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THE KAMAN AIRCRAFT CORPORATION

PIONEERS IN TURBINE POWERED HELICOPTERS

KAMAN

Rotor Tips

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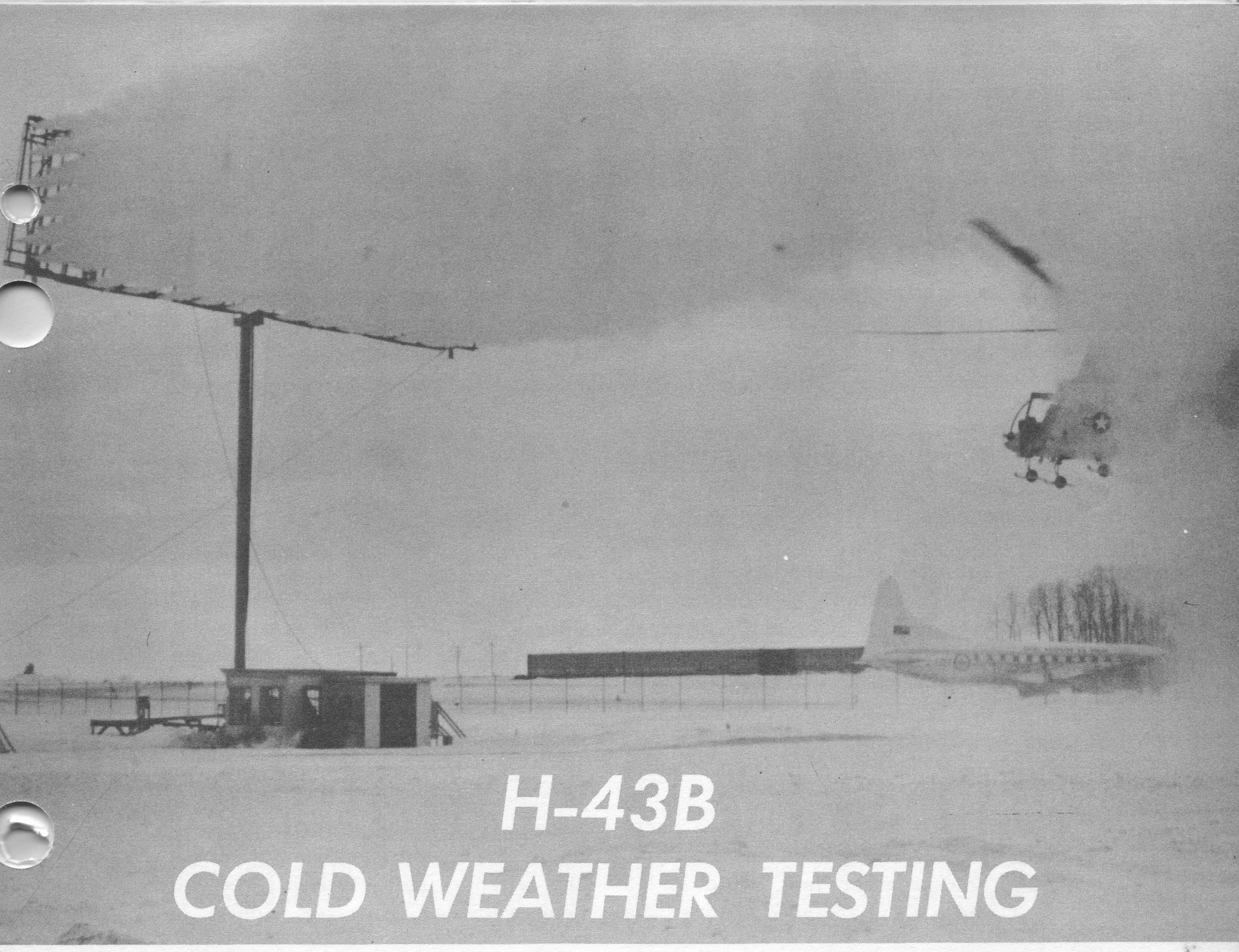
IN THIS ISSUE

THE COVER

Christmas Eve, or any other time, finds the men of the helicopter rescue units ready to perform their life-saving missions.

—— *PLEASE SHARE THIS COPY* ——



H-43B COLD WEATHER TESTING

by P. N. HORSTMANN
Test and Development Engineer

The well known saying has it that "nothing can be done about the weather." Although strictly speaking this is true, something can be, and has been done about the effects of weather—in particular about the cold weather that is upon us. Within the normal development cycle of a military helicopter, it has become standard operating procedure to subject each new aircraft to a cold weather test program in order to discover and correct low temperature operating problems, as well as to develop the special maintenance techniques required under such conditions. Just as your own car has its winter-time peculiarities, such as an occasional dead battery, helicopters present particular problems when operated in extreme low temperatures. Knowledge of what these problems might be, how they are discovered, and what can be done about them, should be of real benefit to operating personnel in these cold winter days. The following discussion will highlight the experience of the Kaman H-43B Huskie during its recent cold weather tests. However, the lessons learned with the "B" can be applied in principle to other Kaman helicopters as well.

Military helicopters are generally required by design specification to be capable of oper-

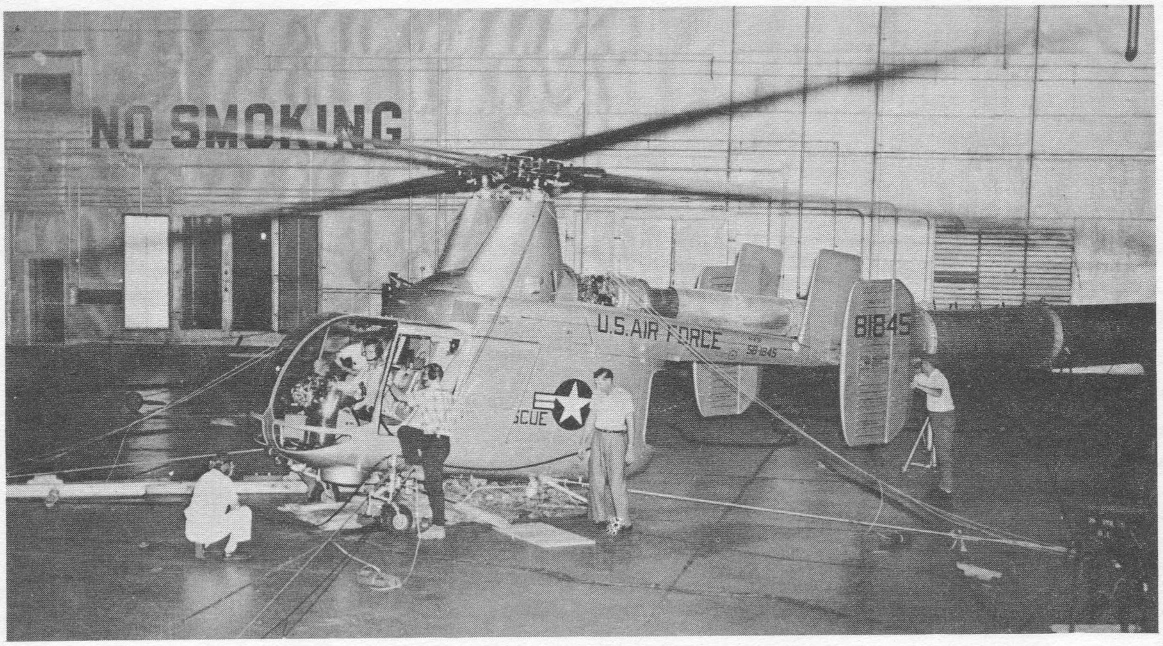
NEXT MONTH: **LIFELINE!**

ation in temperatures down to -65°F. Although extremes of this nature are seldom encountered, when they do occur the machine must be capable of performing its mission. To insure this capability, a wide range of cold weather test facilities are available. These include the Climatic Projects Laboratory at Eglin Air Force Base, Florida; an operational test site at Ladd Air Force Base, Alaska; and a helicopter icing test setup in Ottawa, Canada.

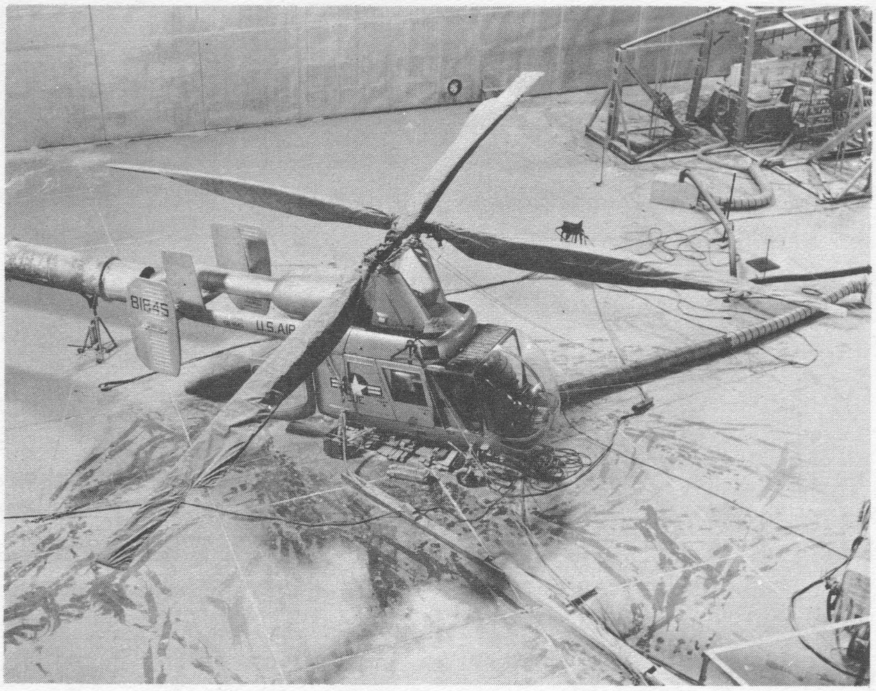
First stop for the H-43B was the Climatic Laboratory at Eglin Field. This is simply a huge refrigerated hangar where controlled temperatures down to -65°F. can be maintained continuously. Here the helicopter was tied down to the hangar floor so that the rotor system could be operated under full engine power with the aircraft still on the ground. Extensive instrumentation to record the performance of the helicopter's systems was installed in the "Huskie", and a heated test booth was positioned nearby to house the recording equipment and to serve as a control center for the test operations. A second booth was provided for tool and spare parts storage and as a working area for the crew. The actual cold weather test cycle lasted about eight weeks, and included at least one full week at each of the test temperatures of +70°, 0°, -25°, -45° and -65°F. The procedure at each temperature decrement was to operate the helicopter without the aid of preheat and after a minimum cold soak period of 24 hours, over a wide range of rotor speeds and powers, to include operation of as many aircraft systems and components as possible. Such a program of standard daily test runs allowed sources of potential trouble to be discovered, investigated, and in many cases eliminated, before the next lower temperature decrement was reached.

The general effects of cold temperatures are obvious—things freeze and moving parts get mighty stiff and slow. This, in general, is the nature of the problems that occur, even at an extreme as severe as -65°F. The results of the H-43B cold weather test were no exception as the following examples will illustrate.

Lubricants and fluids must be chosen with their cold temperature qualities kept firmly in mind. Sometimes this can be done in advance, such as the selection of MIL-L-7808C as an engine and transmission oil for the "B" that will perform well down through the lowest temperatures. However, actual helicopter



SHIRT-SLEEVED TEST ENGINEERS prepare an H-43B for cold weather testing in the Climatic Laboratory at Eglin Air Force Base, Fla. Within this huge, refrigerated hangar, temperatures can be controlled down to —65°F. and maintained continuously while the tied-down helicopter is operated under full power and other tests are performed.



THE HANGAR TEMPERATURE has been dropped from +70° down to 0°, then —25° and finally to a cold, cold —65°F. Test engineers, not anxious to contract a case of frostbite in sunny Florida, have retreated to the heated booth positioned nearby. This serves as the control center for the test operations conducted after a minimum cold soak period of 24 hours.

operation at -65°F. was necessary to determine that the original cyclic control damper fluid did not allow complete cyclic control freedom. This led to the requirement that Dow Corning Grade 510 fluid be used in the cyclic control dampers for all Kaman helicopters on a year 'round basis. Similarly, the inadvertent use of Lubriplate as a lubricant for the N1 twist grip teleflex control cable caused difficulty in moving the twist grip after cold soaking. Since this is a difficult assembly to thoroughly clean, the cable should be operated dry to insure freedom in cold weather. Although they are the more obvious, material problems are not confined to lubricants. Rubber components used in the H-43B such as long blade rod dust boots, landing gear strut bumpers, and weather stripping, are of a composition that allows them to flex and function properly in extreme low temperatures.

For the helicopter to be able to perform its rescue mission at a moment's notice, proper lubrication for engine and transmission must be available immediately upon turnup in cold weather. Simulated "scramble" take offs were conducted in the Eglin hangar, in which starts were made with wide-open throttle and rotor brake off, that disclosed the need for the one-inch lines that now feed the engine and transmission oil pumps. Flow restrictions between tank and pump can cause pump cavitation and consequent oil starvation if not eliminated. Since the torquemeter of the T-53 engine depends on a normal engine oil pressure supply for proper operation, it will read low if the basic engine oil pressure is below the pressure being called for by the torquemeter, possibly leading to a drive system overtorque condition. A suspected torquemeter indication should always be followed by an immediate check of engine oil pressure. Along this line, sluggish torquemeter response during extreme cold weather operation may be remedied by filling the line from the engine torquemeter tap to the torque pressure transmitter with a light instrument oil compatible with 7808C.

Engine starting at low temperatures is very often difficult, but the combination of the nickel cadmium battery and the starting fuel control in the "Huskie" provided excellent self-contained starting performance. It was found that cold battery starts were quite successful at -25°F., and a cold start was even made at -45°F., although this should not be

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READY FOR RESCUE

by F. H. HORN
Asst. Field Service Manager

FIRE IN FLIGHT! . . . *Just the thought is enough to give an aircrewman cold chills. Imagine then, what must have been going through the minds of the men aboard a KC-97 on a recent flight from Davis-Monthan to Plattsburgh Air Force Base . . .*

It was strictly routine until a few minutes ago when an inboard engine started to run rough and had to be feathered. Since then you've constantly reassured yourself with the thought there is actually no sweat, there are three more engines——but that uneasy feeling still persists in your stomach.

Then the other inboard engine begins running rough and all at once some of the fun has gone out of flying and the sky doesn't seem quite such a good place to live. What's going to happen next? Randolph is nearby, and although you're eager to set down and get this bird operating again, you still feel the situation is under control. Again, no sweat! However, "no sweat" has actually become just a figure of speech. The palms of your hands are a little clammy and beneath your flight suit you feel a little trickle of perspiration running down your side. You continue to reassure yourself. The emergency has been declared, Randolph is in sight, and the crash equipment is standing by. They've even launched an H-43A helicopter with a fire suppression kit slung underneath. You smile wryly. That kit won't do much good if the 4,000 gallons of fuel aboard should catch fire——but who's going to crash and burn anyway?

The giant tanker is entering the downwind leg and you're feeling a sense of relief when suddenly the number four engine starts backfiring. Now there's sweat! Plenty of sweat! The engine's afire and the extinguishers won't put it out. You can't make the runway from here and the only possible place to get down is in a plowed field dead ahead.

An engine streaming flames. . . 4,000 gallons of highly inflammable fuel aboard. . . a forced landing seven miles from the base. . . you've never been closer to "buying the farm."

Brace yourself! There's a grinding, tearing, ear-shattering series of noises as the plane slides to a stop; then comes the silence that you know precedes the bright flash and roar you may never hear. But nothing happens. As in a dream you start moving toward the door when you notice a couple of the crew are hurt. Instinct tells you to run, to get out of there before she blows, but instead you join others in aiding the injured from the plane. It only takes seconds, but it's one of the longest periods in your life. Then, suddenly, you are outside the plane and in the clear. The full realization hits you. You've made it! You turn and look back at the plane, damaged but repairable. As you watch, the helicopter which followed the aircraft down releases the fire suppression kit and then begins hovering, blowing the flames away from the ruptured fuel tanks with the rotor down wash. One of the aluminum-suited firemen, protected by this cooling stream of air from overhead, runs forward dragging a hose and begins extinguishing the burning engine, Approximately a minute's time has elapsed from the time the plane crashed and the 'copter touched down. Almost miraculously, the threatening flames near the spill from the fuel tanks disappear beneath the smothering blanket of foam. Meanwhile, the other helicopter crewman begins giving first aid to the injured. Shakily you pass a hand over your face and think back over the last frantic few minutes. What if you hadn't been able to get down in such good shape? Suppose the terrain had been different and the plane wrapped up so that you and the others had been trapped aboard. It is not a pretty thought. Respectfully you look at the foam around the plane and the still-hovering helicopter, then softly murmur, "Thank God those rescue guys were standing by."

Once the fire danger was past, the injured or shaken crewmen from the tanker were flown to the hospital. The rescue helicopter made two such trips before the ground equipment arrived at the crash scene after making the time-consuming, seven-mile trip from the air base.

Let's take a look at the effort which had gone into preparing the helicopter crew for this seemingly fantastic save. For Capt. Charles R. Pinson, the pilot; it started about two weeks before his helicopter was delivered in May, 1959. As with all H-43A pilots, he completed a two-week course at the Kaman Aircraft factory consisting of ground school and flight indocrination with special emphasis on this type helicopter's crash-rescue mission. Indicative of his future performance were his instructor's comments on his eagerness to fly, his interest in the course of instruction, and his outstanding all-around ability.

Upon completion of the course, Captain Pinson flew his H-43A back to Randolph where he began further training of rescue crews and other pilots. The groups worked hard, polishing their rescue techniques and improving team work by constant practice. Among those participating were S/Sgt. Donald L. Baker and A1/C Robert C. Birch, the two firemen on the KC-97 mission.

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PROMPT ACTION by H-43A helicopter crew from Randolph Air Force Base was credited with saving this KC-97 from destruction by fire. (Photo courtesy of the San Antonio Light)

Maintenance Mailbag

Dear Harry,

So how goes the battle? Everyone here is scrambling for leave and moaning and groaning either 'cause they can't go, or they gotta' be back too soon. There's one guy, "Bear Cat" Cloogle, that hasn't that kind of problem. He's staying put for attacking Santa Claus with a broken broom handle.

What happened was Bear Cat came back to the barracks one night and when he went to climb into the sack he found this big, be-whiskered gent in a red suit already in it storing up the ZZZZZs. Cloogle never said a word, just went out, got this handle from somewhere and then charged 25 feet across the room holding it straight out like a lance. Somewhere enroute his foot got caught in a wastepaper basket, which slowed him up a bit, but there was still plenty of steam left by the time the splintered end hit the bulge in the mattress. I tell you, this bird in the bunk went flying up in the air with a kinda' whooping scream and when he came down he wasn't singing Jingle Bells. After considerable excitement, during which Bear Cat got in a couple of good whacks with the broom handle, the lights went on and "Sir Lancelot" found out he'd tangled with one of those 225-pound sergeants from the Provost Marshal's office. This sergeant had been playing Santa Claus for a bunch of kids and was taking a nap before appearing at another party in the "O" club. Incidentally, Bear Cat was in the wrong barracks—his was next door.

Was talking to John Elliott, one of the tech reps from Kaman Aircraft, and he tells me some of the mechs are having difficulty unlocking the nose wheels on the H-43B because they are trying to force the handle straight up and down instead of to the right. As you probably know, directions are on the handle.

Speaking of Kaman tech reps, Bill Wells passes along this possible Murphy in the "B's" collective limiter system. He says the oil lines to the collective limiter can be hooked up backwards during installation. That is, pressure line to the return side, return line to the pressure side. If this happens, the limiter will not operate due to equalization of pressure on both sides of the piston assembly. The collective stick will remain in the full down position and in order to pull it up, you'd have to overcome spring plus oil pressure loads.

Have a good Christmas,

Red

TRAINING

NAVY PERSONNEL from the Naval Air Mobile Trainer Group at NAS Memphis, are checked out on the HU2K-1 Rotor Hub Assembly by KAC Instructor Homer Helm. Left to right are Helm; F. H. Brightman, AMCA; W. A. Ruthford, AMCA; R. L. Welch, AD1; W. C. Morris, ADC; A. J. Niemotka, ADC; J. C. Brandon, AD1; C. F. Robertson, AMCA; S. E. Waldrop, AMCA. Other members of the group are O. Z. Williams, AEC; A. P. MacCracken, AEC; D. W. Glaeseman, AE1; and H. G. Davis, AEC.

Twelve U.S. Navy instructors from the Naval Air Station at Memphis, Tenn., are currently evaluating the full-scale HU2K-1 trainer at Kaman Aircraft to determine if it meets their requirements.

These instructors, nine chiefs and three first class petty officers, are from the Naval Air Mobile Trainer (NAMT) Group at NAS Memphis which utilizes trainers such as this in the instruction of helicopter maintenance personnel. Once these experts find the trainer acceptable for their purposes, it will be transferred by the Bureau of Naval Weapons Resident Representative at Kaman Aircraft to NAMTG. It is anticipated this will happen in a few weeks.

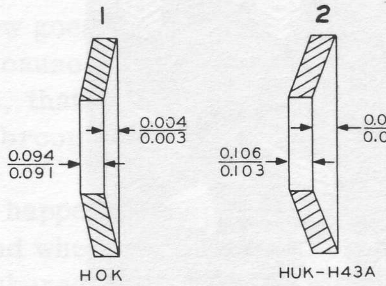
The HU2K-1 trainer will then be shipped to NAS Memphis so the instructors can attain even greater proficiency in its use. At some future date it is planned to move the trainer to Ream NAAS at Imperial Beach, Calif. Half of the Navy instructors now at KAC will accompany it and will then start training the maintenance personnel from ComNavAirPac who will support the HU2K-1s.

Early next year, the second trainer will be shipped to NAS Lakehurst, N.J. Here it will be met by the balance of the instructors now at the KAC School. They will then start training personnel from ComNavAirLant.

Last month, personnel from the Naval Air Test Center, NAS, Patuxent River, Md., evaluated the HU2K-1 trainer. K

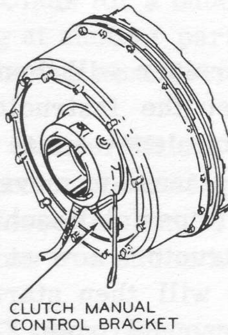
Q's AND A's

If you have a question regarding Kaman Aircraft maintenance, send it along to Rotor Tips. The Service Department's analysts will be glad to answer it.



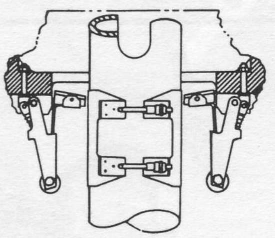
Q. HOW OFTEN SHOULD THE ROTOR SHAFT SPRING WASHERS BE REPLACED? (Applies HOK-1, HUK-1, H-43A)

A. The K371479-11 washers used on the HOK-1 may be used as long as a 0.003 minimum crown is maintained (see sketch #1). The limit for K371497-11 washers used on HUK-1, and H-43A is 0.007 (see sketch #2). Washers which will not meet these requirements should be scrapped. — L. L.



Q. WHAT PRECAUTIONS ARE NECESSARY TO AVOID BREAKAGE OF THE K371552-1 CLUTCH MANUAL CONTROL VALVE BRACKET? (Applies HOK-1, HUK-1, H-43A)

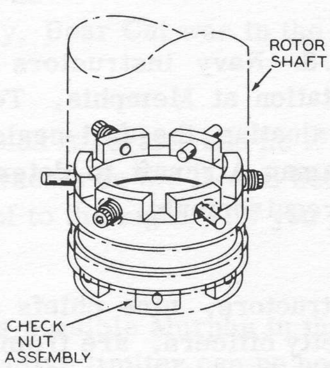
A. FID's A-42 and B-6 have been issued covering the separate handling of this bracket during packaging, shipment and installation or removal of the clutch assembly. — L. L.



Q. AT WHAT ROTOR RPM ARE THE DROOP STOPS SUPPOSED TO DISENGAGE AND ENGAGE? (Applies HOK-1, HUK-1, H-43A, H-43B)

A. The droop stops on the HOK-1, HUK-1 and H-43A disengage at a minimum of 100 rotor rpm, and engage at a minimum of 85 rotor rpm. On the H-43B the droop stops disengage between 48% and 50% of rotor speed and engage between 42% and 44% of rotor speed.

The difference between the engaged and disengaged rpms is caused by inertia. When the droop stops are engaged, they tend to remain engaged until sufficient centrifugal force is developed by rotor rpm to overcome the force of gravity and spring tension. Conversely, when they are disengaged they tend to remain disengaged until gravity and spring force overcomes centrifugal force. On all models a malfunctioning droop stop can cause trouble. Check the proper manual for maintenance of the droop stops. — W. J. W.



Q. HOW CAN DAMAGE TO THE BUSHINGS IN THE TRANSMISSION STUB SHAFTS AND ROTOR SHAFT ATTACHMENT BOLT HOLES BE AVOIDED? (Applies HOK-1, HUK-1, H-43A)

A. It is recommended that the following procedure be used during rotor shaft installation.

1. Check nut assembly (P/N K371404-3, HOK-1) or (P/N K371494-1, HUK-1 and H-43A) for proper alignment to transmission shaft bolt holes prior to rotor shaft installation by first inserting all attaching bolts by hand. Nut assemblies will retain alignment due to snug fit.

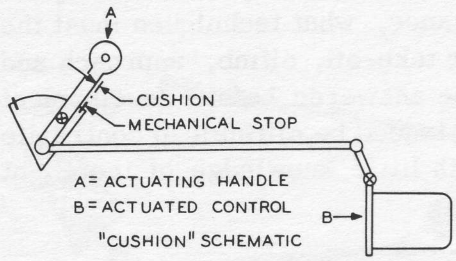
2. Remove bolts and install rotor shafts per instructions in the maintenance handbook.

3. Align rotor shafts to transmission shafts and insert three dowels to maintain alignment. (see note)

4. Install bolts in the remaining holes.

5. Remove dowels and replace with bolts, one at a time.

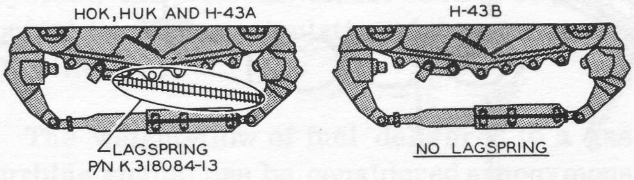
NOTE: HOK-1 dowels may be made from 3/8-inch bolts with the threads cut off. HUK-1 dowels may be made from 7/16-inch bolts, and the H-43A special tool K304521-13 is provided for this purpose. — L. L.



Q. WHAT IS MEANT BY THE WORD "CUSHION" WHEN USED WITH INSTRUCTIONS FOR RIGGING THE MIXTURE AND CARBURETOR HEAT CONTROLS. (Applies HOK-1, HUK-1, H-43A)

A. The word "cushion" is used to indicate that a cushion-like "feel" should exist when the control handles on the quadrant in the cockpit are actuated to their extremities. The "cushion" guarantees that the actuated control has reached its full travel before the actuating handle in the cockpit has bottomed on the quadrant stops.

When the "cushion" is not present, a misrigged condition exists which must be corrected by consulting the proper handbook. — W. J. W.



Q. THE LAGSPRING P/N K318084-13, LOCATED BETWEEN THE GRIP EAR AND THE HUB ON ALL HOK'S, HUK'S, AND H-43A'S, IS CONSPICUOUS BY ITS ABSENCE ON THE H-43B. WHY? (Applies all synchropters)

A. There are two prime reasons; the most obvious is the difference in drive systems. On the earlier synchropters, the familiar lagspring holds the blade against the lag stop when static. The reciprocating engine and clutch setup can impart quite a jolt to the blades on engagement. With the blades anywhere but against the lag stop, relative motion can build up so that by the time the "slack" is taken up and the blade bears against the lag stop, the start can become quite severe, throwing undue loads into the blades and drive system. The spring, holding the blade against the stop assures that the blade will start revolving simultaneously with the rest of the drive system as soon as the clutch begins to engage. On the H-43B, with its free shaft gas turbine engine, the power flow is smooth and the initial motion, when the rotor brake is released, cannot be violent.

Secondly, on the HOK-1, HUK-1 and H-43A aircraft, the lag pin is set in the hub with its top "leaning" forward 1-1/2°. Like a door with crooked hinges that swings open by itself, the blades tend to swing toward the lead stop. The lagspring overcomes this tendency. The lag pin in the H-43B "leans" the opposite direction 1-1/2°. The tendency here is for the blades to swing toward the lag stop by themselves which removes any necessity for using the heavy spring. — N. E. W.

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Report FROM THE READY ROOM

THE TURBINE AND THE SEASPRITE


JOHN L. "JACK" JONES
Test Pilot

In the development of any completely new product, there are countless problems to be met and solved. Naturally, in the case of an aircraft, many of the obstacles encountered assume an importance not normally associated with most consumer products.

Let's take a quick look at some of the basic development problems in any new aircraft program. The aircraft must be flown for the first time with knowledge only of the predicted performance and flight characteristics. It is easy to see that besides the technological development needed, a great deal of pilot development must also take place. For instance, what techniques must the pilot learn which are best in this aircraft for take-off, climb, approach and landing? These and more questions must be answered before development of the aircraft itself can continue. It would indeed be difficult to contribute substantially to a development program with little knowledge of the flight characteristics of the aircraft.

These and other considerations faced us in the early stages of flight testing the HU2K-1 Seasprite. Not the least of these considerations was that of assuring a successful marriage of the HU2K-1 with its gas turbine power plant.

During the pre-flight tiedown running we had the opportunity to become as familiar as possible under test conditions with the engine, the aircraft, and the two as a package. Although we had at the time probably more experience with gas turbine helicopters than any other manufacturer, having pioneered in this field, there were still many things to be learned.

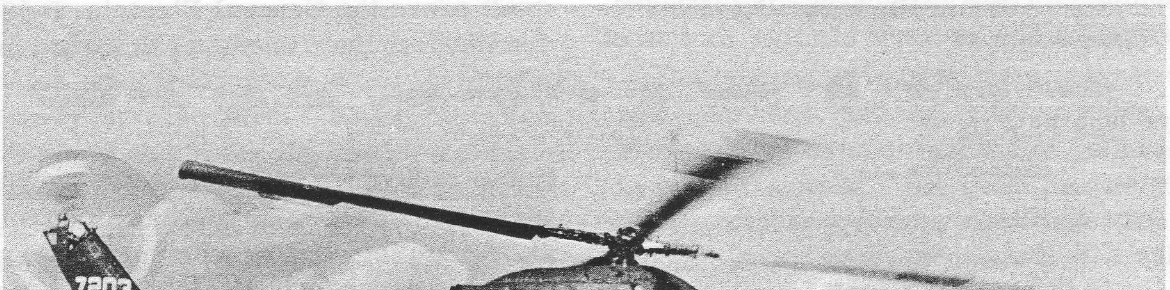
Let's review briefly the operation of a gas turbine helicopter with a free turbine. The free turbine helicopter power plant provides automatic rotor speed governing up to the horsepower output limit of the engine. This relieves the pilot from the usual bother of closely monitoring rotor speed, but it is still necessary for him to be aware of how much power is being used in a particular flight condition. The pilot need only select a rotor speed which is automatically maintained by the system. His left hand is merely used to control the collective pitch of the blades.

Naturally, a more thorough knowledge of the power plant and installation makes the transition of less concern to the pilot than if he merely considers the physical efforts involved. The power plant installed in the HU2K-1 is a General Electric T-58-6 gas turbine. It has a single stage free turbine with a reduction gearbox attached. This primary reduction gearbox receives the output shaft of the free turbine, reduces the speed and transmits the torque to the shaft that drives the transmission. The transmission in turn drives the accessory gearbox, the main rotor shaft, the tail rotor drive shaft and subsequent gearboxes.

There are two methods available to the pilot of controlling engine power output. When using the normal (automatic) system, the collective pitch stick indirectly becomes the power control. When using the emergency system, the pilot has direct control of power output through manipulation of the emergency throttle.

The weight-flow of fuel delivered to a gas turbine engine can be considered synonymous with horsepower delivered by the engine under normal circumstances. It therefore becomes proper to consider power delivered to the transmission in terms of weight-flow of fuel delivered to the engine.

When the automatic mode of fuel control operation is selected, the pilot merely calls for a particular rotor speed (hence, free turbine speed when not in autorotation). The fuel control schedules a fuel flow to the engine



WELL SUITED to one another – the sleek fuselage of the HU2K-1 SEASPRITE and the T58-6 power plant. The free turbine engine, which weighs only 271 pounds without accessories and is 61 inches long, delivers 1,050 shp, military rated power.

to produce enough power to maintain the chosen rotor speed. As the flight condition is changed the power required by the rotor system is changed, and the rotor speed would tend to either increase or decrease dependent upon the new flight condition. The fuel control, through a connecting free turbine drive shaft, senses the slight speed change of the rotor and adjusts the fuel flow rate to match the new power output demanded by the rotor system. Therefore, the pilot's power control is the collective pitch lever. In other words, if the collective pitch is increased, rotor speed tends to decrease. This speed drop, being sensed by the fuel control, causes engine power to increase in order to maintain a constant rotor speed. Conversely, if the collective pitch is decreased, the rotor speed will tend to increase and engine power output will be lowered.

When the pilot operates the helicopter using the emergency throttle control, he then assumes direct control of the fuel flow rate. For each incremental throttle change, a corresponding fuel flow rate change is produced. The situation now is very similar to that of operating a reciprocating engine helicopter. The rotor system must absorb the energy supplied it by adjusting its speed. If a particular flight condition does not call for the amount of power the engine is producing for the desired operating rotor speed, the rotor speed will increase. On the other hand, rotor speed will decay if engine power output is insufficient for the demand of the rotor system.

Certainly pilots will carefully study the exact details and operating instructions for the engine in the appropriate manuals, but it is hoped that the foregoing will prove of value in understanding the relationship of the free turbine power plant to the helicopter.

From the initial flight of the aircraft it was apparent that the HU2K-1 would be a very low vibration-level helicopter. It has remained this way. The turbine engine gives good response and greatly simplifies power control. These advantages, coupled with the effortless handling characteristics of the aircraft prove the General Electric T-58-6 and the HU2K-1 have indeed been a good match.

READY FOR RESCUE

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As soon as all personnel were thoroughly familiar with their jobs, they began standing alert. As in the case of any emergency group, "alert" actually meant waiting for hours, and even days, for something to happen. They couldn't go anywhere, or do anything that would prevent answering a call in seconds. These men, however, used what could have been hours of utter boredom in planning and devising means of doing their job more efficiently and of improving the system in general.

"The system" works like this. The alert helicopter sits on the mat in a "cocked" condition. This means that the cockpit is checked and all switches are set so that when the battery switch is flipped on, the helicopter is ready to start. The fire suppression kit, or "sputnik", is on its trailer nearby. The pilot and crew are in an alert shack equipped with a radio and crash telephone. At the first signal of an emergency, the crew dashes to the helicopter and starts the engine. At the same time they listen to the control tower on the radio, getting information regarding the emergency. If it looks like a possible crash landing, they hook up the sputnik, take off, and head toward the aircraft in trouble. In the case of a bail-out, the sputnik is left behind.

Alert duty is usually a "drag" for the crew on duty because they don't often "go" even on dummy runs. But in the case of Captain Pinson's crew, the hours of training, planning, and just plain standing by have paid off, and in spades. Because of their perfection of the system and their prompt, efficient application of their knowledge and skills, the potential loss of a multi-million dollar aircraft was averted.

But far more important, other airmen have been shown that with the rescue chopper crews standing by, the chances of surviving a crash in which fire is involved have been greatly increased.

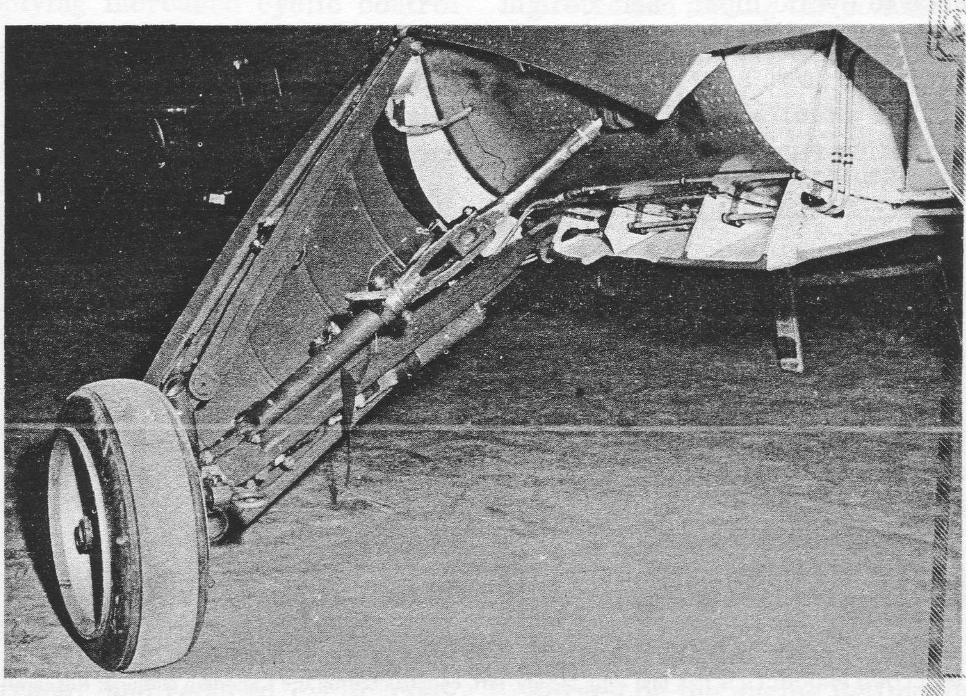
HU2K-1 RETRACTABLE MAIN LANDING GEAR

by OWEN F. POLLEYS
Project Engineer

One of the major missions of the HU2K-1 is that of search and rescue and, due to this, the design was influenced greatly by criteria which will aid in both of those areas. One of the drawbacks of effecting a rescue in the past has been the lack of visibility of the general rescue operation by the pilot. This was due mainly to the large distances between the rescue hoist and the pilot. On the HU2K-1, therefore, the rescue door and the rescue hoist have been placed directly aft of the pilot so that pilot and rescuee are literally "inches" apart. In order to insure that the rescuee will not be bumped up against the landing gear, which is stationed just aft of the pilot's compartment, the gear has been made retractable. This retracted position of the gear also prevents entanglement of the rescue cable, which has been a serious problem in the past.

The landing gear itself is of the levered-suspension type, having the wheel forward of the main gear structure. When retracted, only the wheel and lever fits inside the fuselage lines. The main tripod itself folds flat and lies along the skin line, thus preserving fuselage continuity. To insure freedom from mechanical instability during take-offs and landings, great care was taken to insure that the gear structure was stiff in both the vertical and lateral directions and that good damping characteristics were obtained. The vertical stiffness was obtained through the structure itself; the lateral stiffness was obtained by the structure and a special "low aspect" ratio tire. This tire, a special development in the HU2K program, is stiff laterally due to the fact it is quite wide in proportion to its height. Good damping characteristics are achieved due to special cord orientation in tire fabrication and use of a liquid spring shock absorber. As its name implies, this spring is a piston which depends on compression of oil for its "springiness." No air or mechanical springs are involved. In addition, damping is achieved by forcing the oil through a small orifice in the piston.

The landing gear is hydraulically retracted and extended and is mechanically locked either up or down. In case of failure of the hydraulic system, the gear can be dropped and locked by gravity, thus insuring a safe landing under all conditions. K



RETRACTABILITY and this special "low aspect ratio" tire are two of the features of the HU2K-1 main landing gear.

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expected in service. Warm battery starts were easily made at -65°F. APU starts of course provide the greatest margin of safety in cold weather and should be used wherever possible. In turn, battery starts are greatly enhanced if the battery is kept warm and fully charged. Starting fuel control proved invaluable in controlling EGT during long battery cranking periods. EGT can be held within desired limits quite easily by toggling starting fuel "on" and "off" as required.

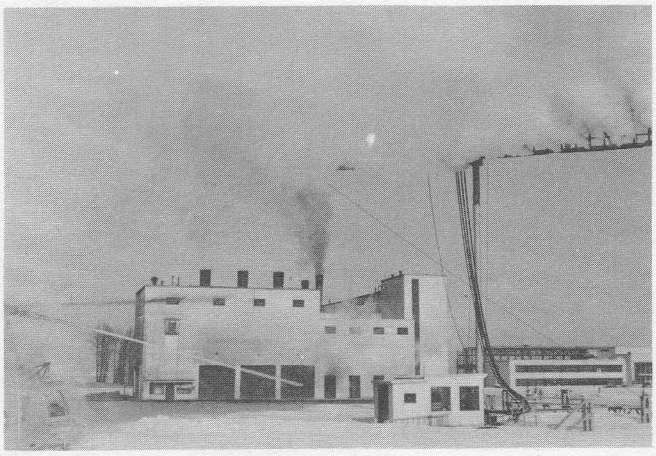
Water and ice entrained in the fuel can be very troublesome in cold weather, eventually leading to fuel starvation if operation is continued under severe conditions. A large capacity aircraft filter, located where it can receive a warming influence from engine compartment or cabin heat, is essential. The safest course is to insure the use of uncontaminated fuel, in warm as well as in cold weather.

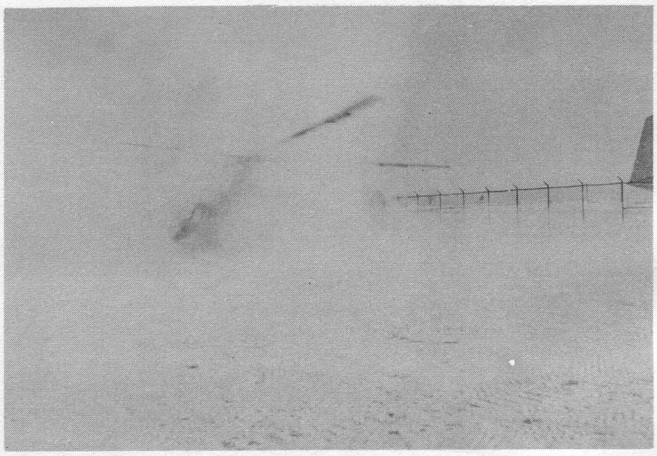
Cold air can play unseen tricks too. The increased air density boosts rotor servo flap effectivity so that a helicopter with an improper autorotation cone setting may, when on the ground, operate in negative pitch with full down collective at extreme low temperatures. This can be detected by a reversed ground response to cyclic input, and a slight reduction in engine torque as the collective stick is eased off the down stop and the rotor passes through flat pitch. Maintaining proper seasonal autorotation rigging will, of course, avoid this annoying, but not serious, situation.

Even pre-flight inspections have a new twist in low temperature operations. Items peculiar to these conditions should be emphasized—reduced air or fluid pressures in tires, struts, or accumulators; static leaks from contracted or hardened seals, freezeup of any movable parts or controls, and removal of large snow or frost accumulations on the blades, nose bubble, or the aircraft itself. In this connection, maximum use of protective covers is very beneficial when the mercury drops.

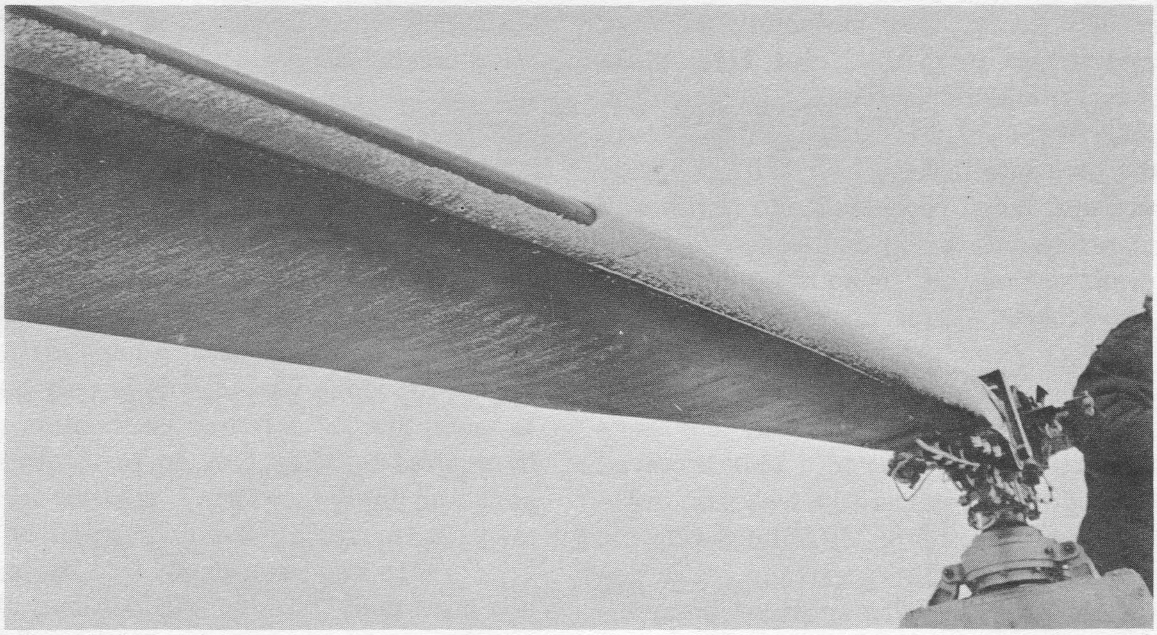
Although, as previously indicated, much was learned during the H-43B's stay at Eglin Field, that was not the end of the line. Ottawa, Canada, was the next port of call to evaluate the "B's" performance in icing flight conditions. Here the Canadians have constructed a rig that creates an artificial icing cloud of sufficient size to completely envelope a helicopter rotor system. Water, atomized by steam, is pumped out of a large spray frame 70 feet in the air. Control of the water and steam flows allows the icing intensity of the cloud to vary from light to heavy. At this site, the ship was hovered in the cloud under various conditions of temperature and icing intensity to cover a wide range of icing conditions.

Even though the H-43B is not presently produced as an all-weather helicopter, having no blade ice protection system, no major problems were encountered down to about





ARTIFICIAL CLOUD PRODUCER is this test icing facility, left, constructed by the Canadian National Research Council at Uplands Royal Canadian Air Force Base, Ottawa, Ontario. At right, H-43B Huskie is almost obscured by whirling snow as it turns up preparatory to entering icy cloud at test rig.



H-43B ROTOR BLADE TESTING under icing conditions shows that reasonably even self-shedding takes place periodically. Due to the twisting action of the Huskie's blades, unshed, vibration-producing ice can be effectively removed by momentarily increasing cyclic control.

12°F. Ice formed on the blades all right, but as it built-up, reasonable even self-shedding took place periodically. During these cyclical build-ups, aircraft vibration level increased somewhat as would be expected, but heavy vibration was only encountered if the self-shedding took place unevenly, leaving unequal amounts of ice on opposing blades. Fortunately, due to the twisting action of the H-43B blades with cyclic inputs, it was found that this unshed ice could be effectively removed by applying increased cyclic control momentarily. The rigid mounting of the H-43B transmission and rotor system also minimized the effects of ice unbalance on helicopter vibration, rather then amplifying it as is the case with some flexibly mounted systems.

Below 12°F. flap ice formation became a problem. It had been determined that the ice adhered to a neoprene surface, like the flap leading edge, more firmly than to a stainless steel surface. In addition, flap ice formed unevenly, probably due in part to the flap's location behind the blade. These effects made the formation of flap ice unpredictable, and not prone to even self-shedding. The net result of this erratic flap performance under ice build-ups, was additional rotor vibration due to out of track, and reduced cyclic control sensitivity. Vibration levels were not so high as to cause structural concern, but they might be upsetting to the pilot, particularly if the cause were not clearly realized. From this standpoint, it is felt that unprotected flight in icing conditions below 12°F. should not be attempted unless absolutely necessary. Nevertheless, some form of flap protection alone would provide a significant improvement in the "Huskie's" icing flight capabilities. Along this line, Kaman Aircraft will evaluate several means of temporary flap protection during the coming winter.

While blade ice formations do not appreciably affect lift at normal angles of attack, drag is of course increased. Additional power required to hover the helicopter with maximum ice build-ups averaged about 75 H. P. This figure is, of course, well within the reserve power available in the H-43B for normal flight conditions, particularly in cold weather. However, extreme maneuvers should be avoided in any helicopter when in icing conditions due to the reduction in blade maximum lift coefficient as a result of ice formation.

The T-53 engine inlet is protected by its own automatic anti-icing system, but at no time during the Canadian tests was ice observed on the engine bellmouth or the bullet-nose. Rime ice build-up occurred on the inlet screen wires, thus removing much of the liquid water from the inlet air, while most of the remainder probably impinged on the bottom of the inlet plenum before it could make the turn into the engine. With the wide mesh screen, area reduction due to ice was never significant as far as engine air requirements were concerned, even after an hour's run in the cloud.

Ice of course formed on any protruding object, even rivet heads, but only one moving part restriction occurred. This involved a droop stop, and fortunately was not difficult to remedy. However, it did point up the necessity for particular vigilence, with respect to the operation of important components, when operating in icing conditions. Forward flight in ice will probably also result in bubble ice formation, so that the aircraft's defogging system should be in normal operating condition.

The experience and information gained during the Eglin and Ottawa tests of the H-43B has been extensive and valuable. Cold hangar operations after long, cold soaks with no pre-heat, and actual flight test in heavy icing conditions provided a severe and thorough evaluation of the aircraft's capabilities. The results of these tests have not only been used to make the "B" a better helicopter, they can be applied to other Kaman products as well, past and future. Thus, another important step in improving the utilization of Kaman helicopters has been made. So the next time you hear that "nothing can be done about the weather," remember that in the field of cold weather helicopter operations, something has been done. K

CURRENT CHANGES

FIELD INFORMATION DIGESTS (KAMAN)

Applies - H-43B	No. B-31, 18 November, 1960 Instructions for Removal and Repair or Replacement of H-43B Azimuth Stud Assembly.
Applies - H-43A	No. C-4, 10 November, 1960 Electronic Rotor Tracking, Installation and Operation Procedure.

AIRCRAFT SERVICE CHANGES (USN)

Applies - HOK-1 HUK-1	HOK/HUK ASC No. 82, 2 November, 1960 Furnishings, Modification of the Rescue Hoist Installation to Provide a Cable Tensioning Device. ROUTINE ACTION.

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The Air Force has chalked up another mark on its record of high-altitude, H-43B rescues in rugged terrain.

A mountain climber, injured after a fall, was successfully evacuated recently from an area near 10,000-foot-high Thousand Island Lake by Capts. Paul J. Balfe and Jim S. Honaker of the 6512 Test Group (Aircraft) at Edwards Air Force Base, Calif.

Captain Balfe was pilot, and Captain Honaker acted as co-pilot, on the flight to the lake which is northwest of Bishop, Calif.

T'WAS THE NIGHT!

'Twas the night before Christmas, along the flight line,
Not a 'copter was stirring, everything looked fine.
The pilots were sleeping, all set for the night,
With no visions at all, of the impending flight.

And at Ops, in the office so warm and bright,
The OD settled down, for a long, lonely night.
He glanced at the blizzard that stormed up outside
And thought, what a night for old Santa to ride.

His gaze touched the clock, hanging there on the wall,
And he said, "Well, it's midnight, Merry Christmas to all!"
When all of a sudden the phone began ringing.
He answered it wondering what news it was bringing.

"Is this local base rescue?" said a voice warm with cheer.
"This is Kris Kringle with a disabled reindeer."
He had just left the Pole on a southerly track,
With Rudolph the Red Nose ahead of the pack.

He whisked over Canada, shrouded in sleep,
Then stopped to refuel (because oats there were cheap.)
It wasn't until he crossed over the border,
That his troubles began causing all this disorder.

He was picked up on radar, a blip on the scope,
But with IFF out, he did not have much hope.
For then from below a Sidewinder rose,
And homed in dead center on Rudolph's red nose.

The Sidewinder hit with a terrible smash,
And Kris and his crew got all set for the crash.
He flipped over to guard, gave out a distress call,
Then dead-sticked it in fine, with no damage at all.

"Now you know why I'm calling," said he to the OD,
"I'm in great need of help, as you surely can see.
If you can assist me in delivering these gifts and these toys,
You'll be bringing much cheer to the girls and the boys."

"Just sit tight good Santa," said the smiling OD,
"And I'll break out the crew on the H-43B.
Ring out the alarm, and prepare for a flight,
We've got a real job on this dark Christmas night!"

Then the crew tumbled out and immediately were busy;
Their speed on that night would have made you feel dizzy.
Not a minute had passed, when the preflight was made,
And the aircraft sped off to give Santa Claus aid.

Then just as they landed, a figure appeared,
A short, fat fellow, with a bushy white beard.
"I'm sure glad to see you," he said with a smile.
"Hope you don't mind helping me out for a while.

"The toys must go through, come what may,
To put smiles on kids' faces on Christmas Day."
They transferred the load, from the sleigh to the ship,
Climbed in and took off on a Christmas Night's trip.

From roof top to roof top, they flew through the night,
And returned to the sleigh, by the dawn's early light.
Said Santa, "Poor Rudolph, but I really believe
He'll be back in commission by next Christmas Eve.

"We've delivered the toys, many thanks to you all;
If you ever need help, please give me a call.
I've had a fine time, and a wonderful flight,
Merry Christmas to all and to all a good night!"

JACK L. KING
Senior Field Service Representative