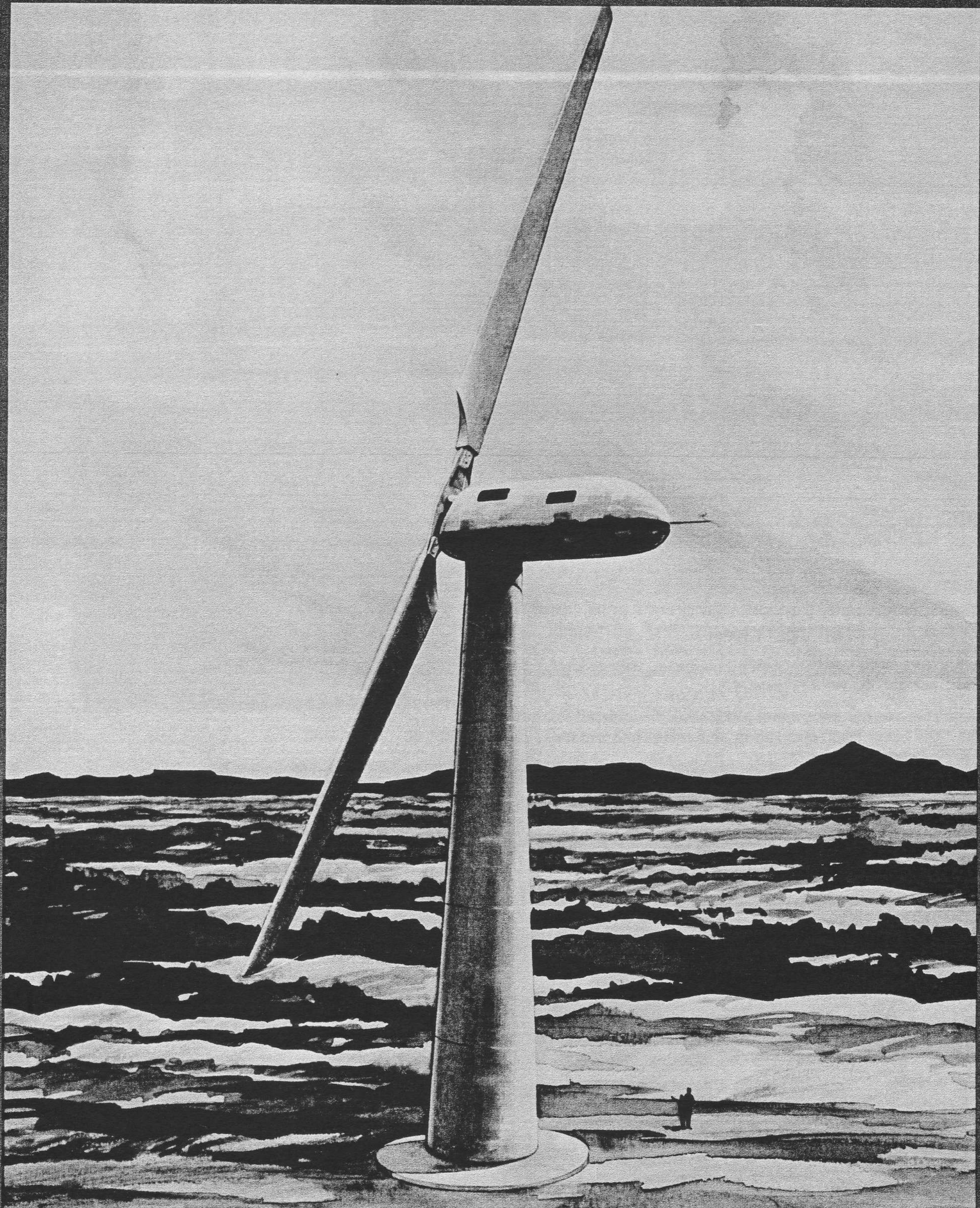
KAMAN Rotor Tips

MAY-JUNE, 1975



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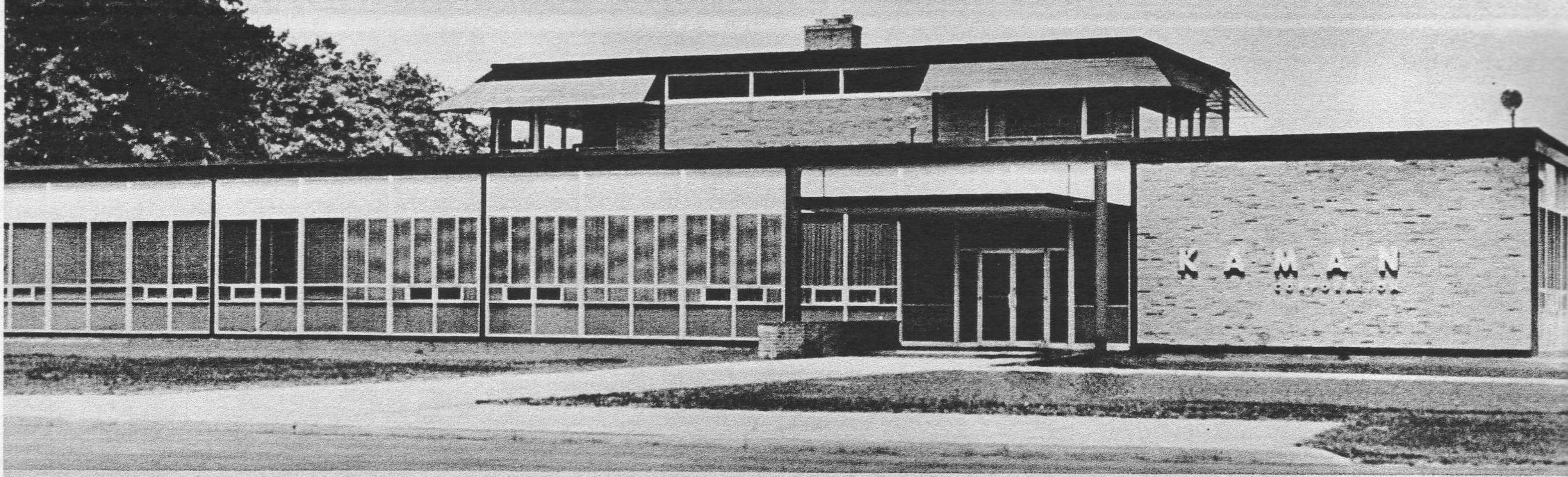

Rotor Tips

John P. Serignese, *Editor*

Volume VIII No. 10

On The Cover

Kaman's proposed alternate energy source as depicted by S. Cox. For details, refer to page 4.

Photographer for the March-April 1975 cover now identified as the "The Silver Fox," also known as Kaman Field Service Rep R. C. Belisle.

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HSL-34 Heads LAMPS Participation

by Lt A. C. Robertson
HSL-34 PAO

Helicopter Anti-Submarine Squadron Light Thirty-Four (HSL-34) came up with two winning combinations recently at the "Rotorhead Rumble," the annual reunion for helicopter pilots held in Jacksonville, FL, on February 14th and 15th. Cdr Borgquist and the "Professionals" had the largest LAMPS squadron representation and they were the only squadron to bring operational SH-2 LAMPS helicopters to the "Rumble."

Despite being the Navy's newest Atlantic Coast LAMPS squadron with only fourteen officers permanently assigned, HSL-34 had the largest representative contingent of any LAMPS squadron with a total of nineteen officers attending.

Cdr Ray Johnson, Executive Officer, meets Cdr Bruce W. Borgquist, Commanding Officer of HSL-34 and ENS Dave Willmann upon their arrival at NAS Jacksonville. Lt Rich Jaeger and ENS Pete Obermans, not shown, were in the second formation aircraft. (Photo by Lt Robertson)

A highlight of "The Professionals" participation was the arrival of a formation flight of two of the squadron's aircraft led by Cdr Bruce W. Borgquist, HSL-34's Commanding Officer. The H-2 aircraft, fully equipped for ASW operations, were the only two LAMPS aircraft from any squadron representing this fast growing helicopter community.

HSL-30 Claims First

by Ens D. K. Wright
HSL-30 PAO

Commodore W. L. Jensen, Commander, Helicopter Sea Control Wing One, congratulates Ensign Kathy Cummings on being the first woman to graduate from H-2 FASO. Fleet Aviation Specialized Operational Training (FASO) is a basic course in Anti-Submarine Warfare and ASW tactics as they apply to the LAMPS mission. ENS Cummings is HSL-30's Air Intelligence Officer. (Photo by PH3 K. E. Catlett)

Kaman Test Pilot Aids "Career Day"

Most LAMPS squadrons are involved with civic interests. Some include high school drill teams, Junior Achievement activities, sports teams, and other youth-related projects. Kaman Aerospace is also involved with aiding youth, this time with the help of test pilot John Anderson. The Future Business Leaders of America Club (FBLA) located in Bloomfield, CT, a short distance from Kaman's facilities, recently sponsored a Career Day at the local high school. Club members are students enrolled in the Business and Office Skills Programs in various town schools. Together with their faculty advisors, other teachers and administrative personnel, the FBLA members had more than 50 careers represented in the school gym.

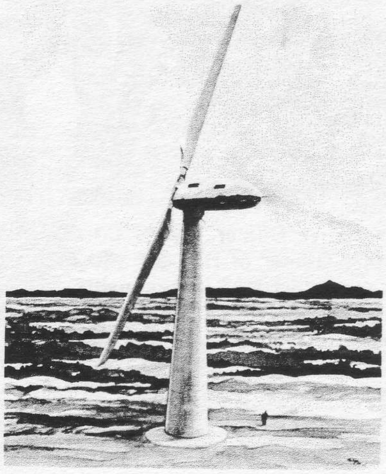
As the photo on the right indicates, Anderson was an extremely busy man as he fielded questions. "You have to experience it to realize the degree of intelligence and the depth of knowledge some of these students have."

(Ruggiero photo)

KAMAN Rotor Tips

MAY-JUNE, 1975

An Alternate Energy Source



by R. C. Meier, Manager
Wind Energy Program

The Energy Crisis

By now, all of us are aware of the energy crisis, which was dramatically emphasized by the oil embargo of just over a year ago. That embargo brought into sharp focus the developing energy shortages which have been mounting for several years in this country and overseas. The problem is not just the dependence on foreign oil, which can be manipulated in supply level and price, but also the basic structure of our society; how it works, how it plays, indeed, how it lives.

The solution to the problem is apt to take a long time and carry a high price tag. It will require a substantial reduction in energy demand in this country and in other developed nations. It will require an increase in energy production by all energy producing nations. And it will demand choices on the development of new fossil fuel resources and an increasing dependence on nuclear power.

Although it appears that coal, oil, gas, and nuclear energy will supply most of our requirements for the rest of this century, alternative forms of energy are being sought to aid in meeting our needs. One of the largest and most intensive development areas is solar energy, the heat of the sun, harnessed to heat and cool buildings, generate electricity, and provide heat for industrial processes. Another form of solar energy presently under development is wind power. Although usually not referred to as solar energy, winds are generated by the global heat cycle and thus qualify.

Wind Power

Wind power is one of man's oldest forms of energy. References to the utilization of wind power can be found as far back as the ancient Greeks, although the oldest documented use of wind power was, ironically enough, in Persia (Iran), in the seventh century A.D. Gradually, the technology of wind power migrated westward and appeared in France in about the twelfth century. By then, the propeller-type windmill (as opposed to the paddle-type windmill used by the Persians) was developed, and quickly spread to England, Holland, Spain, and other countries. The Dutch were the most prominent in developing the windmill on a large scale and perfected their designs, between the fifteenth and eighteenth centuries, to a relatively sophisticated level of technology. The English then took over the lead until the U.S. became one of the largest producers and users of wind-generated energy systems. Over one million windmills were produced in this country, but by 1950, only 50,000 were still in use.

The success of rural electrification and low cost energy, in the form of coal, oil, and gas, caused the demise of the windmill or, as it is now called, the wind generator system. However, as the energy crisis emerged in the late 1960's, the United States Government turned to the task of examining wind generator technology to determine if it could compete with, or supplement, other forms of energy.

Why Wind Power?

Wind power has many distinct advantages. It is a feasible alternate energy source (many successful energy generation systems based on wind power have been built in the past); it is a non-depletable source of energy (it is solar energy); it is independent of foreign embargoes; it could be a readily exportable product; it involves only moderately sophisticated technology; and, very importantly, it has low environmental impact. Its disadvantages can be summed up in one word: cost.

Although many of the older wind generator systems built in the U.S. had technical problems, they were identifiable and correctable. Despite this however, all technically-successful wind generator systems have failed commercially. The largest and probably the most successful wind generator system ever constructed was the famous Smith-Putnam wind turbine. This unit was built in the early 1940's, and operated intermittently on the Central Vermont Public Utilities network until 1945. The machine was capable of producing 1250 kilowatts of regulated electric power, suitable for use by an electric utility. It had a two-bladed stainless steel rotor, 175 feet in diameter, mounted on an oil derrick-type tower. The machine failed in 1945 when one of its blades broke at the root and was thrown 700 feet down the mountain. The project was not abandoned due to the blade failure, but rather due to the fact that in 1945 the utility could purchase alternative forms of generation capacity at 40 percent less per installed kilowatt, and utilize low-cost fossil fuels.

Additional wind generator system development work was conducted in Europe after the Smith-Putnam project was concluded. The best work was conducted in France, Denmark, Germany, and England, with the most modern machines being constructed in Germany in the late 1950's. These machines utilized helicopter-type fiberglass blades. Because of their modern technology and sophisticated design, one of these machines is currently being reproduced by NASA, near Cleveland, Ohio, and it is scheduled to begin operation in July of this year.

The purpose of NASA's wind generator is to provide a test unit capable of evaluating different types of components and gathering operational and engineering experience on wind generator systems. This task is part of NASA's project to assist the Energy Research and Development Agency (ERDA) to develop a cost-competitive wind generator system for electric utility use by 1980. It is believed that the application of modern helicopter technology and innovative design approaches can overcome the cost and technical problems that have plagued past wind generators and that's where Kaman comes in.

The Kaman Wind Generator System Project

NASA's program to assist ERDA includes the preliminary design of a wind generator system utilizing the latest state-of-the-art technology in components and design. In November of 1974, Kaman Aerospace Corporation and the General Electric Company were awarded parallel contracts to develop such preliminary designs. The program, scheduled for completion in July of this year, will lead to the award of a subsequent contract to detail design, build, and test a prototype wind generator system. After a two-year test and evaluation period at utility sites, it would be possible to begin production in 1979 or 1980.

Wind generator systems are viewed as a near-term energy source alternative to coal, oil, gas, and existing forms of nuclear energy. Therefore, the objective of Kaman's program is to develop the lowest possible cost wind generator system, utilizing current state-of-the-art technology expertise to this task, which in many ways is similar to the problems encountered in the development of new helicopter systems. In some ways, however, it differs, not only in the type of equipment involved in the system, but also in the rotor technology itself.

Wind Generator System Configuration

The cover illustration presents an overview of the conceptual design which Kaman has recommended to NASA for optimization and preliminary design. Although not all of the details of the system, including size, have been finalized, the basic configuration has been selected, and we anticipate that the final preliminary design will be basically as shown. The accompanying cut-away view of the NASA wind generator machinery capsule, which is similar to Kaman's, illustrates the basic component arrangement.

The system consists of a low-speed rotor (about 40 to 50 rpm) which drives a high speed (1800 rpm) AC alternator. The speed step-up is accomplished through a standard gear-type transmission, with the necessary clutches, couplings, brakes, and other drive train components similar to those found in helicopters. Kaman's recommended rotor consists of a hingeless, two-bladed design, controlled either by a servo flap or directly by a root actuator. The hub has no flapping or lead-lag hinges, but is sufficiently flexible to permit stress relieving coning and flapping of the blades.

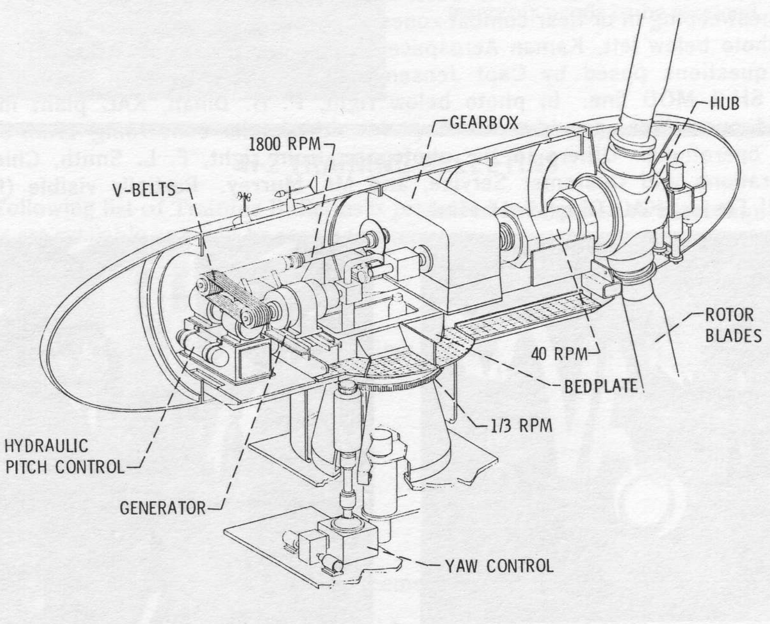
The entire assembly is mounted on a bed-plate on top of the tower. Both a conventional truss-type of tower, similar to an oil derrick, and a more aesthetically pleasing shell-type tower are being evaluated. Due to the changing direction of the wind, the wind generator rotor must turn as the wind shifts its direction to maximize its power output and to minimize the loads on its blades. As a result, the bed-plate is rotated by a gear driven mechanism to face the wind under any wind direction condition. This additional capability adds to the weight and cost of the system but is necessary to develop the maximum amount of power from the wind.

The Economics of Wind Power

As mentioned before, the greatest challenge confronting development of a successful wind generator system is its cost. Although our studies are not complete, preliminary estimates indicate that wind generator systems can achieve capital costs (the cost to a utility to purchase and install the system) for approximately $500 per kilowatt and energy costs (the cost to generate power at the powerplant) of about 4¢ per kilowatt hour. When compared to nuclear power plants, costs are relatively attractive; when compared to oil-fired or coal-fired plants, costs are less attractive. However, a serious drawback to the wind generator system is its inability to generate power on demand, which is presently a requirement of every utility in this country.

Normally, a wind generator system will develop its full rated power at wind speeds which occur less than 25% of the year. The remainder of the time it is generating less than its rated power, and some of the time, when the wind is very low or not moving at all, it is incapable of developing power. This means that either the electric power network would have to draw power from another source when the wind generator system was not functioning, or that power storage must be provided in batteries or some other device. Although Kaman's program does not include the study of storage devices, we are considering the economics of wind generator systems with and without such storage devices in typical utility applications. We believe this is necessary to determine what cost goals should be formulated for wind generator systems which would make them attractive to utilities.

100 kW EXPERIMENTAL WTG
100 kW WIND TURBINE DRIVE TRAIN ASSEMBLY



To properly address economic and operational questions, Kaman is being assisted by Northeast Utilities, an electric utility serving a large section of Southern New England. Northeast Utilities has a wide variety of generating facilities (nuclear, oil, coal, and hydroelectric) and a wide variety of service requirements (urban and rural, residential, commercial, and industrial). Personnel from Northeast Utilities are also advising Kaman on technical matters relating to the wind generator. With a high level of activity in the development of many new energy sources, and broad capabilities in all aspects of utilities operations, these personnel are also helping to insure that our evolving design will meet the requirements of the consumer.

Other Applications

Although the current study is oriented toward utility applications, there are a number of additional applications for wind generator systems in other sectors of our economy and overseas. Electricity produced by a wind generator system can be used to power irrigation systems and might be very attractive for large scale farming operations. There are also applications in the process industries where the demands on power are not time critical. The drying of grain, for example, which currently consumes great quantities of propane, could be at least partially accomplished with wind power, perhaps in combination with other solar power.

An even greater potential exists for foreign sales. In countries such as India, vast areas of interior lands will greatly benefit from irrigation projects currently under development. Farm wells of these projects are filled with water from diesel-powered electric pumps. Because of shortages of fuel in India, the Indian government has actively pursued wind generator system technology development in recent years. Thus, it is quite possible that the technology developed under this program will find broad applications in countries such as India and provide Kaman with another export market.

Advanced Wind Generator Systems

Beyond the immediate goals for wind generator systems lies their potential applications in the far future. Some of the most popular discussions on wind generator systems have centered about their use off the coast of New England, which is one of the most windy areas of the world. Vast "farms" of these units could be used to generate electricity which in turn would convert sea water to hydrogen. The hydrogen would then be used in lieu of natural gas for heating and other applications. Another idea envisions using large floating wind generators for the production of ammonia, the basic ingredient of artificial fertilizers. It has been claimed that a wind generator powered floating ammonia factory in the Southern hemisphere could produce much of the ammonia required for the world's fertilizer production.

The question of whether these advanced uses for wind generator systems materialize will be heavily influenced by the work which Kaman is now conducting. As is the case with most technological developments, it is difficult to forecast whether wind generator systems will be competitive with other forms of energy technology. However, we are confident that Kaman's expertise in rotary wing technology will evolve a wind generator system design capable of meeting that goal.

Commodore Jensen Visits Kaman

Capt W. L. Jensen, Commander Helicopter Sea Control Wing One, visited Kaman Aerospace Corporation's facilities in Bloomfield, CT, to tour the SH-2 MOD line and other LAMPS-related areas. While at Kaman, the Commodore was briefed on upcoming LAMPS improvements including the new tail rotor blade. He took advantage of the opportunity to view Kaman's effort in producing various F-14 components for the Grumman Aircraft Co. Cdr M. A. Runzo, CO of HM-12 accompanied the Commodore on his visit. HM-12 is the last remaining Navy minesweeping squadron and, although only four years old, the unit has received world-wide recognition for two of its minesweeping operations: Operation Endsweep off the coast of North Vietnam and Operation Nimbus Star in the Suez Canal. Both efforts included extensive airborne minesweeping in or near combat zones.

In photo below left, Kaman Aerospace Corporation president, William R. Murray, answers questions posed by Capt Jensen, center, and Cdr M. A. Runzo as they tour the SH-2 MOD line. In photo below right, P. H. Dinan, KAC plant manager, Bloomfield operations, provides the Captain with details concerning LAMPS manufacturing operations. Others in the photo are, from right, F. L. Smith, Chief, KAC Test Operations and Customer Service, and Mr. Murray. Partially visible (far left) is "Andy" Foster, KAC Chief Test Pilot.

KAMAN

Rotor Tips

TECHNICAL SECTION

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The information contained here has been reviewed by Customer Service Department Engineering Personnel. The data is either in existing Official Publications or will be contained in forthcoming issues of those publications. The information supplied does not in any way supersede operation/maintenance directives established by cognizant authorities.

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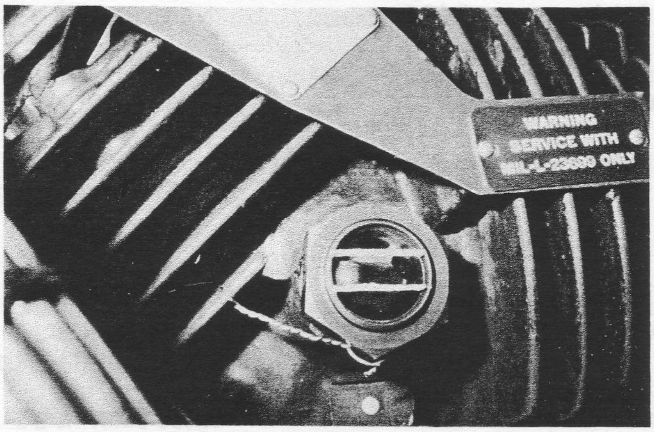
INTERMEDIATE AND TAIL ROTOR GEARBOX SIGHT GAGES



New oil level sight gages will soon be available for Fleet use. The P/N S51E gages replace the old gages, P/N K671433-1. The S51E gages, shown in the accompanying photo, will improve the ease and accuracy of visually checking oil levels in the tail rotor and intermediate gearboxes, thus reducing maintenance time. Note the aluminum ball which floats with the sump oil level. When the ball is raised to the top line, as shown, the oil level is adequate; when the ball is seen below the lower line, it indicates that the oil reservoir needs to be serviced.

R.J. Trella, Service Engineer

H-2 TRAINING BULLETINS

The following list of Training Bulletins is presented in response to Fleet inquiries. Reprints are available and will be sent upon request.

NUMBER	SUBJECT	DATE OF RELEASE	PUBLICATION AFFECTED
1	T-58 Engine Fuel Control Rigging/Adjustments and Operational Checks	1-4-74	NA01-260HCA-2-4 NA01-260HCB-6-1 NA01-260HCD-1
2	Rotor Overspeed RPM Limits	1-4-74	NA01-260HCD-1 NA01-260HCA-2-4.1 NA01-260HCA-2-4.2
3	Brake Disc P/N 9532964 Replacement	1-4-74	NA01-260HCA-2-2
4	Main Rotor Blade Stainless Steel Leading Edge (SSLE) Separation	1-8-74	NA01-260HCA-3

NUMBER	SUBJECT	DATE OF RELEASE	PUBLICATION AFFECTED
5	Rust Lick Procedure	1-8-74	NA01-260HCA-2-4
6	Pilot Seat — Height Adjust Track, Identification of	1-16-74	NA01-260HCB-4-2
7	Alignment of LN-66HP Radar Display Unit	1-23-74	NA01-260HCA-2-7
8	SH-2D/SH-2F — Sensor Operator Seat Inertia Reel	1-23-74	NA01-260HCB-4-4
9	K660006-5 Azimuth Arm Assembly and K660014-7 Trunion Bar Assembly Rework Limits	2-5-74	NA01-260HCA-2-2.1
10	ASE Accelerometer Solenoid	2-8-74	NA01-260HCA-2-5
11	Rotor Overspeed Inspection Requirements	2-15-74	NA01-260HCA-2-4.2
12	Bearing Installation, K659667-11 Beam Assembly	2-26-74	NA01-260HCB-4-7 NA01-260HCA-2-4.2
13	Cancelled		———
14	Folding Stays Installation — Main Landing Gear	3-12-74	NA01-260HCA-2-2
15	Tail Rotor Drive Shaft Self-Aligning Bearing	3-14-74	NA01-260HCA-2-4.1
16	Inspection of Retention Control Cranks after AFC 176	3-15-74	NA01-260HCA-2-2.1
17	Rescue Hoist Striker Cap	3-28-74	NA01-260HCA-2-3
18	Engine Build-up/Engine Installation	4-16-74	NA01-260HCA-2-4 NA01-260HCA-2-4.1
19	Tail Wheel Lock Control — Installation of	4-22-74	NA01-260HCA-2-2
20	Tail Rotor Spider Removal and Inspection Criteria	4-23-74	NA01-260HCA-2-4.2
21	Fuel System, Boost Pump Pressure Switch	4-24-74	NA01-260HCB-4-5
22	Intermediate Gearbox — Fuselage Skin Interference	5-3-74	NA01-260HCA-2-4.1
23	APN-171 Radar Altimeter	5-10-74	NA01-260HCA-2-7
24	Pilot and Co-pilot Cyclic Control Stick Connector Installation	6-13-74	NA01-260HCB-4-3 NA01-260HCA-2-2.1
25; 25A; 25B	Cancelled	———	———
26	Oil Cooler Blower, P/N K677707-1 Troubleshooting/Inspection of	7-12-74	NA01-260HCA-2-4

NUMBER	SUBJECT	DATE OF RELEASE	PUBLICATION AFFECTED
27; 27A; 27B	Cancelled	———	———
28	T58-8 Engine Combustion Casing "HOT SPOTS"	8-5-74	NA01-260HCA-2-4
29; 29A	Cancelled	———	———
30	Damage Limits for the K614022-101 Tail Rotor Blade	9-9-74	NA01-260HCA-3 NA03-95D-17
31	SH-2F Tail Strut Servicing	8-21-74	NA01-260HCA-2-1
32	Cancelled	———	———
32A	SH-2F Retention Connector Assembly P/N K659617-1	10-29-74	NA01-260HCA-2-2.1
33	Lubrication of Control Components SH-2F Helicopter	9-9-74	NA01-260HCA-2-1 NA01-260HCB-6-3
34	K610102-1 Fairlead Assembly Function, Installation and Wear Limits	9-23-74	NA01-260HCA-2-4.2
35	Pilot/Rescue Door — Aft Lower Stop	10-1-74	NA01-260HCA-2-2 NA01-260HCB-4-2
36	Combining Gearbox Removal — Without Removing Engines	10-7-74	NA01-260HCA-2-4.1
37	SH-2F Shoestring Rod Bolted Connection	10-8-74	NA01-260HCA-2-4.2
38	Transmission Mount/Flex Hose Chafing — Elimination of	10-21-74	NA01-260HCB-4-6 NA01-260HCA-2-4.1
39	Rodend Damage Criteria	10-22-74	NA01-260HCA-2-2.1
40	Main Rotor Blade Tip Cap Sealing and Drain Hole Size Increase	10-28-74	NA01-260HCA-3
41	Main Rotor Blade Tip Area Corrosion	11-1-74	NA01-260HCA-3
42	Blade Folding Check List	11-26-74	NA01-260HCA-2-1
43	Control Tube Damage — Non-Rotating Flight Controls	12-10-74	NA01-260HCA-2-2.1
44	Flap Rod Inspection	12-9-74	NA01-260HCA-2-4.2
45	Fuel Quantity System, Shielded Wire Repair	12-12-74	NA01-260HCA-2-8.1
46	Main Rotor Blade, K611670-1 and -3, Revised Negligible Damage	12-16-74	NA01-260HCA-3
47	Cancelled	———	———
47A	Landing Gear Control Schematic	1-15-75	NA01-260HCA-2-8.1
48	Tail Rotor Pylon	1-10-75	NA01-260HCA-3

MAIN TRANSMISSION/ROTOR HUB ATTACH-BOLT

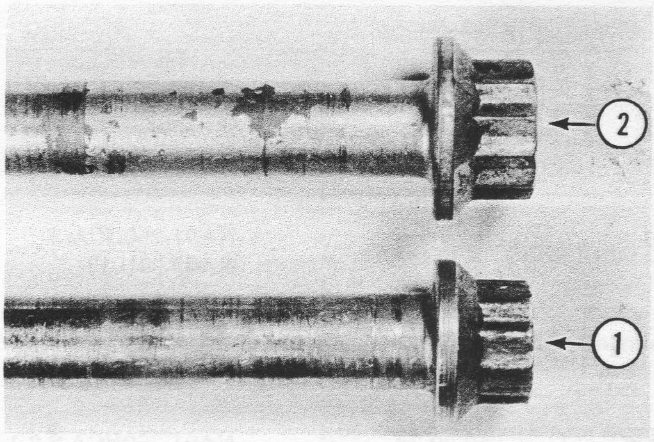


PHOTO 1

1. Bolt, P/N LWB-22-7-46 - NOT FOR SH-2F
2. Bolt, P/N K618769-11 - SH-2F APPROVED

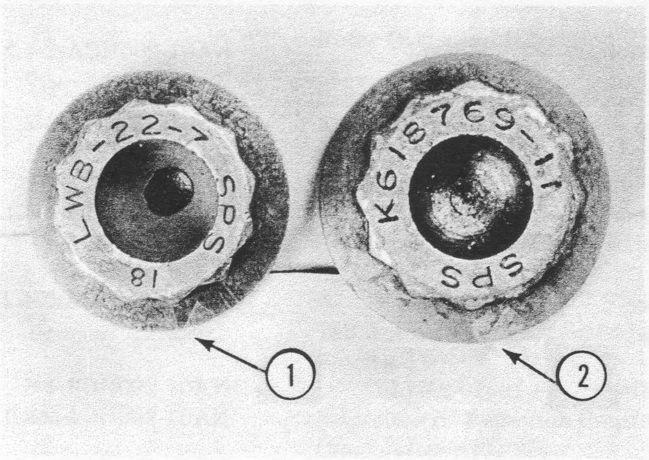
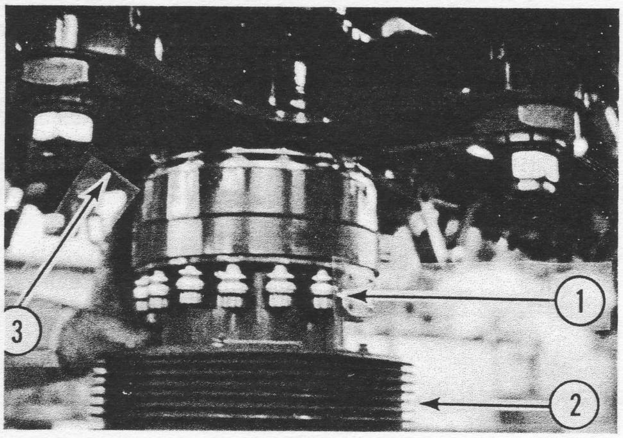


PHOTO 2

Although the bolts shown in Photo 1 have the same shank diameter, they are not identical because one has a higher tensile strength and a larger bearing head as can be seen in Photo 2. The larger-head, higher-strength bolt, P/N K618769-11, is used on the SH-2F aircraft. While the stronger bolt may be used on all H-2 aircraft, in no case should the smaller-headed bolt, P/N LWB-22-7-46, be used on SH-2F aircraft. The bolt secures the main rotor hub to the main transmission as seen in Photo 3. When installing the bolts be sure to use new PLI washers, P/N PLI7-14.4.

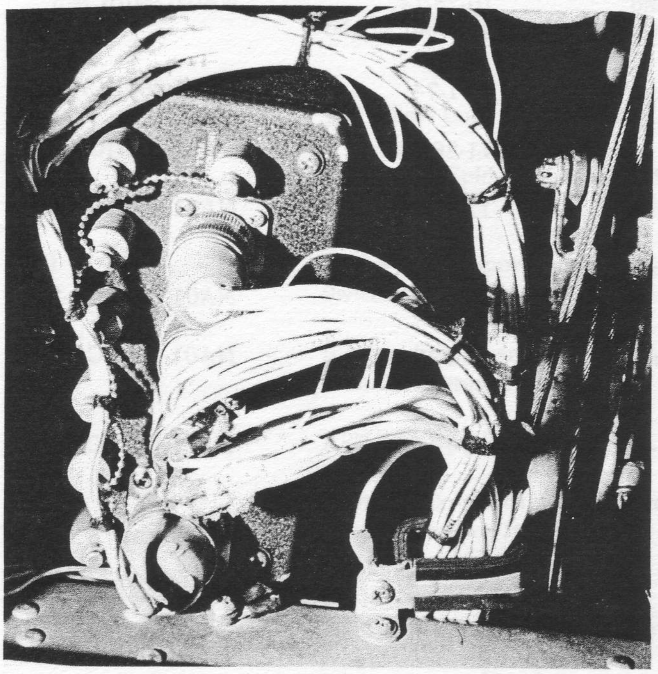
The quickest method of determining if the proper bolt is installed is, the SH-2F bolt, P/N K618769-11, requires use of a 9/16-inch, 12-point socket or box end wrench and the LWB-22-7-46 bolt requires a 1/2-inch, 12-point wrench.

W. Wagemaker, Service Engineer



1. Bolts with PLI washers (untightened).
2. Transmission with slipring assembly.
3. Rotor hub.

PHOTO 3



What's Wrong???????

A major maintenance error is visible in the accompanying photo. The area shown is the fuel quantity amplifier and related wiring located beneath floor, aft of pilot's seat. For the answer refer to page 14.

FLUID LEAKAGE RATES

R.J. Trella, Service Engineer

Component fluid leakage rates during operation or in a static state varies between components and aircraft systems. These differences have resulted in confusion as to when a seal or component requires maintenance action and consequently, many man-hours have been unnecessarily expended replacing seals and components. The following data provides guidelines for defining whether the leakage rate is allowable or excessive for H-2 helicopter component/systems.

(a) Allowable Leakage:

When fluid escaping is of an insignificant quantity and will have no detrimental effect on component operation, other than cosmetic, and when correction of this slight leakage does not warrant the maintenance time involved, the leakage is then termed "Allowable."

(b) Excessive Leakage:

When fluid leakage rate is such that the reservoir level may be depleted or dangerously lowered during normal operation, or a fire hazard created, or the airworthiness of the aircraft is compromised, the leakage is termed "Excessive."

(c) Cumulative Leakage:

Under certain circumstances, several individual components in a single system may exhibit "allowable" leakage so that the combined leakage will be Excessive, or, Allowable leakage over a given period of time or operating hours can also be classified as Excessive. If this condition is suspected during troubleshooting, the fluid level in the sight gage should be monitored closely and a record maintained of the fluid quantity added during servicing. Leakage sources should be corrected when the total fluid lost from the system is in excess of the "allowable" rate per-flight-hour of operation as indicated in the following table.

H-2 COMPONENT LEAKAGE RATE TABLE

	Component	Allowable Maximum Leakage Rate
1.	Main and Combining Gearbox	Repair leak when oil added to tank exceeds 1.5 quarts per 8.0 flight hours.
2.	Intermediate Gearbox	Repair leak when oil added to gearbox exceeds 8 ounces per 8.0 flight hours.
3.	Tail Rotor Gearbox	Repair leak when oil added to gearbox exceeds 2 ounces per 8.0 flight hours.
4.	Hydraulic System a. Windshield wiper equipment b. Landing gear retraction equipment c. Rescue hoist equipment (cont.) d. Automatic stabilization equipment control actuator e. Rotor brake equipment	Repair leak when oil added to hydraulic tank exceeds 8 ounces per 8.0 flight hours.
5.	Engine and speed decreaser gearbox (normal leakage and oil consumption rate combined)	Repair leak when oil added to tank exceeds 1 quart per 2.0 flight hours.
6.	Miscellaneous Components a. Rotor blade damper b. Main landing gear liquid spring c. Tail wheel strut	Operate component through five complete cycles (unpressurized or pressurized). Repair leak when more than one drop forms. Allow component to stand for 15 minutes; repair leak when more than one drop forms.

H-2 COMPONENT SERVICING FLUIDS

Component	Fluid	Component	Fluid
Main and combining gearbox	MIL-L-23699	ASE control actuator	MIL-H-5606
Intermediate gearbox	MIL-L-23699	Rotor brake equipment	MIL-H-5606
Tail rotor gearbox	MIL-L-23699	Engine/speed decreaser gearbox	MIL-L-23699
Windshield wiper system	MIL-H-5606	Rotor blade damper	MIL-H-5606
Landing gear retraction system	MIL-H-5606	Main landing gear liquid spring	MIL-H-5606
Rescue hoist equipment	MIL-H-5606	Tail wheel strut	MIL-H-5606

AUX TANK JETTISON CABLES

H. Zubkoff, Service Engineer

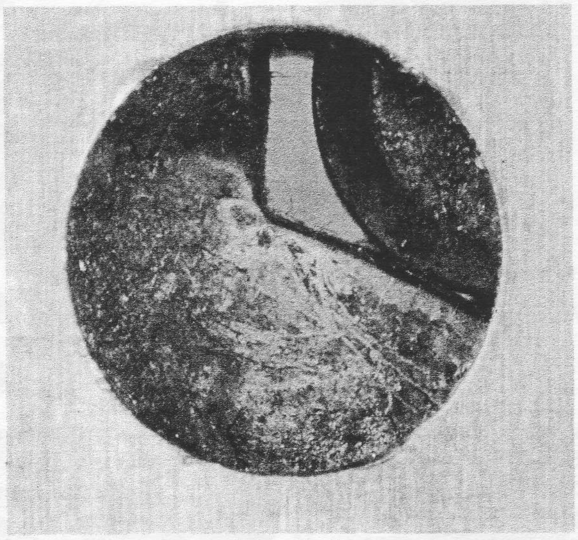
Several recent UR's report aux tanks dropping to the deck when the ground safety pins were removed. Review of information contained in the MMI, NAVAIR 01-260HCA-2-4, revealed that the procedures are correct and adequate to properly accomplish the rigging. Photo A shows a close-up of what should be observed when looking through the inspection hole. Before withdrawing the ground safety pin, be sure the cam-angle is as shown.

Photos B and C show unsafe conditions. If the cam/roller position resembles these photos, DO NOT remove the ground safety pin. Instead, remove the shackle access panel on top of the aux tank support and determine why the shackle release lever is not correctly positioned at the aft end of the lever slot as shown in PHOTO D.

Photo E applies to SH aircraft only because it deals with the aux tank electrical solenoid release mechanism. Note that the solenoid has been activated and is pressing against the shackle release lever, forcing it to the forward (release) position. If inspection reveals a condition as shown in Photo C, suspect that the solenoid has been activated. Do not remove the ground safety pin. If the condition shown in Photo E is discovered, recocking of the shackle and solenoid is required. The latched position for the solenoid is as shown in Photo D. Note that the solenoid plunger is retracted and the release lever is aft.

Inadvertant tank drops when pins are removed, can only be attributed to one of the following:

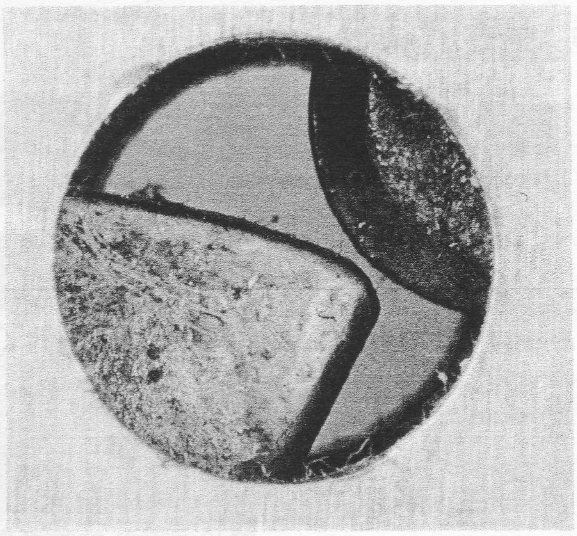
a. Release cables not rigged per the MMI (Cable Tension too tight).
b. An interference exists somewhere in the release cable routing.
c. The electrical jettison system had been activated.



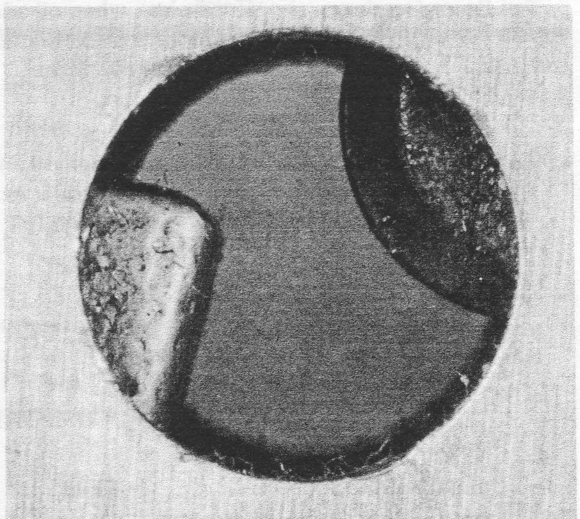
Correct View
PHOTO A

Any of the three possible causes will result in the visual indication of an unsafe shackle as shown in Photos B or C (when viewed through the inspection hole). Complete rigging instructions are included in a previous KRT article (September-October 1972 issue) and the MMI.

Refer to "What's Wrong" on page 10 for more on jettison cables.

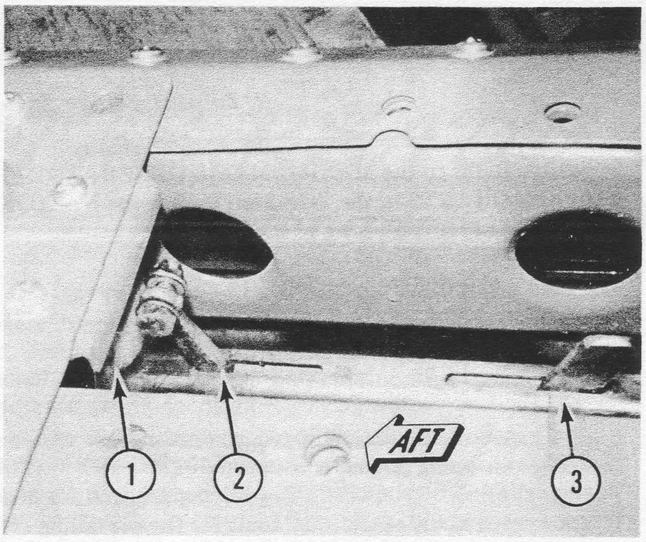


Unsafe view . . .
suspect binding or improperly rigged cable.
PHOTO B



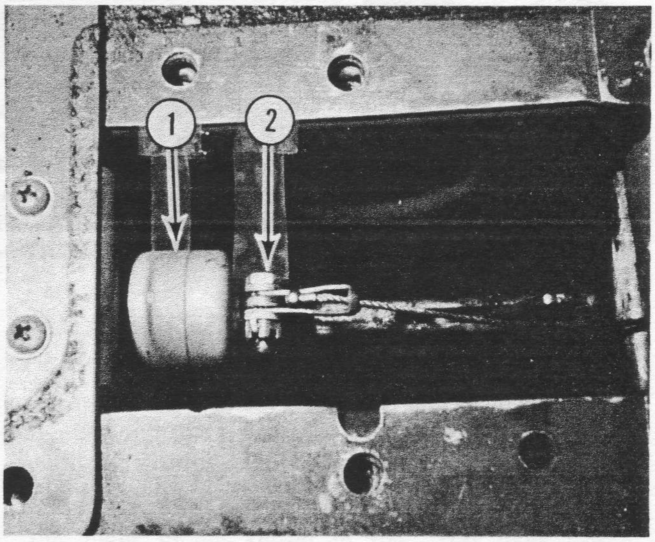
Unsafe view . . .
If inspection reveals this condition, suspect solenoid activated.

PHOTO C



Shackle release lever must be at aft end of lever slot as shown.
Correct view
PHOTO D

1. Electrical solenoid
2. Shackle release lever
3. Shackle cocking lever



Activated solenoid plunger, item 1, pressing against release lever, item 2. Unsafe view . . .

PHOTO E

FORWARD ENGINE MOUNT INSTALLATION

H. Zubkoff, Service Engineer

A recent inspection of the forward engine mount installation, P/N K672751-3, revealed the presence of unauthorized and, in some instances, unsafe mount bolts (too short). The correct bolt, P/N AN103912, shown in Photo 1, has a 7/8-inch threaded grip length, a recessed head with 6 lockwire holes, and the marking E11 or E1. (The E11 mark supersedes the E1 mark.) The markings identify the material specification and heat treat condition: IT DOES NOT INDICATE BOLT LENGTH! For example, Photo 2 shows a bolt with the E11 marking; however, note also that the head is solid, has only one lockwire hole, and only a 5/8-inch threaded grip. This bolt must not be used in the engine mount installation. Photo 3 shows the correct and incorrect bolts inserted in the engine mount fitting. Note the difference in threads available for engagement.

To inspect for correct length of installed bolts, insert a thin three or four-inch long piece of wood or aluminum into the open end of the bolt holes from inside the engine air inlet. Bottom the "gage" against the end of the installed bolt and make a pencil mark, flush with the end of the bolt hole. Withdraw the "gage" and measure the length from the pencil mark to the end which butted against the bolt. If dimension is more than 3/8-inch, the bolt is too short and should be replaced with an AN103912 bolt.

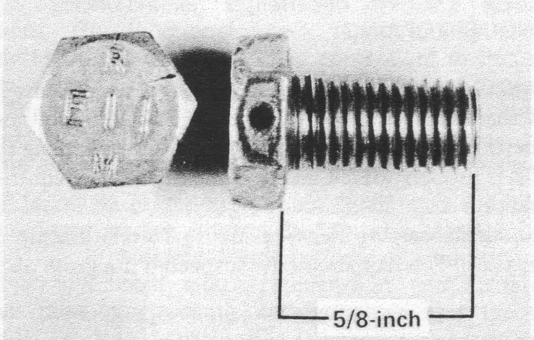


PHOTO 2

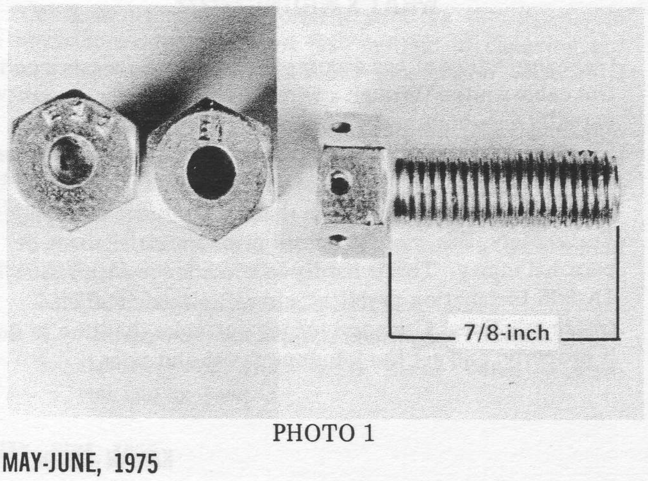


PHOTO 1

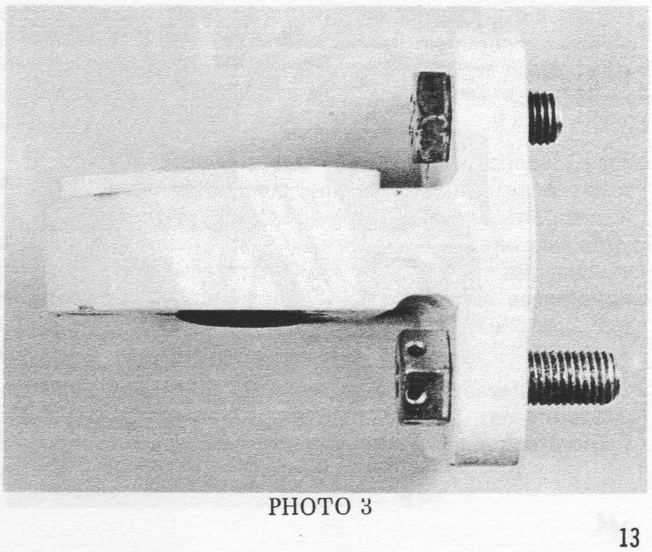


PHOTO 3

HOT AIR

H. Zubkoff, Service Engineer

The coming summer months suggests some thoughts be given to areas which can relate to higher ambient temperature operating conditions. Among such areas are SDG OIL TEMPERATURE ENGINE TOPPING and IN-FLIGHT OPEN CABIN DOORS.

SDG OIL TEMPERATURE

Airframe provisions for cooling the SDG oil are adequate and effective ---PROVIDING--- no degradation of the cooling system is permitted to continue. Primary conditions that will eventually cause excessive SDG oil temperature, if not corrected, are:

a. dirty oil coolers.
b. deteriorated or distorted engine aft firewall seals (allowing hot engine air into the SDG compartment).

A detailed article on this subject appeared in the July-August 1974 issue of Rotor Tips. In summary, it suggests washing the exterior of the oil coolers concurrent with the scheduled aircraft wash. It further suggests checks to insure proper condition and contact of the engine aft firewall seal against the engine nacelle upper door.

ENGINE TOPPING

Prevailing temperatures are now in the range where T5 will be the limiting factor instead of Ng. This should raise a question concerning accuracy of the T5 indicating system. Was it properly JET-CAL checked at the last required inspection as detailed in NA01-260HCA-2-4? Pilots should conscientiously be aware of the Ng-T5 relationship during topping. T5 error should be suspected if a gross disparity exists. Refer to the MAXIMUM GAS GENERATOR SPEED CHARTS in the T-58 MMI and/or the NATOPS MANUAL:

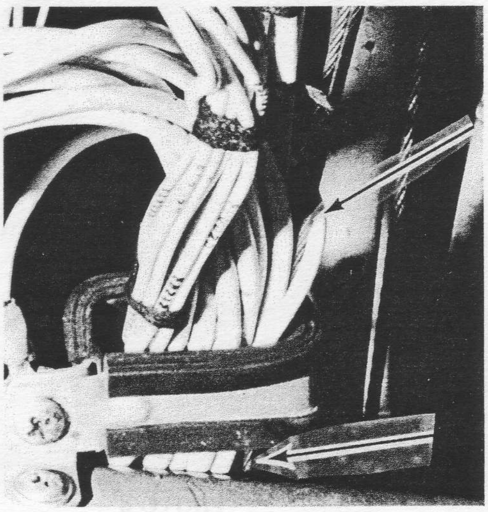
NAVAIR 02B-105AHD-6-1, 15 October 1973, Figure 10-21.
NAVAIR 01-260HCD-1, 15 April 1974, Figure 11-5.

As a general reminder, no topping adjustment is required if T5, at topping power, is between 684°C - 690°C (T58-F engine) or 671°C - 677°C (T58-8B engine), and Ng does not exceed MAX operational limit for the prevailing temperature.

To summarize the physical act of adjusting topping, clockwise rotation of the adjusting screw will increase T5 and Ng. Counter clockwise rotation will decrease both. Ten clicks will change Ng by 0.8% and T5 by 11°C. However, there is a limit on how much the topping adjustment screw can be turned in one direction. A sudden noticeable resistance to further turning is an indication that the adjustment screw has bottomed. Continued attempts at turning the screw in the same direction can cause internal failure of the control.

IN-FLIGHT OPEN CABIN DOORS

Summer weather operation invites flight with partially open cabin doors. It can also invite trouble - if tracks are worn, if roller hardware is worn or if doors are not properly rigged. A quick pre-flight check for excessive vertical play and for proper lower roller engagement is strongly suggested. For complete, detailed information relative to door hardware inspection and rigging, see NAVAIR 01-260HCA-2-2.



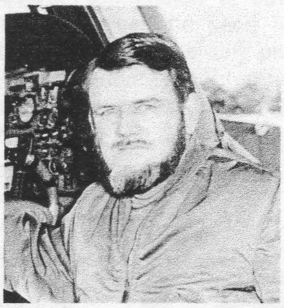
WHAT'S WRONG??????

Close inspection of the accompanying photo reveals a control cable routed through a wire harness cable clamp apparently accomplished subsequent to re-wiring/repair! Note the cable entering at upper arrow and leaving at lower arrow. This particular cable was...the aux tank jettison cable running from the bomb shackle up to the cockpit. Fortunately, this was discovered prior to fire, damage or personal injury. This is hardly in accordance with NA01-1A-505 Installation practices; aircraft electric and electronic practices. Use good judgement, take the time to do it properly, and get the job done faster and safer.

FROM...

THE READY ROOM

Maintenance Test Flying



by Al Ashley,
Test Pilot

A higher than normal element of risk is attendant to every functional check flight. It is therefore customary to designate only the more experienced pilots as Functional Check Pilots not only to increase safety but to increase maintenance efficiency as well.

Most designated functional check pilots have a good overall knowledge of their helicopter and its systems; however, the procedural aspects of the check flight itself can be greatly improved. Too often the proper conduct of a functional check flight is compromised in order to conform to local course rules designed for the handling of normal traffic.

For example, an expedited, normal NATOPS takeoff into busy bounce pattern traffic for a circuit to a hover pad is no way to begin a check flight. The airborne phase of the helicopter functional check flight begins with a very cautious and precise liftoff-to-hover while assessing control response characteristics and control positions. For this first takeoff such systems as the ASE and coupler should be "OFF" so that the basic control system rigging can be evaluated. Only after determining that the basic control system is rigged normally, and while in a stable hover, add one system at a time, in building block fashion. Engage the Lateral Coupler switch first; trimmed control positions should remain unchanged. If the cyclic stick or pedal trim position changes appreciably (½ inch or more), turn the coupler switch back to "OFF" to verify the control position trim change. There is no point in proceeding beyond this stage if a cyclic or directional trim change of more than ½ inch occurs, since neither the coupler nor the ASE can work properly.

Regarding the VIDSCARD writeup, there should be little confusion as to appropriate maintenance action since the trim change occurred when the coupler was turned "ON" while in an established, stable hover. If no trim change occurs when turning the lateral coupler "ON," engage ASE as the next step and evaluate the ASE in a like manner. If basic ASE checks out, add ALT HOLD, Ground Speed mode, etc., and evaluate each in turn.

Using a disciplined approach such as this results in a more accurate, safe, and fast method of checking out the aircraft and generates more meaningful VIDSCARD writeups.

The initial hover check was selected for this discussion because it is the most important step in the functional check flight procedure and curiously is usually the first step to be compromised.

A partial listing of the malfunctions readily determined in a hover check is as follows:

1. Basic control system misrigging.
2. "Sticky" tail rotor pitch bearings.
3. Hardover or stuck ASE Servo Valve — pitch, roll and/or yaw.
4. Automatic heading hold failure.
5. Heading gyro failure.
6. Lateral coupler failure.
7. ASE failure.
8. RAD ALT hold failure.
9. Ground Speed mode failure.
10. Pitch, roll or yaw trim failures.

The flight profile shown in the "Functional Check Flight" checklist, NAVAIR 01-26-HCB-1-6 would be more appropriate if "Hover Checks" were a separate part of the "Inflight" checks. Under the "Inflight" heading on Page 5, "Hover Checks" should be further broken down to ASE and COUPLER OFF checks followed by COUPLER ON and then ASE ON checks to be consistent with the building block approach.

Prior to moving off into forward flight, disable the automatic tracking system. At a moderate airspeed in level flight, check out the tracking system with the inflight test set, P/N **K604616-3,** prior to reactivating the automatic mode. The test set is used to check resolver phasing, accelerometer signal and tracking actuator operation. The functional check pilot's ability to accurately identify a malfunctioning component in this system will save many maintenance manhours and repeated check flights. Any necessary track adjustments should be done by manual actuation of the tracking switches until the entire system is checked out with the test set.

At this stage of the check flight, all systems which have an input to the Control System should have been checked out in building block fashion: mechanical controls, hydraulic boost, lateral coupler, ASE, trim actuators, resolver phasing, tracking accelerometer and tracking actuators.

If the helicopter does not fly normally with all systems engaged throughout the entire speed range, disengage one system at a time until the mode causing the trouble is identified. It is important for the maintenance people to know whether a control system problem occurs only with ASE ON or whether it also occurs with ASE OFF or even BOOST OFF.

It is not feasible to present definitive Functional Check Flight procedures for the entire helicopter as a Rotor Tip. Hopefully, it **is** feasible to generate the mental attitude that must prevail in order to safely and efficiently carry out the Functional Check Flight. After all, there is no point in scheduling a check flight if the assumption is made that all systems will operate normally and that normal procedures are therefore applicable.

All Functional Check Pilots should reevaluate their check flight procedures periodically and recognize the importance of following these procedures in the interest of flight safety and maintenance efficiency.

Vibration Troubleshooting The H-2 Helicopter

Part 4

Part 1 explained how to recognize vibration frequencies and methods of isolating the problem to a general area on the helicopter. Part 2 presented information on the operation of H-2 basic systems because without knowledge of what a system is supposed to do, it is sometimes difficult, occasionally impossible, to determine if a system is functioning properly. Part 3 explored methods of troubleshooting those vibrations which occur as a result of maintenance actions.

by Jack L. King,
Senior Field Service Rep

Having discussed low frequency range vibrations, the next area to be considered is the medium frequency range. As called out in the MMI, medium frequencies on H-2 aircraft include: Tail rotor one-per-rev at 1708 RPM; main rotor four-per-rev at 1192 RPM; and, tail rotor drive shafting at 3122 RPM. Remember, however, the Vibratach will not provide exact readings, thus RPM's of approximately 1700, 1200, and 3100 will be noted. Taking them in the aforementioned order, let's start with tail rotor one-per-rev. In the September-October, 1974 issue of Rotor Tips, we pointed out the method whereby tail rotor one-per-rev's can be isolated from other medium freqs via the use of the vibratach. Let's discuss cause and corrective action.

The H-2 tail rotor contains most of the basic features of the main rotor assembly. That is, it has flapping and lead/lag provisions as well as pitch change capabilities. It is actually a bit simpler than the main rotor from a control standpoint because all control inputs from the pilot are collective in nature with no cyclic considerations. Our "azimuth equivalent" for the tail rotor would be the pitch change spider mounted on the tail rotor gearbox pitch change shaft. The only "rotating flight control linkage" are the four tail rotor pitch links which extend from the spider to the individual tail rotor blades.

Lead/lag provisions are provided via the crowned center portion of the rocking pins while flapping is provided through the flapping bearings in the tail rotor blade-to-hub connection. The inner race for the flapping bearings are the bearing surfaces at each end of the rocking pins. Pitch change is accommodated by bearings securing the blade shank in the blade grip housings.

When faced with a tail rotor vibe, one of the first things that should be checked is the tip-path track between opposing blades. Proper rigging will normally preclude this possibility. When rigging tail rotor blades, it is a good policy to position each blade being checked in the "hanging down" or vertical position. After rigging pins have been installed, give the pitch control spider a "jerk" away from the fuselage before checking each blade in order to eliminate any play in the system. (This will give more accurate readings on the protractor.) Make it a point to check blade rigging angles a couple of times after you initially set them. You might find that the protractor you thought was correctly seated on the blade grip was actually riding up on the grip surface and consequently providing erroneous readings.

One of the least understood, yet most important aspects of tail rotor blade installation involves proper shimming at the hub attaching joint. There is a two-fold concern for insuring that this is accomplished correctly. The first is that excessively loose shimming can cause a vibration to occur due to excessive lead/lag action of one individual blade as related to its opposing blade. Conversely, excessively tight shimming can cause some binding, especially in the flapping axis. Any binding can result in a vibe. The second, and most important feature of proper shimming is that it provides proper lubrication sealing for the flapping axis components. Insufficient shimming will allow grease leakage to occur during operation and a lack of adequate lubricant will eventually cause a flapping bearing and/or rocking pin deterioration.

The obvious answer here is "shim it to the MMI instructions." There are mechs who state that a "standard" amount of shim will work every time. This is not true. Tail rotor blade grips are often reworked to remove scoring from the grip ear faces during overhaul with a resultant variation of this dimension. A good clue to undershimmed tail rotor blades is heavy grease leakage streaming down the blade. Properly shimmed blades will have some feathering of grease from the flapping axis outboard but not thick, heavy deposits.

Since the establishment of a 240-hour service life on tail rotor flapping bearings, an extremely limited number of tail rotor vibrations can be traced to defective bearings, or rocking pins. In cases where vibrations have occurred, insufficient lubrication was usually found to be the cause. The 60-hour inspections presently required for this installation will usually detect impending problems.

Excessively loose/worn pitch link rodend bearings and/or rodends which are binding due to insufficient "rod roll" can cause vibrations. The clevis ear sliding bushing concern discussed in the March-April, 1975 issue of KRT can also cause problems (the bushing must be properly seated). Any pitch link rodend that is free to move axially on its attaching bolt shank can cause a vibration.

Since the flapping and lead/lag axis problems can cause tail rotor vibrations how about pitch bearings? In truth, I have never experienced a pitch bearing problem which gave tail rotor vibes and if we review tail rotor pitch operation we can see why. Since all pilot-induced control to the tail rotor is collective, and since the tail rotor blades essentially remain at fixed angles for steady state flight, no cycling input is present. If a worn pitch bearing causes a problem, it is usually one of a sticking nature where the pilot attempts to push rudder control and the rudder will not move. Since all the blades are actuated by the same spider, one sticking blade will cause the other three to also remain immobile and since the track between the individual blades doesn't change, no vibe develops. If the pilot succeeds in freeing the blade from its stuck position, then all four blades move together retaining a constant track condition.

Any loss of stiffness in the tail rotor gearbox mounting provisions can amplify existing, minor vibrations not normally reported as pilot complaints. Check for proper mounting hardware torques as well as support structure and gearbox mounting lugs for cracks and other visible damage. Since the output shaft of the tail rotor gearbox is turning at 1708 RPM, the tail rotor gearbox itself must be included in any list of suspect areas. Although experience has shown that this is an infrequent cause, it should be checked after all other possibilities have been exhausted unless chip detector indications start occurring.

Another cause of tail rotor vibes which pops up now and then is tail rotor blade unbalance. This usually occurs as a result of moisture entry into the honeycomb core. A good check for this is to X-ray the tail rotor blade. Moisture in any reasonable degree will be indicated on the film. If this fails to detect the discrepant blade, and tail rotor blade unbalance is the most likely cause of your vibe, then replacing each blade in sequence will usually pinpoint the culprit. In some rare cases, two blades might be out of balance.

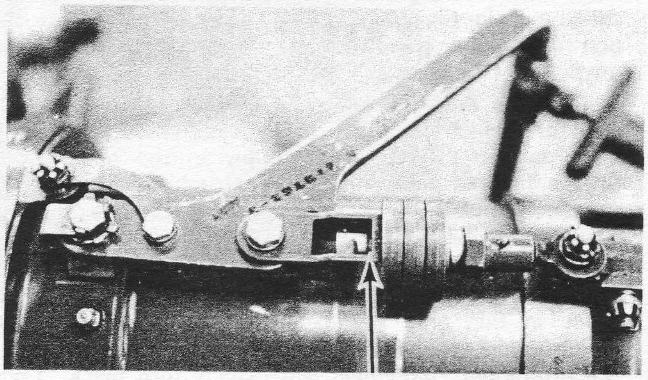
One final point on tail rotor vibes: Since all the blades use the same spar and afterbody, the only difference between blades used on various models is the counterweight and pitch arm assembly. Use the IPB and be sure to install the correct assembly for the aircraft configuration. Take nothing for granted — just because the blade has the correct part number on it does not mean it has the correct pitch arm assembly installed. The same logic applies to tools. Many hours of troubleshooting time have been wasted only to learn that a defective tail rotor blade protractor or micrometer was being used thus compounding what might have been a simple maintenance task.

The preceding completes tail rotor vibes so let's move on to the next frequency, 1192 RPM, or four-per-rev of the main rotor. This is probably the easiest vibration on the H-2 to eliminate once its existence has been established.

Four-per-rev of the main rotor is inherent in the H-2 helicopter. (All helicopters have an inherent main rotor vibration of a frequency related to the number of blades.) Various means or devices are used by different manufacturers to "dampen" or "tune" the vibration so as to minimize its magnitude. These devices range from shock mounting the entire power transmission and rotor system to tuning a mass to absorb vibrations. The main point here is to determine when a vibration becomes excessive. This is the pilot's job. He flies the helo every day and can recognize what is "normal" and what is "excessive." When the four-per-rev exceeds the norm that he is accustomed to, a Vidscard gripe will usually appear as "A/C has excessive four-per-rev."

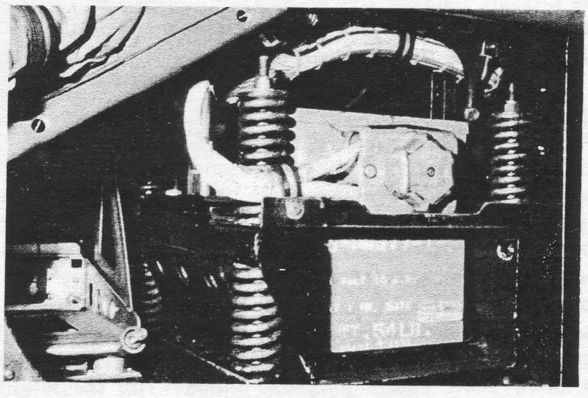
When this occurs, 90% of the time it is after the following has been replaced: all four main rotor blades or retentions, or the main battery. You can eliminate almost all four-per-rev gripes by checking folding pins, folding locks, or the vibration absorber installation.

Folding pins and folding locks require proper seating and torque in order to minimize four-per-revs. It does not take much time to check each folding pin for proper torque (using a torque wrench), whenever the gripe is written up. Always check for correct torque in the tightening direction. If the nut breakaway is below 350 foot-pounds, continue tightening (up to 400) in order to achieve cotter pin alignment. If the torque wrench reaches 350 without the nut turning, the pin is properly torqued and no action is required other than installing a new cotter pin. Where the folding locks are concerned, a simple visual check for the required dimension is sufficient to insure proper adjustment as can be seen in the Photo. One final point on folding pin torques: any pin which continually loosens after repetitive retightening should be removed and checked for proper seating. Check the MMI for correct procedures.



Gap (0.068-0.088) must be visible at arrow.
Folding Lock Dimension

We previously stated that various means of damping or tuning are used to minimize inherent vibrations in helicopters. In the H-2, the main battery is mounted and tuned so as to resonate in opposition to four-per-rev vibratory inputs. NAVAIR 01-260HCA-2-1 and the March/April, 1970 issue of Rotor Tips provide detailed descriptions of its operation. In troubleshooting this vibration, two points should be considered. First, be sure that the absorber is tuned to resonate at four-per-rev frequency, at a preselected main rotor RPM. Secondly, be sure that the selected RPM is at the desired point within the flight beep range. Always be sure that the battery absorber installation is properly secured and free of interference with adjacent structure and wires. Adjustments to the absorber installation should only be accomplished in accordance with the MMI, NAVAIR 01-260HCA-2-1. As explained in the MMI, the installation is tuned to a frequency range or null by adjusting the springs. Then, by adding or subtracting weight to the entire mass, we can move the null point to the proper RPM. In the SH-2F, the proper point is at 105-106% NR.



Vibration Absorber

The greatest asset in troubleshooting any problem is common sense. If an aircraft has flown without four-per-rev problems for a number of hours and then returns from a flight with excessive four-per-revs after the main battery has been replaced, it does not make much sense to start checking the folding pins or locks; the battery weight and absorber installation should be checked first. Apply logic and do a little research into past maintenance actions whenever any vibrations "pop up." In many cases, a clue might be that a component was replaced and/or adjusted.

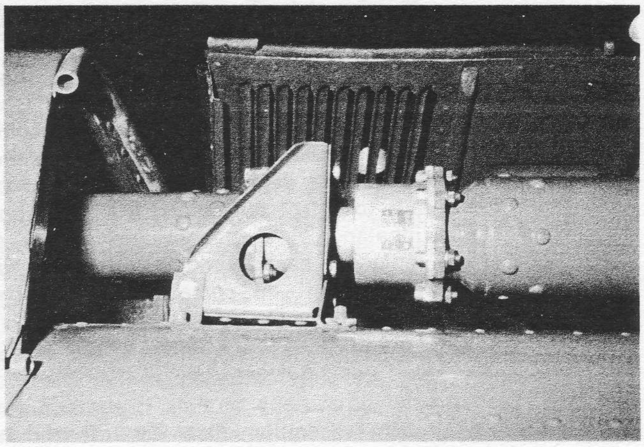
If the preceding areas check out, then there are other places to explore. For example, the flat strip which runs down the center of the aft cabin floor adds stiffness to the fuselage structure and aids greatly in minimizing four-per-revs. Check the torque on the bolts securing the strap to the floorboards. A warning here: tighten the bolts with a torque wrench only to the proper torque as called out in the MMI. "Overtorquing" can break the bolt and cause needless effort in replacement of the anchor nuts beneath the floor boards.

The final place to look is for cracks/failures in any structure which supports heavy electronics equipment, such as the LN-66 power supply in the nose doors. Cracks/failures here results in structural flexing and, ultimately the heavy component will resonate and aggravate the vibration.

The final vibration in the medium frequency range is the 3122 RPM of the tail rotor drive shafting. Vibratories in this area are usually accompanied by visual confirmation of a malfunction: the temp tape closest to the discrepant component will usually turn black. Components which fall into this category are: defective tail rotor drive couplings, warped drive shafts or worn pillow support bearings. If a vibration develops and there is no visual indication of the trouble area, the field can still be narrowed considerably by the use of the Vibratach. Part I of this series discussed how to use the Vibratach by positioning it at various locations on the fuselage while watching for a change in the vibratory magnitude. When a change is noted, the malfunctioning component has been found. Remember, however, always stay well clear of that tail rotor blade!

What are the primary causes of tail rotor drive shafting vibrations? Answer: couplings, shafts, bearings and gearboxes. Coupling malfunctions will invariably result in an overheated and blackened temp tape to alert the troubleshooter; disassembly and examination of the coupling is then in order. When checking for bent or warped drive shafts, two methods may be employed. One method is to place a straightedge on the shaft and look for bends; the second, and preferred method, is to clamp a dial indicator and rotate the shaft one revolution to determine maximum bend. Out-of-balance shafts are difficult to detect. If no obvious signs are evident, such as missing balance weights, etc., we are back to "replace and turnup." (Not the best method, but it is all we can do at the line maintenance level in this case.)

Troubleshooting pillow support bearing problems is generally straightforward and logical with one exception. A bearing malfunction will usually show up via a discolored temp plate; however, remember that the bearing is mounted in a universal housing of the "uniball" type in order to allow for self-centering during normal operation. Prolonged inoperation, particularly in humid weather, can allow fretting corrosion to form and the bearing mount to "take a set." When this happens, the self-aligning feature is defeated and troubleshooting can become difficult. For example, recently a temp tape on a drive shaft coupling turned black. The coupling was replaced and the new temp plate turned black while the temp plate on the bearing remained white. The mechanic assumed the drive shaft was at fault, and, it was the next item to be replaced, but again the temp plate turned black. Finally, the coupling was disassembled and a frozen uniball was discovered. Light oil was applied to the bearing area and it was "worked" with the hands until it loosened and pivoted freely, then it was reinstalled. A subsequent 15-minute hover disclosed the coupling running cool to the point that the bare hand could be held on it immediately after aircraft shutdown. The point here is that whenever tail rotor drive shaft components are disassembled, check the self-aligning feature on the support bearing. Apply light oil and check that each is free to pivot to any angle within its range. You might be saving some work you would otherwise be doing later. Another point to remember is to use the proper coupling in the proper location. According to the IPB, the PD 854 coupling is to be installed in the "A" location only, while the coupling used in other locations is the PD 832. (The PD 854 coupling can be identified by its longer hub which contains a slot.)



Tail Rotor Drive Shaft and Coupling

The preceding sums up medium frequency vibration troubleshooting. Remember, the key to successful troubleshooting is taking logical action, to pinpoint a problem in as short a time as possible, with a minimum of effort and — this means with a minimum of parts changing. Almost anyone can cure maintenance problems by changing all the parts until the errant one is "found." The professional, however, gathers data, analyzes it and then moves in the most logical direction to solve the problem. In some cases, it's as much a process of eliminating "What it isn't," as it is in finding "What it is." Remember these key points:

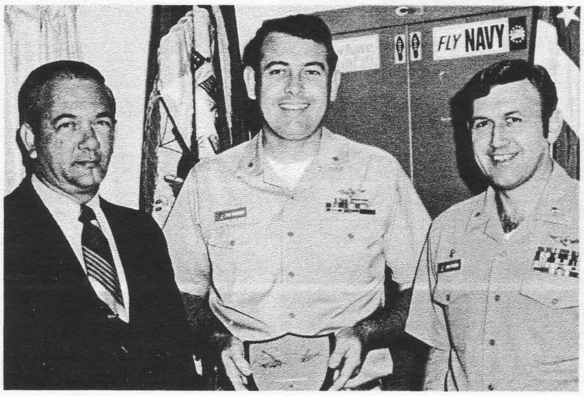
1. Review recent maintenance records. When a smooth flying aircraft suddenly experiences vibrations after a rotating component change or adjustment, troubleshooters should certainly first consider the newly-installed/adjusted component as the cause.
2. Check that the right parts are installed correctly. Remember, many UH-2C, SH/HH-2D parts are physically but not functionally interchangeable with those of the "F" model. Intermixing non-functionally interchangeable parts such as these can lead to serious problems.
3. Take nothing for granted. Start at the basics. If an engine will not start — check to see if there is fuel in the tank, etc. If continued rerigging hasn't solved a rigging problem — check your tools — they may be discrepant, or . . . review your procedures, perhaps you overlooked or misread a key point.
4. Learn how a system is supposed to operate — when it fails to do this properly, your job of determining why will be made a great deal easier.
5. When working on an aircraft — perform the work as if **you** were going flying in it on the next flight. Pilots and flight crewmen depend on you to keep them safe. Their trust deserves your best.

In conclusion . . . Have a PROFESSIONAL attitude.

If there are any questions remaining, write to us and we will try to answer them. Also, let us know if the information has been useful in practice or if further expansion is desired.

1,000-Hour Awards

HSL-33



When Lt Pat Mahoney started flying UH-2A's back in 1966, one of the first aircraft he flew was Bureau Number 149017.

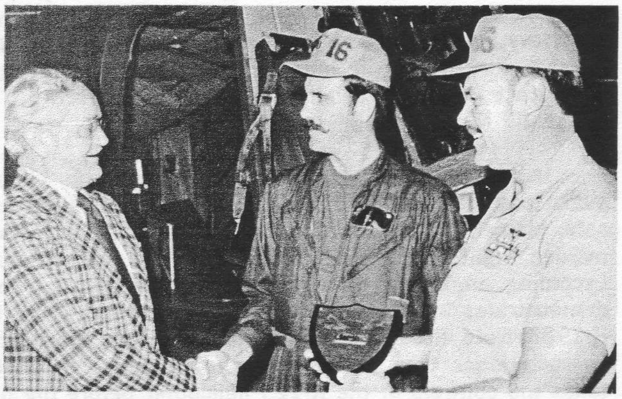
When Mahoney's first detachment, HC-4, Det 47, deployed, 149017 was the aircraft assigned.

When LCdr Pat Mahoney flew his 1,000th hour in an H-2, he was piloting 149017, now an SH-2F. The years have seen both pilot and aircraft cross the country and be "reunited" at HSL-33. Mahoney is a plank owner in the Imperial Beach, California based squadron and recently assumed duties as OINC of HSL-33's Cubi Point, Philippines detachment.

Mahoney's H-2 flying career has been highlighted with many memorable moments. The most memorable to him, however, was when he flew the first H-2 across the Arctic Circle in 1966, off the Coast Guard Icebreaker, Westwind.

Presenting the award to LCdr Mahoney was Mr. Don P. Alexander, Kaman Aerospace Service Representative, left. Also in attendance at the presentation was another 1000 hour award holder, Cdr L. "L" Stoker, right, Commanding Officer of HSL-33, who has accrued almost 2000 hours of H-2 flight time. (USN photo)

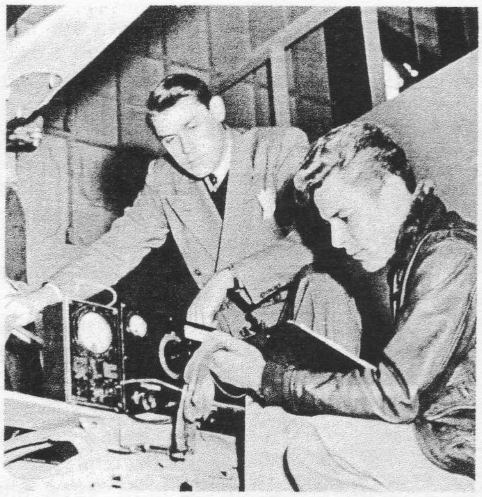
HCT-16



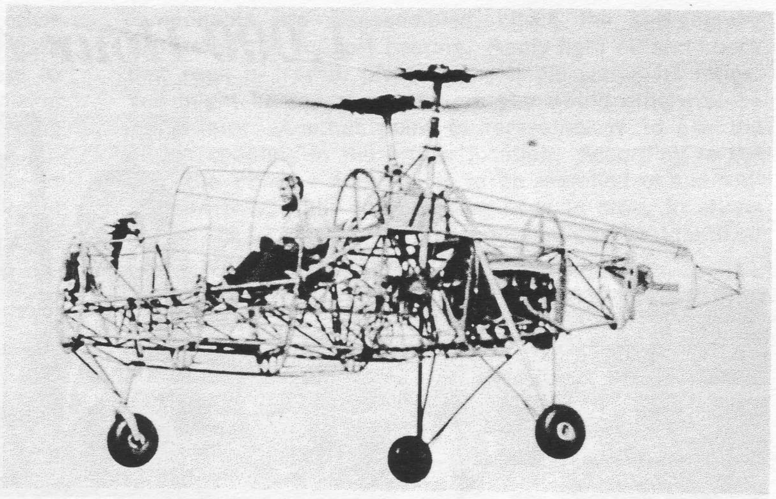
LCdr Lee Wright, far right, Commanding Officer of Helicopter Combat Support Training Squadron Sixteen (HCT-16), displays the 1,000-hour plaque belonging to Lt Terry W. Black. The plaque was presented to Lt Black by Kaman Service Rep, Homer C. Helm who is on left congratulating the lieutenant. HCT-16, commissioned on 1 November 1974, is home-based at Pensacola, Florida, and is tasked with providing Search and Rescue (SAR) coverage to the Naval Air Training complex, both in the Pensacola area and on board the USS Lexington (CVT-16). The plaque is the first awarded to a member of HCT-16 since it was commissioned. (USN photo)

HSL-32

Kaman Field Service Rep, H. F. Sam Field, recently awarded a Kaman 1,000-Hour plaque to LCdr Louis H. Petersen. LCdr Petersen, who was stationed with HC-2, Oceana SAR Det, is currently OINC of HSL-32's LAMPS Det 9. LCdr Petersen has seen each of the Seasprite's growth models as he has flown in the UH-2A; UH-2B; UH-2C; HH-2D; SH-2D and is presently flying the SH-2F aboard the USS Miller (DE1091) now at sea.



Kaman *Murray*



First Flight

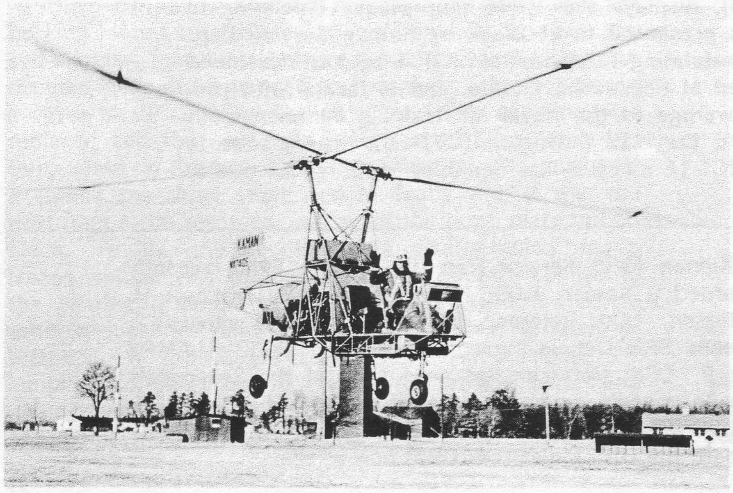
Translation

The gap between founding a business based on one's ideas and seeing the fruition of your labors is great. Yet, Charles H. Kaman achieved that goal in a short time because he seemed to inspire everyone around him. No one reflected that attitude more than Kaman's first full time employee, test pilot, and friend, William "Bill" R. Murray. The two men worked hours-on-end translating test data into hardware and then mating all into a functional aircraft. With limited capital, progress was slow at first. However, by 1946, sufficient engineering had been accomplished to prove that the servo flap control was not only practical but it offered advantages. With proof in hand, Kaman was able to get greater financial support. In January of 1947, the experimental Kaman helicopter, designated the K-125, made its initial flight. With the first flight, the military began to take an active interest, and, in May of 1947, the Navy Bureau of Aeronautics gave Kaman its first Navy contract for engineering development. A second, similar contract, followed in early 1948.

Cognizant Navy personnel were following the Kaman progress and arranged to buy two K-225's for tests and evaluation. Shortly, thereafter, the U.S. Coast Guard also purchased a K-225. When the exhaustive tests were completed and evaluated, the Navy was impressed and immediately placed its first large order for production aircraft, the HOK-1, in June of 1950. In September that year, Kaman also received a contract for Navy Training helicopters, the HTK-1. The first HTK was delivered to Anacostia Naval Air Station on April 26, 1951.

In photo above left, Bill Murray checks his clipboard data against the test rig gages and Charlie Kaman checks the entries. Both men insisted their aircraft be a safe, stable platform. In photo above right, the first Kaman helicopter on its historical maiden flight. Designated the K-125, the aircraft was powered by a four cylinder Lycoming engine of 125 horsepower. In photo below left, test pilot Bill Murray demonstrates how well the pioneers succeeded as he flies the second helicopter, the K-190. Note the "hands-off" hover proving their aircraft to have the safe, stable characteristics they were striving to produce. In photo right below, Kaman himself takes the controls of the K-125 helicopter before the fuselage was completed.

Hands-Off



Kaman