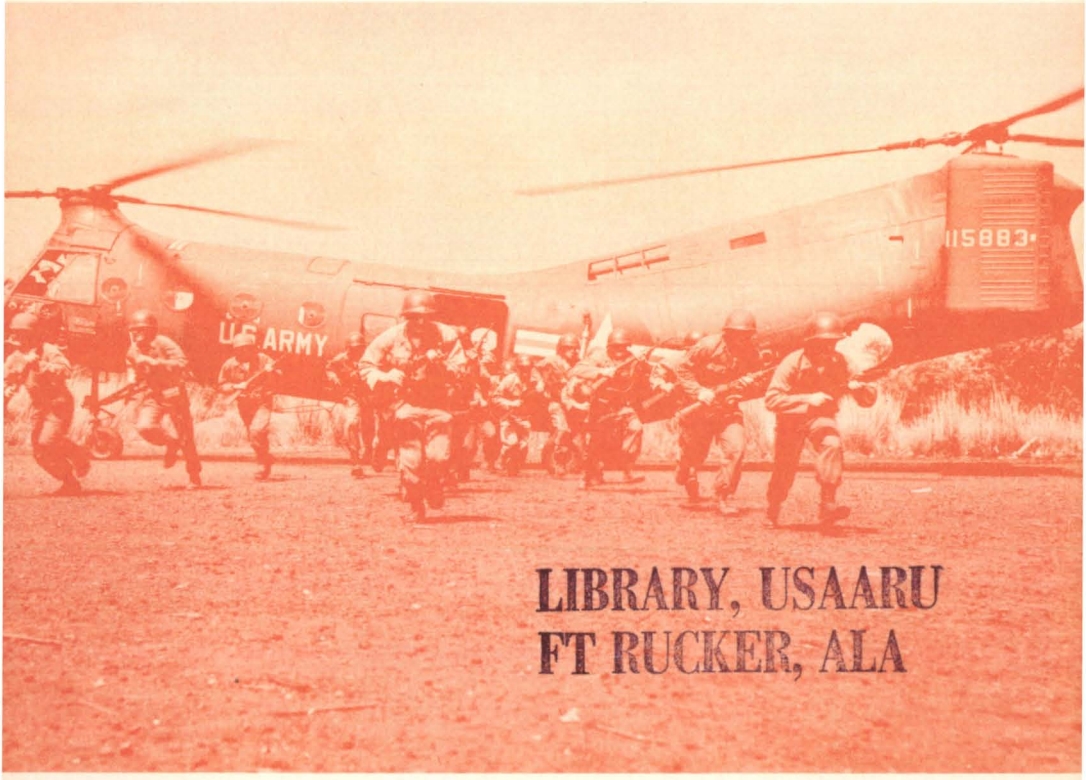
ARMY AVIATION DIGEST



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ARMY AVIATION SCHOOL

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JUNE 1955 VOLUME 1 NUMBER 5

ARMY AVIATION SCHOOL

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ARMY AVIATION
DIGEST

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COVER: The H-21, "Army Work Horse," often called the "Flying Banana," can gross 14,500 pounds, carry 20 combat equipped troops, or 12 litter patients plus 2 medical attendants. For additional information see page 5.

This copy is not for sale. It is intended for more than one reader.

PLEASE READ IT AND PASS IT ALONG

ARMY AVIATION 1942-1955

On 6 June 1942, the War Department approved the adoption of organic air observation for field artillery and directed that the Field Artillery School conduct training of pilots and mechanics to man aircraft.

THE COMMANDANT'S COLUMN

Brigadier General Carl I. Hutton, *USA*

The views expressed in this article are the author's and are not necessarily those of the Department of the Army.—The Editor

The following excerpts were taken from a letter which was sent to the Editor of The Army Aviation Center post newspaper:

Dear Sir:

. . . . . I'm an Artillery Officer. After graduating from OCS in 1950 I went overseas and served with a battalion supporting the 25th Division. Over there I used to think air observers were useless, mostly because they were always taking missions away from me. At any rate, ... I felt that to be a complete Artilleryman I should have [flight] training and so requested flight school and was accepted. The feeling has been growing on me since I began that I'm on a one-way street that is dead-ended somewhere up ahead. In other words, where will I be when I become a rated pilot? . . . . .

The answer to this young man's doubts cannot be given in explicit terms. However, there are certain fundamentals which bear on the problem. Some of these are:

1. By definition, Army aviation consists of the personnel, aircraft, and organizations of the Army devoted to providing aviation combat and logistic support.
2. Aircraft of some type (fixed wing, rotary wing, convertiplane, ballistic plane, or other) are a permanent part of the military arsenal.
3. The Army has a need for increased mobility.
4. Aircraft can contribute to increasing the Army's mobility.

5. No one service or branch has a natural or inherent monopoly of any type of vehicle or weapon.

If the fundamentals are true, then certain propositions follow. Obviously, the Army will need aircraft (and personnel to operate and maintain them) in direct proportion to the ability of aircraft to assist in accomplishing the Army's job. Ambitious young people will only be attracted to a career field which offers opportunities for advancement.

Everybody in Army aviation and a great many people out of it recognize the problem, and they are working on it to the best of their ability. The Commandant's advice is—have a little patience, and a solution will be forthcoming.

This is the third in a series of columns written by Brigadier General Carl I. Hutton for the ARMY AVIATION DIGEST. General Hutton is Commandant of The Army Aviation School and Commanding General of The Army Aviation Center, Camp Rucker, Alabama. He is a graduate of the United States Military Academy and the National War College. He has also completed the Basic and Advanced Field Artillery Courses in The Artillery School and is a qualified fixed and rotary wing Army Aviator.—The Editor

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"Safety is not an accident."

ARMY WORK HORSE

Colonel Frank K. MacMahon, Transportation Corps, *USAR*

The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor

The family of Army aircraft has recently received a new addition—the H–21C Work Horse. Aircraft of this type are currently assigned at Camp Rucker, Fort Riley, Fort Bragg, and Fort Huachuca.

The H–21C is a single–engine cargo helicopter with twin lifting rotors which are disposed longitudinally. Each of the 44–foot diameter rotors has three fully articulated blades. Because the rotors turn in opposite directions, there is no unbalanced torque reaction on the fuselage, and hence no need for a power–consuming anti–torque device. Since the rotors are located at the top of the aircraft, they present no hazard to personnel on the ground, and permit tail–low flares close to the ground.

The 52′–6″ long fuselage which serves as structural support for the rotor system is all–metal, semi–monocoque construction which is fabricated from corrosion–resistant alclad sheet. The banana–shape is derived from blade flapping angles. Rotor gear boxes are mounted in the fuselage structure with a forward tilt so that the parasite drag of the fuselage is at a minimum in the cruising attitude. In cruising flight, the floor of the passenger/cargo compartment in the forward portion of the fuselage is level (Figure 1, Page 6).

The fuselage aft of the oval constant cross–section tapers to form an effective dorsal fin area. This dorsal fin and the fixed vertical surfaces of the empennage contribute to directional stability in forward flight.

The long fuselage which results from the tandem rotor configuration provides an efficient structure for enclosing cockpit, cabin, fuel cell, and power plant with a minimum frontal

Figure 1

area. The cabin can accommodate twenty troop seats, or, alternatively, twelve litters plus seats for two medical attendants.

Because the pilot can vary the lift of the two rotors differentially, by means of a longitudinal stick positioning wheel on the console, the H–21C has a long permissible range of center of gravity travel ($41\frac{1}{2}$ inches). As a result, metic-

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Frank K. MacMahon is Military Liaison Administrator for Piasecki Helicopter Corporation, Morton, Pa. He received his B. S. Degree in Aeronautical Engineering from Mass. Institute of Technology in 1933. He entered active duty in February 1941 with the 118th Obsn. Sq., Conn. NG and later served as Chief, Troop Carrier Branch, Office Asst Chief of Air Staff—Training Hq AAF. In 1944 he graduated from the AAF Helicopter Pilot School at Seymour, Ind. After the war he was engaged as consulting engineer by the Mass. Aeronautics Commission, and later directed helicopter operations for Wiggins Airways, Norwood, Mass., before becoming affiliated with Piasecki in 1951. He is a Colonel in the Transportation Corps, USAR.—The Editor

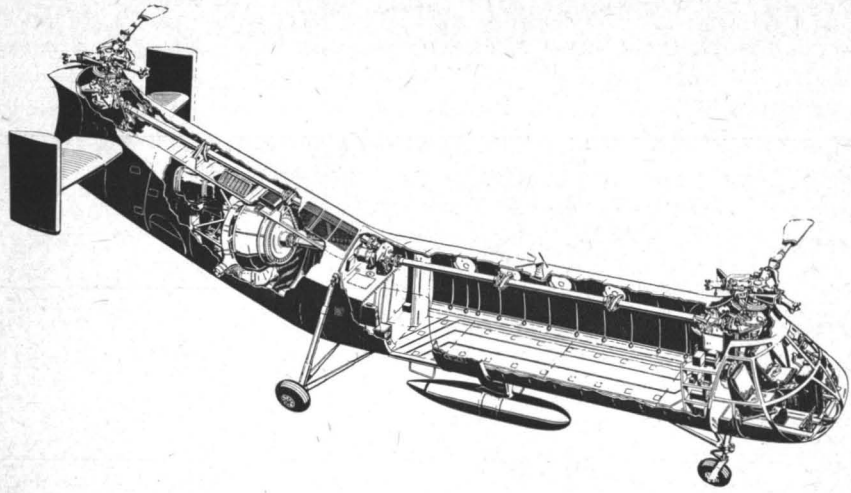


Figure 2

ulous care in the placement of personnel or materiel within the cabin is unnecessary.

Powerplant

As shown in the cut–away view (Figure 2 above), the supercharged 1425 horsepower Wright R–1820–103 engine in the H–21C Work Horse is mounted in the conventional (airplane) attitude. Lubrication problems which are sometimes created by unconventional mounting angles are avoided. A radial fan mounted on the engine driveshaft provides sufficient air for cooling under all operating conditions. This cooling air is drawn in through louvres in the dorsal fin fairing and is discharged through two circular openings in the lower part of the fuselage near the tail.

Power is transmitted from the engine to the center gear box by means of a short section of driveshaft. A combination engaging–overrunning clutch is mounted on the input side of the center gear box. The two output shafts of the center gear box turn in opposite directions at engine rpm. Sections of driveshafting connect the center gear box to the rotor gear boxes directly under each rotor hub. Most sections of driveshaft are interchangeable.

A single-stage planetary reduction gear system in each of the rotor gear boxes reduces rotational speed to about one-tenth engine speed. A high percentage of parts are interchangeable between the front and the rear rotor gear boxes. Two hydraulic pumps are driven by the forward rotor gear box. One furnishes hydraulic pressure to operate the control boost system; the other, to operate the 400-lb. capacity rescue hoist.

Flight Deck

The cockpit or crew compartment located in the nose of the aircraft features large areas of transparent panels for good visibility. Accommodations are provided for side-by-side seating of pilot and copilot with the pilot on the right side. A copilot is not mandatory for operational missions since the helicopter can be flown by one pilot—even with the control boost inoperative—and all equipment can be operated from the pilot's station. However, the side-by-side seating arrangement and complete copilot accommodations facilitate training operations.

Engine controls, longitudinal "trim" wheel, and communications equipments controls are mounted on a pedestal, centrally located between the pilot and copilot. Basic flight instruments, gyro instruments (including gyro-magnetic compass), power plant, and gear box gauges are mounted on the instrument panel where they are easily read by either pilot. Individual instrument lighting (red) with dimming feature is provided. Switches for lighting and auxiliary equipment are arranged on a convenient overhead panel.

In order to hold the stick erect and to provide control "feel" when operating on boost, a centering device is incorporated on the cyclic stick and directional pedals. A button is provided on each cyclic stick which, when depressed and released, establishes a new neutral position for the control centering device. Hydraulic control actuation is provided on cyclic stick directional pedals, and collective pitch. However, with boost-off there are no large unbalanced forces present in the control system to be overcome by the pilot. Provisions are included in the control system for an automatic pilot installation.

Pilot seats are adjustable vertically and cushions may be removed to accommodate either seat or back–type parachutes. Directional pedals are also adjustable. The sliding window on each side of the cockpit may be opened for increased ventilation and can be jettisoned for emergency egress. A two–speed electric windshield wiper operates on a laminated glass panel directly in front of the pilot. Defroster outlets direct air from the cabin heater over a large area of transparent panels for defogging and for cockpit ventilation or heating.

Communications

Communications equipment includes a USAF Combat Interphone System, Aircraft Radio Corp. Type 12 VHF set, and Aircraft Radio Corp. medium frequency range receiver and loop antenna. In addition, complete provisions are incorporated for the installation of VHF navigational receiving equipment AN/ARN–30, and for one FM receiver–transmitter component of the AN/PRC–8, –9, or –10 series. A two–position trigger switch is provided on each cyclic stick: the first detent is the interphone position; the second position is "transmit."

Passenger/Cargo Compartment

A passageway gives direct access in flight between the cockpit and the passenger/cargo compartment. A zippered closure is provided for this passageway.

The passenger/cargo compartment is 20′ long, 5′6″ high and 5′8″ wide at window level. The all–metal floor is 4′ wide and incorporates fittings on a standard 20–inch grid pattern for cargo tie–down rings or to accommodate the legs of troop seats or litter support straps. The floor consists of two aluminum alloy skins bonded to aluminum honeycomb core. The top skin is finished in a non–skid, diamond pattern to which is bonded skid rails of hard–surface, half–round aluminum strips. Flooring is designed for a localized load of 600 lbs. on any square foot, for an ultimate cargo loading of 400 lbs. per sq. ft. evenly distributed over the rear half of the compartment, and for 200 lbs. per sq. ft. over the forward half. All floor panels are either hinged or readily removable to

give access to control cables, wire packs, and fluid lines under the floor.

The passenger/cargo compartment is provided with two sliding doors. The main loading door is on the left side of the helicopter at the rear end of the compartment. It is 46″ wide and 61″ high. A second smaller door is provided on the right side of the aircraft at the forward end of the compartment.

Hoist

The boom of the rescue hoist can be swung forward by the hoist operator so that the pilot is afforded an excellent view of the load being hoisted. When the load is raised to the level of the cabin floor, the hoist operator can swing the boom to its rear position which centers the hoisted load at the forward door. Operation of the hoist winch can be controlled by either the pilot (with the up–down thumb button on the cyclic stick) or by the hoist operator at his station near the rescue door. An integral emergency cable cutter is provided at the hoist operator's station.

Fuel

To the rear of the passenger/cargo compartment, and separated from the power plant compartment by a stainless steel fire wall, is the main fuel compartment. This compartment is designed to accommodate a fuel bladder—either a 300–gallon capacity Pliofilm cell or an interchangeable 283–gallon capacity bullet–sealing cell. For extended range missions or for long range ferry flights the H–21C can be equipped with two 165–gallon external fuel tanks (Figure 3, Page 11). An electric transfer pump, operable from the cockpit, is used to transfer fuel from the external tanks to the integral fuel tank. The external tanks can be dropped individually or jettisoned by means of switches in the cockpit.

The oil tank on the H–21C helicopter is of the bullet-sealing type. Additional protection against small arms fire can be provided by installing the armor kit. This kit includes aluminum alloy, formed armor plating for gear boxes, engine and gear box oil coolers, and the lower portion of the nose enclosure. In addition, it includes flak curtain to be sus-

Figure 3

pended inside the transparent panels comprising the lower portion of the nose enclosure.

The wide–tread, long wheel base, nose–wheel type tricycle landing gear affords excellent roll–on landing characteristics, ease of handling in taxiing, and ground stability. The nose wheel is full–swiveling, self–centering, and lockable. Hydraulic brakes on the main wheels are individually operated from toe pedals at the pilot's station and are lockable for parking. The alighting gear is designed to accommodate inflatable, jettisonable floats which fit over the wheels (Figure 4, Page 12).

Cargo Sling

Each H–21C is equipped with a 4500–lb. capacity external cargo sling which permits the transporting of items which are too bulky to fit inside the cabin. During the first few months of operational use of the H–21C, this sling has proved most valuable. For example, last December an L–19 which had taken off from Marshall Army Airfield, Fort Riley, experienced an engine failure and the pilot was forced to land on a sandbar in the Kansas River. Retrieving this airplane could have been an extremely difficult operation, but by employing

Figure 4

the external cargo sling on an H–21C, it was easily lifted and flown back to Marshall Field (Figure 5, Page 13).

The external cargo sling also proved effective recently at the Army Electronic Proving Ground, Fort Huachuca, where it was employed to retrieve a 1400–lb. missile. It was located at White Sands, New Mexico, at the end of a blind canyon surrounded by sheer rock walls that rose approximately 1,000 feet above the level of the missile. The missile was lying approximately 75 feet down from the top of a hill within the canyon and on a 40–degree slope. All of the terrain within the canyon sloped steeply down toward the bottom of the gorge, and it was impossible to land a helicopter within a quarter of a mile of the missile. Pressure altitude at the missile site was 6300 feet. Because of its location, the missile would not have been recovered otherwise except by completely dismantling and carrying it out piece by piece.

During an exercise at Fort Sill in January, 1955, the H–21C helicopter was employed to transport the 105–mm howitzer, less tube (Figure 6, Page 13). This exercise demonstrated that two H–21C helicopters can transport a 105–mm howitzer, its 10–man crew, and ten rounds of ammunition, a combat load previously requiring five smaller helicopters.

Figure 5

Above H–21 airlifts L–19 wreckage.

Below H–21 demonstrates airlift of 105–mm howitzer

Figure 6

At the time this article was written, over two dozen H–21C helicopters had been delivered to Army operating activities. Flying time on these aircraft is being accumulated rapidly, and additional quantities are scheduled for delivery on a continuing basis. The manufacturer is confident that the H–21C can make a noteworthy contribution to the increased mobility of the Army.

The world's present helicopter altitude record of 24,500 feet was established by an Army Aviator, Warrant Officer Billy I. Wester, on 17 October 1954.

DENSITY ALTITUDE

Captain William H. Harper, *Infantry*

The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor

Density altitude is defined as pressure altitude corrected for temperature. To gain a better insight into the problem of density altitude and its effect on the performance of helicopter and fixed wing aircraft, let us explore the physical properties of air and resolve the meaning of: (a) Air density, and the effects of pressure, temperature, and humidity on this density; and (b) Standard atmosphere.

Pressure

Air, like liquids and other gases, is a fluid. Because it is fluid, it flows and changes shape under pressure. Air is "thin" at high altitudes; that is, there are fewer molecules per cubic foot of air at 10,000 feet than at sea level. The air at sea level, of course, is "thin" or less dense, when compared to the compressed air in a truck tire.

Another example is to think of air in layers. These layers of air press down on one another, like woolen blankets in a stack. The bottom blanket is under the weight of all the blankets above it. As a result of this pressure, the bottom blanket may be squeezed down until it is only one-tenth as bulky as the fluffy blanket on top. The bottom blanket is ten times as dense as the top blanket and occupies less space. In the same way, air layers near the surface of the earth have much greater density than air layers at higher altitudes.

Temperature and Humidity

Even when pressure remains constant, great changes in air density will be caused by temperature changes. The same amount of air that occupies one cubic inch at a low tempera-

ture will expand and occupy, two, three, or four cubic inches as the temperature increases.

These changes in air density affect flying. If an aircraft's wings (or helicopter blades) have to pass through or displace a certain amount of air in order to lift the weight of the craft, it will naturally take off in cold weather more easily since the air is more dense. On the other hand, in taking off from a high altitude field on a hot day, an airplane will require a longer run and a helicopter may require a ground run (to establish translational lift) rather than rising vertically. The air at the higher altitude would be "thin" not only because of the lower pressure found at the higher elevation but also because of the decrease in density caused by higher temperature.

Finally when temperature and pressure are constant, changes in the moisture content of the air will slightly change air density. Air always contains some moisture. The amount of it varies from almost none to very high humidity and the density of the air decreases as the moisture content increases. Therefore, aircraft taking off from a field at high altitude on a hot, humid day will require slightly more take-off run due to the further reduced density resulting from high humidity. Fortunately, this effect is so small as to be almost negligible.

Standards

Due to the fluctuations of atmospheric conditions, a criterion of standards has been established. Standard pressure is 29.92 inches of Mercury (1013.2 Millibars) and standard temperature is 59°F (15°C) at sea level. There is a standard temperature lapse of 3.56°F per 1000 feet of elevation. Aircraft performance is evaluated by using these standard atmospheric conditions.

Captain William H. Harper is the Executive Officer, Department of Publications and Non-Resident Instruction, Army Aviation School, Camp Rucker, Alabama. He is a graduate of the Citadel, Officer Candidate School and the Infantry Advanced Courses, Fort Benning, Georgia, and of the Army Aviation Tactics and the Army Helicopter Aviation Tactics Courses at Fort Sill, Oklahoma.—The Editor

Helicopter Performance

The effect of air density on the performance of aircraft has long been recognized, and with increased helicopter operations this effect becomes even more important since the areas from which the helicopter operates are usually more restricted than those used by fixed wing type aircraft. Generally speaking, helicopter operation in hot weather is less efficient than it is in cold weather. Hovering, vertical ascent, and vertical descent may be impossible when the temperature is high. Decreased air density often necessitates running take-offs and landings, and engine RPM loss is likely as blade pitch is increased to effect sufficient blade loading to lift the craft or to stop its descent. An over–rev is permissible prior to take–off and landing provided it does not exceed the maximum RPM allowable.

All aircraft, regardless of design, have an eventual ceiling limit where the air finally becomes so thin that the airfoils are no longer able to provide sufficient lift to sustain the craft in level or climbing flight. Power plant efficiency also decreases since there is not sufficient air available for proper fuel/air mixture. Although civil and military tests have proved the helicopter capable of performing successfully at high altitudes, they have also proved that high altitude operations are usually marginal and demand deliberate, detailed planning.

Army helicopter pilots *must* be familiar with the high–altitude factors affecting helicopter performance and the flying techniques of such operations. Three major factors should be understood.

Density

a. *Altitude:* An increase in altitude causes a decrease in air density.

b. *Temperature:* An increase in temperature causes a decrease in air density.

c. *Humidity:* An increase in humidity causes a decrease in air density.

Wind

If there is sufficient wind velocity to afford translational lift while hovering, helicopter performance is improved

considerably. Such a wind condition permits the rotor to operate more efficiently because of the increased downwash velocity obtained with translational lift.

Load

a. Under conditions of high "density altitude" additional engine power is required to compensate for the thinness of the air. The maximum gross weight of the helicopter may at this point exceed the limits of available engine power thus necessitating a reduction in load.

b. Due to periodic changes in density altitude and wind velocity during the day, the weight–carrying capability of a particular helicopter may vary many times in a single day.

c. Established service ceilings for each aircraft must be considered in computing maximum load for safe operations.

Load is the only one of the factors which can be controlled by the pilot. The pilot must consider carefully this variable factor, deciding, for example, whether to carry smaller amounts of fuel in order to improve his performance and increase his useful load or to carry more fuel and increase his range.

Measuring Density Altitude

No instrument is available for correctly measuring density altitude. It must be computed from the known temperature and pressure at the particular altitude under consideration. Once the temperature and pressure are obtained, the chart on page 20, may be utilized as a field expedient to compute the density altitude. It must be realized that the answers derived are merely guide figures. There are two means of obtaining the temperature and pressure and of applying them to the chart.

The first method, which is slightly less accurate than the second but which requires no instruments other than those in the cockpit of the helicopter, is as follows:

(1) To compute density altitude while in flight, set the altimeter (Kohlsman dial window) to 29.92, fly as close to the point of landing as possible while maintaining translational lift, and read the height as indicated by the altimeter. This figure is the *pressure* altitude. Let us assume

that it is 2800 feet. (If the aircraft is on the ground, all computations may be made prior to take–off.)

(2) Read outside air temperature from the cockpit thermometer. Let us assume that it is 20° Centigrade.

(3) At the bottom of the chart, page 20, find the outside air temperature on the temperature scale. In our example, it is 20° Centigrade.

(4) Trace upward to the point where the vertical line intersects the correct diagonal *pressure* altitude line. In our example the *pressure* altitude is 2800 feet. It is necessary to interpolate between the 2000 and the 3000 foot lines.

(5) Move left horizontally to the correct *density* altitude reading on the left side of the chart. In our example the answer is 4,000 feet.

Thus we have determined, by the use of the altimeter and temperature gauge and by making a low pass over the point of intended landing, the density altitude. The density altitude may be determined more accurately providing there are weather facilities at the point of take–off and landing. It is done by using the same chart but field elevation is also taken into consideration as follows:

(1) Obtain barometric pressure for point of take–off/landing. (From weather station)

Example: . . . Barometric pressure 28.60″HG

(2) In left column on the right of the chart, find the pressure reading (28.60″HG). In the adjacent column read corresponding altitude addition correction for obtaining pressure altitude. In our example, the correction is plus 1,245′. Add or subtract this correction as indicated to the field elevation. (Field elevation is obtained from the map.) The result will be the *pressure* altitude.

Example: . . . Field Elevation	2,000′
Plus Pressure Correction	1,245′
Pressure Altitude	3,245′

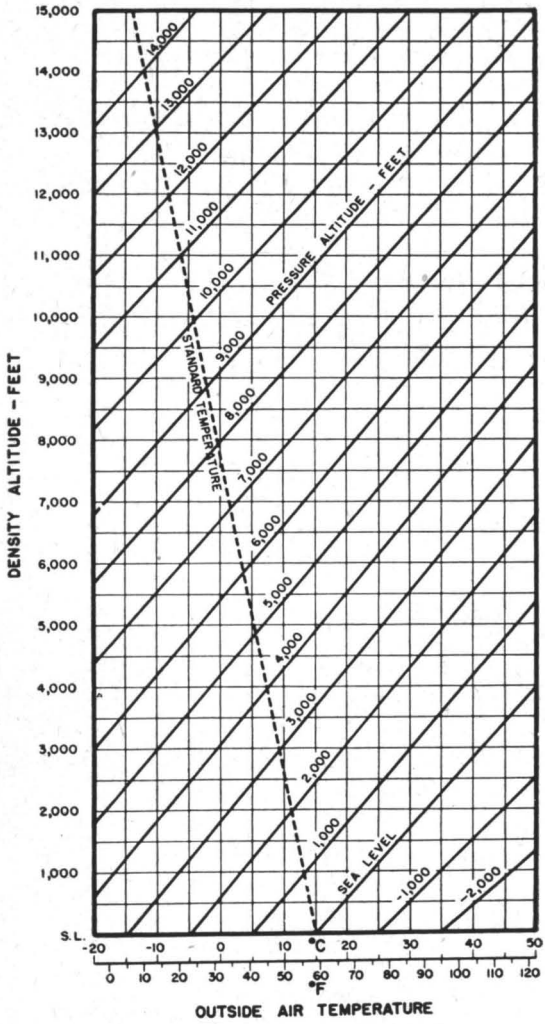
(3) Obtain the outside air temperature at field elevation at point of intended take–off/landing. (From weather station)

Example: . . . . . 95°F (35°C)

(4) Find this temperature reading on the temperature scale at the bottom of the chart. Move the pointer vertically

PRESSURE ALTITUDE DENSITY CHART

SET ALTIMETER TO 29.92 IN. HG. WHEN READING PRESSURE ALTITUDE



ALTIMETER SETTING IN. HG.	ALTITUDE ADDITION FOR OBTAINING PRESSURE ALTITUDE
28.0	1,825
28.1	1,725
28.2	1,630
28.3	1,535
28.4	1,435
28.5	1,340
28.6	1,245
28.7	1,150
28.8	1,050
28.9	955
29.0	865
29.1	770
29.2	675
29.3	580
29.4	485
29.5	390
29.6	300
29.7	205
29.8	110
29.9	20
29.92	0
30.0	- 75
30.1	-165
30.2	-255
30.3	-350
30.4	-440
30.5	-530
30.6	-620
30.7	-710
30.8	-805
30.9	-895
31.0	-985

from this temperature reading until it intersects the correct diagonal *pressure* altitude line.

Example: . . . . . *Pressure Altitude* 3,245′

(5) Move pointer horizontally to the left and read resultant density altitude in feet.

Example Answer: . . . . . 6,400′

Thus we obtain a fairly accurate density altitude reading. Since the effect of humidity is almost negligible it was not taken into consideration on this guide. In using the chart, regardless of the means employed to obtain the temperature and pressure altitude, a simple rule to remember is, "Read right, up, and left."

Once this density altitude reading is obtained the pilot should consult the tables in the Flight Handbook for the helicopter concerned which show the maximum gross loading and operational limitations for the particular helicopter with given density altitudes.

HELICOPTER INSTRUMENT FLYING

Captain Richard W. Kohlbrand, *Infantry*

The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor

"Instrument flight conditions in a helicopter, due to oscillations and peculiar control forces, can quickly cause a well developed form of hysteria among pilots not familiar with instrument flying," according to instructor pilots at The Army Aviation Center who have recently been conducting limited helicopter instrument flight test experiments.

Several helicopter accidents have occurred within the past year which were the direct or indirect result of the pilots' lack of knowledge concerning instrument flight. Military necessity will increasingly require the use of helicopters in all–weather and night operations; therefore, the helicopter pilot will become more and more involved with instrument flight conditions. Within the limitations of the equipment, Army helicopter pilots must become qualified instrument pilots.

A great deal of work is being done in the field of instrumentation and in other engineering developments, such as increasing stability and pilot assist devices. As far as Army pilots are concerned, the Army Aviation School project was to determine if instrument flight was feasible, and if techniques could be integrated into the present helicopter pilot training courses.

The tests indicated that, within definite limitations, instrument flight is practicable in the present utility type helicopter. The conclusions presented are not final; however, they do indicate the problems that will be encountered in flying the H–25 and H–19 helicopters on instruments. The limitations should be noted very carefully. They apply to the quality of the pilot and to his training and technique as well as to the characteristics of the helicopters.

H–25

Twelve hours of flying under simulated instrument conditions were completed in the H–25 at the time of this writing. The tests were conducted under diversified conditions, including winds up to 30 mph with a gust spread of 15 mph.

Tests showed that monitoring of the instruments had to be exacting and continuous due to the tendency of the H–25 to pitch, roll, and yaw in normal flight. Controlling airspeed and altitude did not present any particular problems, if a pre–set manifold pressure were used in conjunction with proper use of the cyclic. The manifold pressure setting was determined by trial and error in the particular helicopter being flown. The most satisfactory results were obtained with 26 to 28 inches.

Slight overcontrolling was prevalent when making airspeed corrections. It was caused by the instruments' giving a reading of the attitude of the fuselage instead of the attitude of the rotor disc, which is what the pilot is primarily concerned with. Preventing overcontrol in slow flight is also extremely difficult.

In level flight directional control was maintained by the use of pedals only. A ten degree direction change in rough air was not uncommon and corrections were made with

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Captain Richard W. Kohlbrand is Assistant Editor–in–Chief of the ARMY AVIATION DIGEST. He attended the University of Cincinnati and is a graduate of the US Army Aviation Cadet Program, Pathfinder Crew Training Course, The Associate Infantry Officers Basic Course, Army Helicopter Aviation Tactics Course, and the Army Helicopter Instructor Pilot Standardization Course. He has logged approximately 3,100 hours in rotary and fixed wing aircraft. During World War II he was a Pathfinder pilot in the Troop Carrier Command of the Ninth Air Force in Europe. During the Korean War he served as an Army Aviator and Aide–de–Camp to Major General Arthur G. Trudeau, Commanding General of the 7th Infantry Division. Upon returning to the ZI in 1953 he was assigned as a helicopter pilot instructor at The Army Aviation School. He recently received his present assignment with the ARMY AVIATION DIGEST.—The Editor

pedals only. Directional control could be maintained if the pedals were set even, or opposite each other (accomplished with the mechanical pedal adjustment), and the aircraft trimmed for straight and level flight.

In turns, an 8° bank was found to be the most desirable. A turn with a bank of greater than 8° usually resulted in excessive vibrations which made the instruments extremely difficult to interpret. A four minute needle turn and bank indicator is recommended because it is less sensitive and facilitates interpretation. Airspeed and altitude control in turns were normal.

During climbs or descents no particular difficulty was encountered. The best airspeed for control in a climb was found to be between 50 and 60 knots, with 33 to 35 inches of manifold pressure. The descent also was best accomplished at an airspeed of 50 to 60 knots. Airspeeds which were lower than this resulted in a corresponding increase in attitude change and excessive vibrations.

Autorotations

Power–recovery autorotations were tested under the hood with recovery being effected between one and two hundred feet above the ground. Some difficulty was encountered upon entry due to the fast decrease of airspeed caused by the inherent tendency of rotary wing aircraft to pitch upward when collective pitch is reduced rapidly. It was necessary to monitor the instruments closely upon entry and during recovery in order to correct for sudden changes in direction due to the reduction and increase of torque forces.

Approaches

Numerous GCA approaches were executed with encouraging results. The best glide path approaches were made at an airspeed of 60 knots and a rate of descent of 300 feet per minute to the touchdown point. Minor difficulty was experienced with GCA operation because of the GCA operators' lack of experience with the peculiarities of helicopter flight.

It was found in radio work, low range orientations and letdowns, that the pilot had considerable difficulty in tuning the radio of the H–25. The copilot must be responsible for

all radio tuning. The beam following and letdown presented no particular problems.

H–19

Fourteen hours and thirty minutes of hood time were logged in the H–19. Tests were conducted in smooth and gusty air with very little difficulty.

The H–19 was stable in flight and had little tendency to pitch and roll. During straight and level flight, at forward speeds from 20 to 70 knots, airspeed was controlled within 10 mph, altitude within 50 feet, and headings to within 5° of that which was desired. Yawing was encountered at speeds below 30 knots; however, the instruments remained steady and readable, and control response was positive. The best forward speed for ease of flying was found to be from 50 to 60 knots.

Instrument take–offs from a hover were not too successful. From the hover until translational lift was obtained, a heading was impossible to maintain due to the excessive yawing of the helicopter. A 45–degree deviation from the desired heading was not uncommon during the initial phase of the take–off but after translational lift was obtained the climbout was normal.

Altitude was controlled primarily with the collective pitch while cross–checking the altimeter and rate of climb indicator. An average manifold pressure setting for the particular conditions was a definite advantage and was deter-

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The helicopter instrument flight tests discussed in this article were conducted by Captains Ellis C. Langford and Emil E. Kleuver. Captain Langford, chief of the test project, is Flight Commander of the Rotary Wing Check–Flight Section of the Army Aviation School. He has logged approximately 3,900 hours flight time, is instrument rated, and is an instructor pilot in the H–13, H–23, H–25, and H–19.

Captain Kleuver is Assistant Flight Commander of the Twin Engine Flight at the Army Aviation School. He has logged approximately 3,200 hours flight time, is an instrument examiner, and is an instructor pilot in all Army fixed wing type aircraft as well as the H–13, H–23, H–19, and H–25.—The Editor

mined by cross-checking the manifold pressure gauge with the altimeter and rate of climb instruments.

Pitching was controlled by the use of the cyclic stick. Overcontrolling caused an excessive pitching and pendulum-like action of the fuselage. The primary instruments for pitch control were the airspeed indicator and the artificial horizon.

Directional control was maintained by the coordinated use of the cyclic stick and anti-torque pedals. This coordination was necessary since with the single rotor configuration of the H-19, use of pedals alone will change the heading without changing the direction of flight. The primary instruments used to maintain directional control were the slave compass, artificial horizon, and the turn and bank indicator.

When executing turns, the cyclic, anti-torque, collective pitch, and throttle controls had to be coordinated. Altitude was maintained in the turn with collective pitch and throttle. It was found that in making steep (30° bank) and shallow (8° bank) turns there was no tendency to lose control or induce excessive vibrations. Because of the rapid control response, no lead was necessary in rolling out onto a heading. The artificial horizon and the slave gyro compass were the primary instruments used in this maneuver. The turn and bank indicator was of limited help due to the sensitivity of the needle.

The collective pitch and the throttle were the primary controls required to establish and maintain a rate of climb. The cyclic stick was used to control airspeed and lateral movement and was also coordinated with the torque pedals for directional control. The most satisfactory airspeed and rate of climb were 55 knots and 500 feet per minute.

No special problems were discovered in descents, which were made at an airspeed from 30 to 60 knots. The most satisfactory airspeed was 50 knots and the best rate of descent was from 200 to 300 feet per minute.

Autorotations under simulated instrument conditions were practiced without much difficulty. Upon entry the helicopter would turn to the left, but could be quickly corrected by use of right pedal alone. Autorotative turns presented no problem. Power recoveries were made at the termination of

each autorotation and cruising flight resumed with a minimum of effort.

G C A

Numerous GCA approaches were practiced while flying at various airspeeds between 30 and 60 knots. A number of approaches were made at slow speeds, approximately 30 knots, and all were fairly successful. However, approaches at low speeds are not recommended because of the possibility of a settling with power condition and the difficulty in staying on the final approach center line, especially in the presence of a cross wind.

The most successful GCA approaches were made at an airspeed of 50 knots and a rate of descent of 200 to 300 feet per minute. Several were made to a touchdown on the runway without any help from the safety pilot. An airspeed of 50 knots was maintained until the end of the runway was passed, then speed was decreased to approximately 10 to 15 knots. The rate of descent was decreased to 100–150 feet per minute, and the ship was held on glide path until contact with the runway was made. The GCA proved very accurate all the way down the approach to touchdown.

Range Orientations

Omni tracking, holding, and letdowns were accomplished with the same degree of proficiency as experienced in fixed wing type aircraft. The published standard procedures and letdowns were adequate for low frequency range work with slight changes. The two minute leg in the holding pattern was satisfactory, but the time to the field had to be adjusted to compensate for the slow speed of the helicopter. The most successful airspeed and rate of descent for the letdown was found to be 50 to 60 knots and between 200 to 300 feet per minute. Location of the radios in the H–19 enabled the pilot to handle all radio tuning.

I L S

It was not possible at the time the flight tests were being conducted to obtain approval for having a marker beacon and ADF installed in the helicopter. ILS approaches

were made successfully by having the safety pilot report visually over the outer and middle markers. The test pilots believe that, with a glide slope and marker beacon installed in the H–19, an ILS approach could be made with a very high degree of precision to the point of touchdown.

Conclusion

Helicopters when flown on instruments are handled essentially with the same procedures as fixed wing aircraft. The slow flying capabilities of helicopters do not, at the present time, reach into instrument flying. Pilot training and technique are the foundation upon which future helicopter instrumental flying will be built. *In the meantime helicopter instrument flying remains an emergency measure until further developments assure us of a sound basis for growth.*

Under present military budget planning, the Army is authorized 3,600 aircraft.

ORGANIZATIONAL MAINTENANCE

Captain Joseph J. Muter, *Transportation Corps*

The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor

The problem of maintaining Army aircraft in a serviceable condition at "using unit" level has been magnified in recent years by the rapid expansion of Army aviation, transfer of logistical responsibility, and an increase in the complexity of the aircraft involved. Although the present structure of Army aviation may be described as being in "a fluid state," the problems of aircraft maintenance have not increased appreciably because the rules of maintenance are more inflexible, being based on well-established principles utilized successfully by other branches for many years. Assumption of logistical responsibility for Army aircraft by the Transportation Corps and adoption of the organization, field, and depot system of maintenance provided a definite area or responsibility for each level of maintenance but did not clearly establish the line of demarcation for each level.

Organizational maintenance, or the daily care and feeding of aircraft, is based on the adage, "Take care of the little things and the big things take care of themselves." It is established, therefore, as the basic but most important level of maintenance since neglect here will result in major repairs. Thus, organizational maintenance becomes the area of greatest concentration by all levels of command and logistics. Field and depot maintenance activities concern themselves with the repair and replacement of major components from wear caused by normal expiration of service life, accidents, and possible neglect at organizational level. They also provide the spare parts and technical assistance necessary for keeping aircraft in a serviceable status, thereby directly supporting organizational maintenance. This system provides a successive method of repair and generally insures a rapid return to serviceability of the aircraft involved.

Maintenance Officers

The organizational aircraft maintenance officer, who is charged with the responsibility of keeping his unit's aircraft flying and who is also the focal point of the concentration mentioned above, is hampered in the performance of his duties because his area of responsibility is not clearly defined. He is not sure where organizational maintenance ends and field maintenance begins. There is no clear, concise, single manual published for his guidance, nor is there an established course of instruction at organizational level at any service school for aircraft maintenance officers. Multiplication of unit maintenance officers, resulting from the rapid expansion of Army aviation, together with establishment of extension courses, will probably bring about correction of these deficiencies.

Areas of Responsibility

The means of delineating areas of responsibility at the present time is to consider availability of parts, precedence, and have a "Statement of Understanding" between the unit and field maintenance officers concerned in any given situation. The unit maintenance officer, desiring to perform all maintenance for which he is responsible but not wishing to encroach on field maintenance responsibility because of the duplication of effort, should adhere to these basic principles.

The availability of replacement parts to organizational maintenance activities is limited to those listed in DA Supply Catalog TC–7, U–Series, for aircraft. If the part needed is listed in the TC–7 and a stock level is shown, or an authorization to requisition the part is indicated by a percentage

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Captain Joseph J. Muter is a Helicopter Maintenance Instructor, Department of Aviation Maintenance, ARMAV, Camp Rucker, Alabama. He attended the University of Maryland and is a graduate of the Army Aviation Liaison and Helicopter Pilot courses. He is also a graduate of the Aircraft Maintenance Officer Course at the Spartan School of Aeronautics. He is qualified in L–19, LC–126, L–20, H–13, H–25 type aircraft.—The Editor

(%) sign, then obviously the authorization to perform that level of maintenance is automatically granted. Conversely, if the part needed is not listed, the obvious conclusion must be that the necessary repair is field maintenance responsibility.

Precedence originated by other branches of maintenance, establishes that repair at organizational level is based on the availability of qualified personnel, time, and proper tools (special tools authorized unit maintenance for each type aircraft are listed in the rear of the applicable TC–7). It seems illogical to attempt repair of our aircraft if the mechanics are not fully trained to perform the work. Nor can it be justified if excess time is required, resulting in neglect of the usual daily and periodic inspections, lubrication, or pilot write-ups. Since units are usually short of qualified mechanics, considerable thought should be given before tying up the available mechanics on extensive repairs when field maintenance activities are readily available and better equipped to do the work. Availability of proper tools imposes the last restriction based on precedence and, if misuse of common tools is required or field expedients must be utilized, it is better to pass the work on to field maintenance.

Agreements between unit and field maintenance officers should generally be limited to those items listed in the TC–7 and indicated by a double percentage (%%) sign. Field maintenance officers should carefully study, before issuance, needs for items requiring their approval. Where emergency necessitates unit repair of field maintenance items, assistance by field maintenance should be given if possible.

Nothing will assist the unit maintenance officer more in the performance of his mission than maintaining close liaison with the field maintenance officer. The field maintenance officer's responsibility is close support in both supply and maintenance and there is no limitation on how much he can give.

Application of the above principles should result in an equitable distribution of work between unit and field maintenance, a clearer, closer establishment of the demarcation line, and a tentative guide for the operation of the unit maintenance section.

ARMY AVIATION DIVISION—TRADCOM

Lieutenant James H. Muller, *Transportation Corps*

The views expressed in this article are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor

Before discussing the objectives of the Army Aviation Division of the Transportation Research and Development Command and how they are being reached, it is well to consider some of the basic problems that complicate any expanding aviation program—to examine them specifically in terms of Army aviation.

Five years ago Army aviation had several hundred aircraft of relatively simple design and maintainability; today it has several thousand much larger and more complex aircraft. This expansion has greatly increased the mission, responsibilities, and functions of Army aviation. Especially is this true with respect to the helicopter with which Army aviation is providing tactical and logistical support to front-line troops. Whereas formerly ship, rail, and truck transportation comprised the full chain of this support, now the cargo helicopter is an added link. When mountains form barriers to other transportation media, when floods make roads impassable, when bridges are destroyed, when redeployment or evacuation is essential, only the cargo helicopter can fill the need for an efficient carrier. Mobility is victory and Army aviation has endowed the Army with a mobility potential never before dreamed.

The Army envisions a fleet of helicopter battalions supported by field-maintenance companies. Each helicopter battalion will consist of three companies, with 21 cargo helicopters per company. These helicopters, under procurement for the Army, are of the $1\frac{1}{2}$-to 3-ton payload category, approximating the size and complexity of a DC-4. Add to this expansion the very pertinent fact of the newness of the helicopter and you approach the crux of the problem. Large

twin–engine helicopters are new, both in design and engineering concepts. No operational experience has been acquired on these large helicopters; many problems will evolve concerning their operation and field–service support that have not heretofore been encountered. A basic one arises in the maintenance of these aircraft. Because of the relative newness of the helicopter, the exigencies of production compel the Army to use short–lived, high–cost components and expend an exorbitant amount of maintenance man–hour requirements per flight hour. As maintenance becomes more complex, additional skill and experience are required for the maintenance personnel, and the need for special tools and equipment increases.

Today the initial cost of a helicopter, as well as the cost of normal maintenance, is high. To obtain a reasonable return on an aircraft investment, it is imperative that methods be devised to minimize the time that the aircraft must be kept on the ground for maintenance. Zero ground time would be ideal but, of course, unattainable.

Take these fundamental considerations and place them in the realistic perspective of supporting a moving army in the field and you will find that your maintenance requirements have been multiplied. We must not gear our thoughts to a fixed–base type of maintenance with permanent hangars and paved ramps. Rather they should be geared to such adverse conditions as mud, cold, snow, heat, or dust. Extreme temperatures, for example, affect viscosity of lubricants; dust and sand abrade gear tolerances, bearings, seals, and cylinder walls. These are the conditions with which we must live, the norm rather than the exception.

First Lieutenant James H. Muller received his Bachelor of Science degree from Fordham University. He entered the military service as a Second Lieutenant in 1951 and was assigned as a weapons instructor at the Replacement Training Center, Fort Eustis. He is a graduate of the Army Aviation Tactics Course and served with the 13th Helicopter Company in 1953 in Korea. He is currently assigned to the Army Aviation Division of the Transportation Research and Development Command, Fort Eustis, Virginia.—The Editor

Objectives and Programs

This discussion must inevitably result in contemplation of economy and availability, the framework within which TRADCOM's interest lies and toward which its programs are targeted. The two objectives of TRADCOM's Army Aviation Divisions are: (1) to reduce operational and maintenance costs; (2) to increase the availability of our aircraft. Now, let's explore the methods by which these objectives are being accomplished, the programs which TRADCOM is conducting, or proposing to conduct:

The first of these programs, a proposal which as yet has not been approved, is reliability testing. The command proposed to accumulate as fast as possible about 1,000 hours of flight time on two, or more, of each new production model. By continual flying TRADCOM expects to log this 1,000 hours within a year. To illustrate the magnitude of the project, weigh against the TRADCOM goal the statistic that a helicopter company in the field normally takes four years to fly 1,000 hours. On its accelerated schedule, TRADCOM should pinpoint and solve unforeseeable maintenance problems before they occur in the field. Out of such tests TRADCOM will obtain information concerning:

1. Early identification and elimination of deficiencies likely to reduce availability in the field.

2. Classification of service life cycles of components and accessories.

3. Determination of personnel, equipment, and parts support requirements.

Here is a brief example of one way in which reliability testing can reduce over–all costs:

A new helicopter is procured and put into the field. Various components of the aircraft must be changed after a certain amount of flying. This amount represents an estimate that allows a good margin of safety, since it certainly would be unreasonable to fly the aircraft until the component actually failed. Let us suppose that the component to be changed in our helicopter is the transmission, costing $10,000, and with a replacement time of 300 hours. Assuming that there are 100 such helicopters in the system, it would cost $1,000,000 to replace all transmissions. However, if TRAD-

COM, after 1,000 hours accelerated flight time on the two ships, had concluded that the transmissions could be used safely for 600 hours, consideration could then be given to the advisability of extending the service life accordingly. The end result of such action would be: reduced maintenance requirements; reduced supply stockage requirements; an over-all monetary savings within the supply system.

Another aspect also can be emphasized by example. Assume that in the course of an accelerated flight test TRADCOM ascertains that the fuel pump fails in an average of 200 hours. The trouble can be determined, then a remedial measure found, and a "fix" recommended. Simultaneously field units would be alerted and action initiated to have the responsible agency establish and publish the modification.

Field-Maintainability

The second program is field-maintainability testing to detect and correct those design features that necessitate higher skills and excessive man-hours of maintenance. This is a logical sequel to reliability. For example, it may be found that before removing the fuel pump (normally a twenty-minute job) we would have to remove many other components, lengthening the operation to a twelve-hour job. This discovery would spark a recommendation for design change. Or perhaps it may be resolved that the methods, techniques, or procedures are not adequate, resulting in a recommendation for their improvement.

The optimum of an aircraft requiring no maintenance during its life cycle can never be obtained; but TRADCOM intends to approach that optimum.

Another ideal but improbable situation would be an unlimited pool of skilled mechanics. The practical alternative method of assuring the most efficient maintenance is development of simplified methods enabling less skilled personnel to achieve superior results. The ultimate end of method simplification is to sustain maximum availability while utilizing the minimum skill.

Traditionally aviation design has emphasized performance while placing relatively little stress on ease of maintenance; yet in a continuing logistical support mission, availa-

bility can be far more important than, say, a twenty percent increase in payload or speed. For that reason TRADCOM proposes to explore systematically such expediters as:

1. Aligning devices; quick disconnects; color coding; sectionalization.
2. Preassembled component grouping.
3. Simplification of technical instruction.
4. Standardization of fastenings.
5. Improved access to frequently removed components.

This exploration will be a continuing process. TRADCOM will apply the results to contemporary aircraft, and incorporate the principles evolved into specifications for future designs.

Ground–Support

The third program may be termed the ground–support phase. It is aimed at providing adequate mobile shops, tools, and equipment to support, under field conditions, the large helicopters being procured. Maintenance support equipment almost invariably lags behind the aircraft it is intended to support. This presents a rewarding area of endeavor, for in many cases such equipment is just nonexistent. TRADCOM is assembling 41 tool sets for use in the various echelons of maintenance. These include Military Occupational Specialty sets, Shop sets for light, heavy, and field maintenance units, and Mobile Van sets which are integrated into a standard side–folding van body mounted on either a truck or semi-trailer to meet combat–zone mobility requirements.

Some typical projects under way may define the objectives of the ground–support program. One project is portable inspection equipment. To detect suspected fatigue, failure, or weakness in a piece of metal, it must be subjected to inspection tests such as magnetic–particle inspection. Under the present system, equipment needed for such a test is installed at fourth echelon, heavy field maintenance units; when a requirement to test an aircraft structure materializes during an unscheduled maintenance period, the aircraft must be grounded while the part is removed and sent to such a unit. With the light–weight portable equipment recently tested by TRADCOM this process can be performed in the field at the organization,

allowing greater availability of aircraft by cutting the ground time from as much as two days to as little as two hours.

Another project is research on blade–tracking devices. Unless helicopter rotor blades rotate in the same plane, vibrations are set up. Periodically the blades go "out of track" and must then be "retracked." At the moment no effective techniques of tracking rotor blades exist. Improvised means have been employed on light helicopters but on the heavier helicopters the improvisation not only becomes completely inadequate but impossible.

Concurrently TRADCOM is conducting studies of air operations and systems of employment, an example of which is the helicopter ship–to–shore investigation. Changing concepts of warfare require changing concepts of aircraft utilization. This need is magnified by introduction into the system of new and larger cargo helicopters whose full scope has not yet been determined.

Procurement and Supply

In support of procurement and supply efforts, TRADCOM is conducting a detailed continuing study of operating and maintenance costs. Reports on such costs are submitted semi–annually. A system of actuarial analysis of high–cost components is also being developed to predict accurately life expectancies and failure rates. Through its achievements, TRADCOM is assisting the Army in realizing the maximum return upon its investment in Army aviation.

BOOKS FOR THE ARMY AVIATOR

THE GYROSCOPE APPLIED—Richardson, K. I. T., M. A. (The Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y., 1954.)

A few years ago the gyroscope was comparatively unknown, except possibly as a toy, involving a wheel spinning in some form of framework which could be made to balance on the edge of a penknife, the rim of a glass, or on a piece of string. Man's application of the device for scientific purposes is, however, over a century old and the name "gyroscope" itself dates from 1852 when the French scientist and philosopher, Foucault, used it to demonstrate the rotation of the earth.

Today, largely as a result of the technical advances made under the impetus of two world wars, especially the last one, there are few engineers or, indeed, few men with a modicum of education or experience in the Services, who are not aware that the gyroscope plays an important part in the navigation and control of ships and aircraft, in gunfire control, bomb sights, and the torpedo. Thus, there has grown up in recent years a major section of the engineering industry specializing in the design and manufacture of gyroscopic equipment which is being extended still further as the guided missile is developed, perhaps leading eventually to interplanetary flight!

A book, *The Gyroscope and Its Applications*, was published in 1946 when secrecy restrictions prevented reference to many interesting achievements and possibilities. Since then, considerable technical advances have been made and the secrecy restrictions have been relaxed to some extent, although they still apply in many instances. The present book, therefore, based on that published in 1946, has been almost entirely rewritten, describing much that is new but at the

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This department is prepared by the ARMY AVIATION DIGEST staff. Views expressed are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor

same time incorporating most of the information given in the first version, although this is presented in a different manner and, in some cases, from a different viewpoint. As an example, the fundamental mathematical treatment has been relegated to an appendix so that readers who are not mathematically inclined will not be appreciably interrupted in their perusal of the book; those who want to follow the mathematics can find it collected in a convenient form.

Unlike the first book which was written by several authors, as stated in the preface, this is the work of one man, who is closely associated with the development of many forms of gyroscopic application in many different spheres. It is believed to be one of the very few books that embraces in one cover as many of the different types of application as possible ranging from small intricate aircraft instruments to large engineering projects, such as the roll-stabilizers for 40,000 ton liners.

AMERICAN STRATEGY IN THE ATOMIC AGE—Reinhardt, Colonel George C. (University of Oklahoma Press, Norman, Oklahoma, 1955. $3.75)

Tells why and how the United States must make full use of its psychological, military, and economic resources in the containment of the Communist–Imperialist ideology *now*, minimize its influence *in the immediate future*, and eliminate it as a threat to the free nations of the world *in our time* and for generations to come.

It gives a realistic, geopolitical approach to the foreign-policy problem of this country, namely, its position in a world divided between the democratic nations and those that adhere to the Communist–Imperialist ideology of the Union of Socialist Soviet Republics. The picture it presents is not one in which any American can take comfort, but, if the courses of action which are defined by its author can be made operative, every American and the peoples of the countries allied with the United States can be reassured.

From the vantage point of thirty years' service in the United States Army all over the world, Colonel Reinhardt analyzes our present situation and suggests the various strategies by which we can unify our allies abroad and consolidate governmental support at home. The areas of the

world are examined from the standpoint of usefulness and availability for such action, and practical ways and means, diplomatic and otherwise, of stalemating and overcoming Communist aggression are proposed.

Colonel Reinhardt shows that there is a way, short of a shooting war, by which the freedom of the world can be guarded, assured, and even restored. Its cost will not be negligible, nor will the path be easy.

SPACE TRAVEL—Gatland, Kenneth W., and Kunesch, Anthony M. (The Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y., 1953. $4.75)

Are you interested in visiting Mars? The answers to this question might be various, but in the minds of the authors there is no possible doubt. They are interested and they know exactly how to get there.

The more adventurous of mankind have become increasingly fascinated by the possibility of interplanetary communication. Here, described with enthusiasm and authority, is not only the whole history of rocket development from the days of the first discovery of an explosive mixture before the birth of Christ, but also the latest information on the harnessing of the tremendous new propellants available today.

Mr. Kunesch and Mr. Gatland have produced a series of blueprints for the construction of an artificial satellite freely revolving in its own orbit around the earth, and for the great liners which will take off from it on their flashing journeys to starry destinations in our own galaxy and even, perhaps, beyond. It is a fascinating field, not only for speculation, but for immediate enterprise and experiment, for the authors are convinced against all argument that, were there funds available, modern knowledge would be sufficient at this moment to make possible the first journey to another world.

The illustrations, as may be imagined, form an integral part of the book. There are approximately 100 of them; historical records of early experiments, modern photographs of the latest achievements, and, in addition, a series of excellent drawings, specially made for the book, of space stations and space ships, which not only fire the imagination, but are precise in every detail.

Grey Hare Says

Fifth of a Kind

In our February column we discussed, "Four of a Kind," stating: "As noted in several of the cases, when the pilot was flying at tree top altitude and started a turn, he naturally dropped his wing in the direction of the turn. The pilots evidently failed to realize that the wing tip was lower than the cockpit since their altitude with relation to the ground and the trees remained unchanged."

A student pilot was flying a radio relay mission, one of the last requirements prior to receiving his Army wings. Upon completion of his mission, he made several passes at ground troops who were maneuvering in the pine forest below. Flying at tree top level he pulled up to approximately 1000 feet after the first dive and approximately 500 feet after

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The Grey Hare Department is prepared monthly by the Camp Rucker, Alabama, Post Safety Director, Mr. William R. Gaines, with information obtained from the files of the world-wide aircraft accident safety review board. The views expressed in this department are the author's and are not necessarily those of the Department of the Army or of The Army Aviation School.—The Editor

the second. Then the troops saw him disappear over the tree line, and seconds later heard the engine noise suddenly stop, followed by a crashing noise.

Hours later the wreckage was found. The accident investigation board determined that the pilot, while flying at tree top level, entered a left turn and that his left wing struck the top of a pine tree, cartwheeling the plane to the ground. Both pilot and passenger were killed instantly.

Radio relay missions are not flown at tree top level. Apparently, the pilot violated flying regulations. The monetary loss to the government in this accident was approximately $60,000; but what about the loss to the wives and children involved?

Deviating from an assigned mission and not maintaining the proper altitude is the cause of this accident. Whenever the regulations are broken and discipline tossed out the window, trees, wires, poles, antennae, buildings, etc., are all reaching out to slap the erring pilot down.

The statistics in the Army Aviation Safety Board files show that buzzing is, without doubt, a close cousin of suicide. There is no safer airplane than the L–19 type aircraft, nor one more forgiving of errors. Unfortunately, it cannot think and does only what the pilot makes it do.

Mighty Sharp

A student pilot who had approximately 150 hours total flying time was on his first cross country in an L–19. The flight was progressing as planned, until there was a sudden loss of oil pressure. He immediately decided to land. The call "May Day" was radioed twice, and the second time an answer was received. He reported the loss of oil pressure, his decision to land, and gave his position.

To make matters worse, on the final approach smoke began coming out of the cowling and obstructing his view. Undaunted, he continued the approach over high trees, dumped sixty degrees of flaps and landed. Immediately after touch–down, he applied brakes and made the 500 foot field look like LaGuardia. This is a cool performance. The student pilot came up with the correct answers like he was reading them from a check-list.

A maintenance test pilot, after arriving at the scene, reported that the pilot had picked the very best field in the area and had performed an outstanding job in the way he handled the emergency.

It is encouraging to see the fruits of our training program plucked in such a competent way. This pilot had been paying attention to his instruction, and applied what he had learned. His cool head saved his neck, the passenger's, and an L–19.

Lost——Six Lives

Six lives were lost during night flight training in H–19 helicopters. The pilots were making landings to flashlight signals given by a ground control party on unlighted landing sites. The first H–19 made a normal approach and was given the proper signal at approximately 200 feet. During the descent the pilot turned on the helicopter landing light and the light beam was diffused by the haze condition which existed. The pilot immediately turned off the landing light, appeared to check his descent, and seemed to be contemplating a go–around.

Immediately after passing the ground control the helicopter assumed a shallow diving attitude, increased speed, and struck the ground approximately 900 feet beyond the point of intended landing. A few minutes later a second H–19 approached the scene of the burning helicopter and a radio transmission was heard, "Let's go down and take a look at this." The second helicopter then made a left turn and began a shallow descent. Two minutes later another transmission was heard, "Turn on the landing light." The landing light of the helicopter which was circling the wreckage was turned on and the helicopter immediately began to steepen its bank and dive toward the ground. Seconds later it also crashed.

The unusual maneuvers of the helicopters prior to crashing indicated that the pilots had vertigo. The haze condition which existed the night these two accidents occurred was greatly increased when the pilots turned on their landing lights. The light most likely caused the pilots to lose their night vision. At that point, they entered an instrument flight condition since they could no longer see outside the

cockpit. The pilots probably experienced vertigo immediately and the crash resulted.

Progress is being made in helicopter instrument flight experiments (see page 22) but unless the pilots are fully instrument qualified and have available adequate flight instruments with which to remain oriented, conditions under which instrument flight might develop should be strictly avoided. Remember, loss of sight of a pilot's outside reference points, whether caused by weather or his being blinded by light, puts him on instruments.

The Army is currently purchasing or operating the following type aircraft:

Beech	L–23	Bell	H–13
Cessna	L–19	Hiller	H–23
Cessna	LC–126	Piasecki	H–21
Cessna	T–37	Piasecki	H–25
De Havilland	L–20	Sikorsky	H–19
De Havilland	U–1	Sikorsky	H–34
	Sikorsky	H–37	

EDITOR-IN-CHIEF
Captain Weyman S. Carver

ASSISTANT EDITOR-IN-CHIEF
Captain Richard W. Kohlbrand

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Manuscripts, photographs, and other illustrations pertaining to the above subjects of interest to personnel concerned with Army aviation are invited. Direct communication is authorized to: Editor-in-Chief, ARMY AVIATION DIGEST, Army Aviation School, Camp Rucker, Alabama.

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Unless otherwise noted distribution applies to CONUS and OS.
For explanation of abbreviations used see SR 320-50-1.

ARMY AVIATION SCHOOL CREST

When reproduced in full color, the colors red, blue, and yellow are used in the crest to indicate representation of all branches of the Army in The Army Aviation School. The school's aviation training mission is symbolized by the perched falcon denoting the art of falconry with its patient training of swift, keen birds for hunting. The mailed fist depicts the military ground arm which exercises the control, training, and direction of the flight.