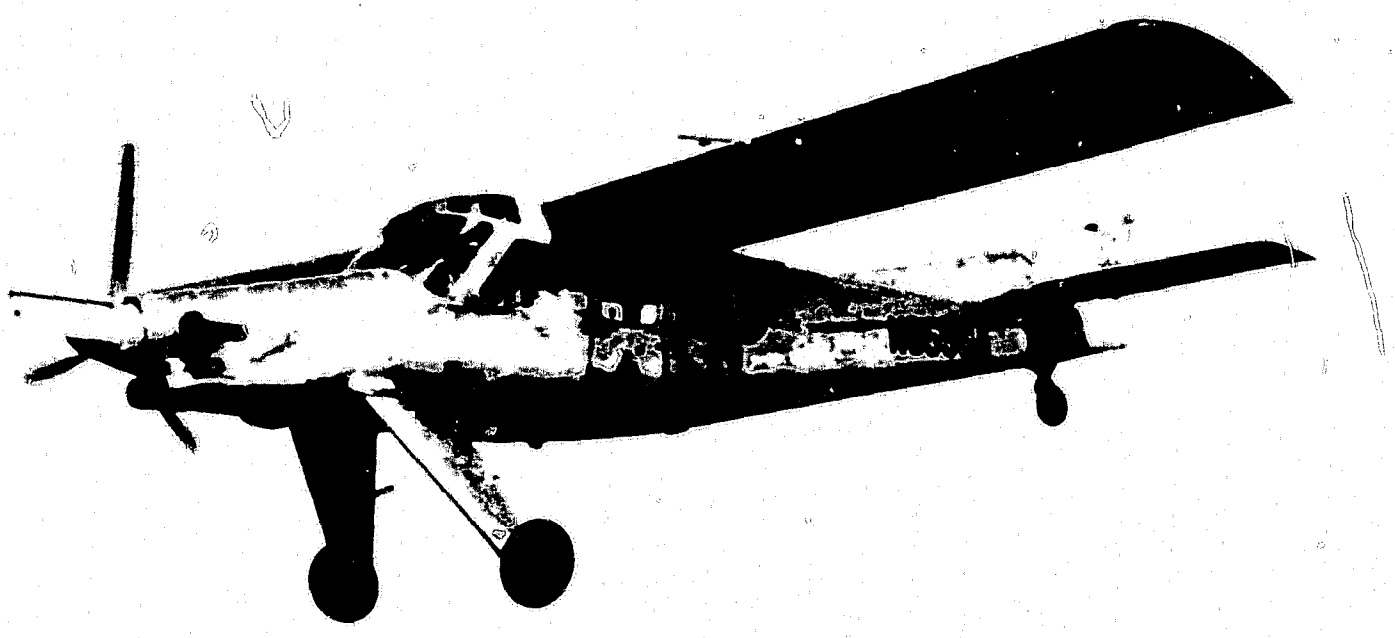

Fig. C–3 HELIO Stallion H–550

Table C–4

FAIRCHILD-HILLER-PORTER COST DATA

Basic price	$[illegible]
Fixed annual costs	
Depreciation (5 years at 50 percent residual	12 000
Insurance—hull at 5 percent, PL PD at $100 per seat for 8 seats	6 800
Hangar	1 500
Total annual fixed costs	20 300
Direct operating costs, dollars per hour*	
Fuel	12 25
Oil	10
Maintenance (including labor, parts, overhaul and reserves)	
Airframe	5 50
Engine	9 00
Total direct operating costs per hour*	26 85

	600 hours per year	1,000 hours per year
Total operating cost per hour:		
Direct operating cost, dollars per hour	$26 85	$26 85
Fixed costs, dollars per hour	33 87	20 32
Total cost, dollars per hour	60 72	47.17

Source: Fairchild Hiller Corp. and Cornell Aeronautical Laboratory, Inc., estimates.

aircraft since helicopters have many expensive components of limited fatigue life which must be replaced or overhauled after a specified number of flying hours (e.g., rotor blades, rotor hub, tail rotor blades, clutch and gear boxes).

Note that hangar costs are included in the STOL fixed costs but not in the helicopter costs in chapter 5. This is done on the assumption that law enforcement agency helicopters may be hangared in many existing heavy equipment garages. STOL aircraft, if stored indoors, will have to be based at airports or have a special hangar built for an off-airport location.

As with the helicopter data, the operating cost data for the STOL aircraft was provided by the manufacturers and may tend to be optimistic.

Table C–5

HELIO AIRCRAFT COST DATA

	Helio Courier H–250	Helio Super Courier H–295	Helio Stallion H–550A
Basic price	$38,400	$44,400	$138,900
Fixed annual c[illegible]			
Annual inspection	275	275	400
Hull and liability insurance	2,078	2,348	[1]7,745
Hangar	1,140	1,140	1,520
Depreciation (5 years at 50 percent residual value)	3,840	4,440	13,890
Total annual fixed costs	7,333	8,203	23,555
Direct operating costs, dollars per hour:			
Gas	5.17	5.17	11.62
Oil	.40	.37	.60
Aircraft and engine maintenance	2.00	2.00	4.00
Reserve for factory remanufactured engine	[2]2.02	[3]4.14	6.00
Total direct operating costs, dollars per hour	9.59	11.68	22.22

	600 hours per year	1,000 hours per year	600 hours per year	1,000 hours per year	600 hours per year	1,000 hours per year
Total operating cost, dollars per hour:						
Direct operating costs, dollars per hour	$ 9.59	$ 9.59	$11.68	$11.68	$22.22	$22.22
Fixed costs, dollars per hour	12.22	7.33	13.67	8.20	39.26	23.56
Total costs, dollars per hour	21.81	16.92	25.35	19.88	61.48	45.78

[1] 1,800 hours T.B.O.
[2] 1,400 hours T.B.O.
[3] 2,100 hours T.B.O.
[4] Hull insurance at 5 percent; public liability and property damage at $100 per seat for 8 seats, providing $1 million single limit with $100,000 per seat limit on coverage.

Source: Helio Aircraft Corp. and Cornell Aeronautical Laboratory, Inc., estimates.

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