KAMAN Rotor Tips

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THE KAMAN AIRCRAFT CORPORATION

PIONEERS IN TURBINE POWERED HELICOPTERS

KAMAN

Rotor Tips

AUGUST, 1961

ADDRESS ALL INQUIRIES TO:
Kaman Rotor Tips
Field Service Department
The Kaman Aircraft Corp.
Old Windsor Rd.
Bloomfield, Connecticut

IN THIS ISSUE

THE COVER

HU2K-1 SEASPRITE speeds over Atlantic shoreline toward open sea during overwater flight test

— PLEASE SHARE THIS COPY —

ROTOR BLADE FIELD INSPECTION

by J. L. KING
Senior Field Service Representative; and
N. E. WARNER
Analyst, Dynamics;
Field Service Department

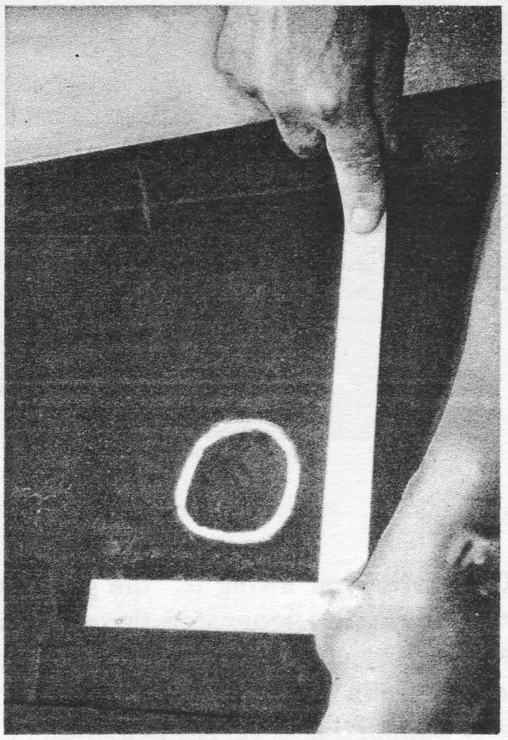
Today's helicopter rotor blades, whether constructed of wood, metal, fiberglas or some combination of these materials, are a far cry from those used on earlier models. Years of research based on information accumulated during millions of operational flight hours, improved manufacturing techniques and the development of new materials have produced blades able to withstand operating loads far in excess of those normally encountered throughout the full range of the flight envelope.

Blades now in use are designed to withstand at least three positive Gs—three times the maximum gross weight of the helicopter—at the very minimum. In other words, if the helicopter's gross weight is 9,000 pounds, the blades must be capable of supporting at least 27,000 pounds in flight. It should be fairly apparent, however, that a rotor system from a helicopter grossing out at 9,000 pounds couldn't be attached to a 27,000-pound trailer truck and then be expected to statically support the truck with cables attached to the outboard section of the blades. The odds are that the blades would buckle before the truck wheels left the ground, and yet, were these same blades rotating at operating RPM, they could structurally support the weight. Obviously then, there is a great difference, strengthwise, between a rotating blade and a blade which is at rest or static.

The reason for this difference can be illustrated with a few simple articles. Take a piece of string a couple of feet long and tie a weight to one end—a fairly large castellated nut will do. Holding the other end overhead, and being sure you have a clear area, start to swing the weighted end around in a flat circle. The faster you swing it, the greater the tension in the string generated through the centrifugal loading. The string, from the weighted end to your hand, becomes stiff and is capable of supporting a weight proportional to the velocity of rotation. Of course, a point is reached where the loading exceeds the strength of the string and it fails. If we stop the rotation, the weighted end hangs limp and its load-carrying capabilities in a horizontal plane have become null and void.

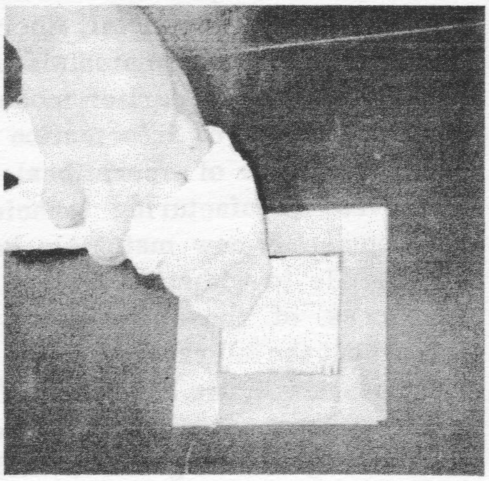
Though the helicopter rotor blade still retains a relative structural rigidity while at rest, it is in this position that the additional strength created through rotation is lacking and consequently the blade, due to its reduced strength, becomes more susceptible to damage. The primary effects of this result in increased skin tension and compression loading due to excessive flapwise bending. Improper tie-down procedures, sometimes coupled with gusty winds and just plain mishandling are usually the guilty culprits.

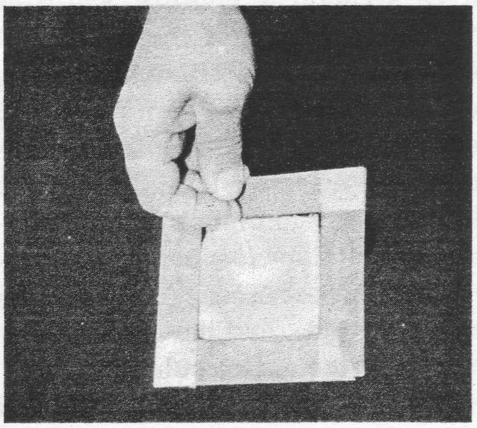
T.O. 1H-43B-2, T.O. 1H-43A-2, and AN 01-260HBA-2 contain information on proper ground handling of the rotor blades. Though all manufacturers set static bending limits on their individual blades, a good rule to follow with KAC synchropter rotor blades is to avoid static bending in excess of six inches beyond the droop attitude. In the event the blades are subjected to bending loads in excess of this, a thorough inspection should be made. If an area exhibits suspicious surface irregularities, use the following information as a guide to insure a thorough inspection. REMEMBER—they're your blades and the integrity of the helicopter depends on you.



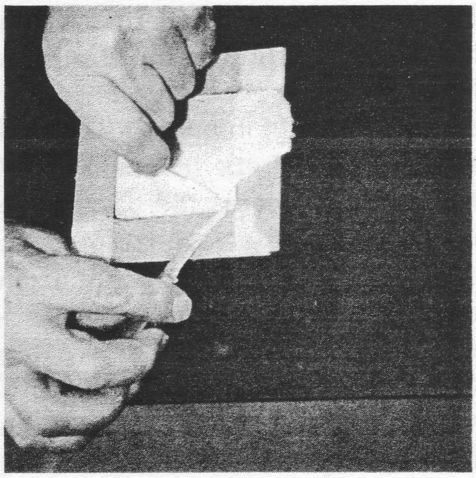
1 If an aircraft inspector finds a surface indication which requires further investigation, the area should be circled as shown and penetrant inspected in accordance with instructions in T.O. 1H-43A-3, T.O. 1H-43B-3 or AN01-260HB-3. If the penetrant inspection shows a flaw, the area should be sanded lightly with 400 or 600 grit sandpaper and inspected once more. Should the sanding fail to remove the indications, the next step is to mask off the area with acetate fiber tape keeping at least one inch away from the indications.

2 Using a cloth dampened in lacquer thinner (Fed. Spec. TT-T-266), wash the fabric within the masked area to remove all finish. Use extreme care that thinner doesn't drip on other areas of the blade. NOTE: Should the area be covered with fiberglas rather than fabric, proceed to step 6 after removal of the finish.

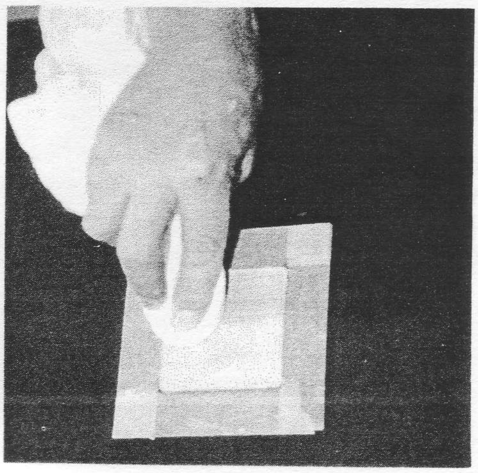




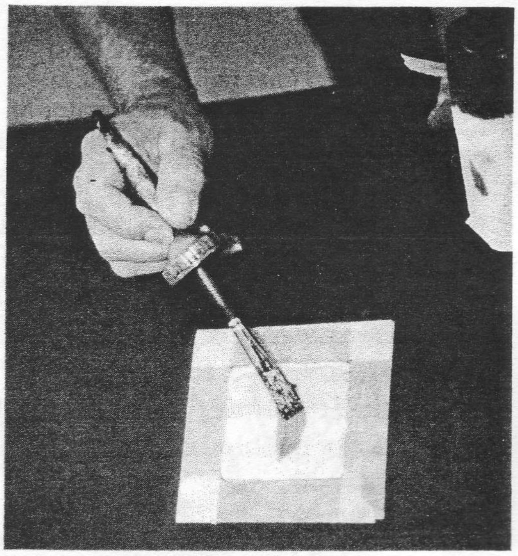
3 Keeping the exposed fabric damp with thinner, use a needle or straight pin and pick the center of the fabric from the plywood surface. (Note in the photograph the light circle in the center indicating the area where the fabric has been raised from the plywood.) Do not scratch or penetrate the wood with the pin or needle. Once the fabric has been released from the wood it may be cut without danger of damaging the plywood grain. Use thinner to loosen the bond between the fabric and the wood, and cut the fabric until the wood in the masked-off area is exposed.



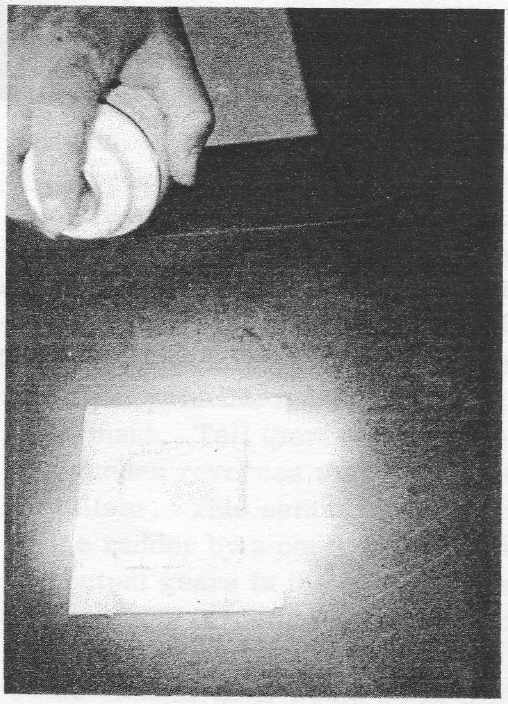
4 Holding the loose fabric perpendicular to the blade surface, use a sharp knife and cut away all fabric within the masked-off area. Be careful not to touch the plywood skin with the knife as damage in certain areas could require replacement of the rotor blades. To be sure, hold the knife parallel to the blade surface and leave a small lip of fabric (1/8-inch) at the edge of the masking tape.



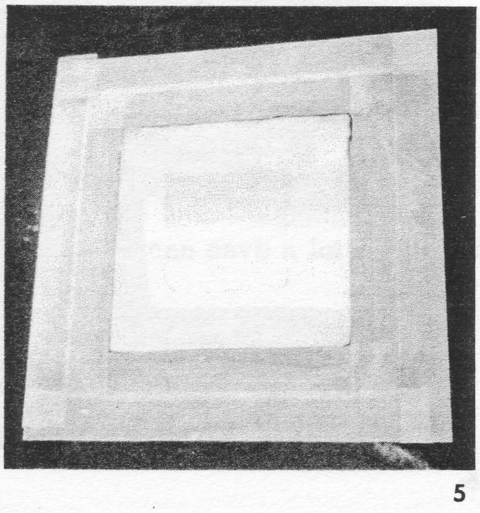
5 After the fabric is removed, wash the exposed wood with a cloth dampened with thinner. Repeat until all traces of dope are completely removed from the surface of the wood. Allow surface to dry before proceeding to the next step.



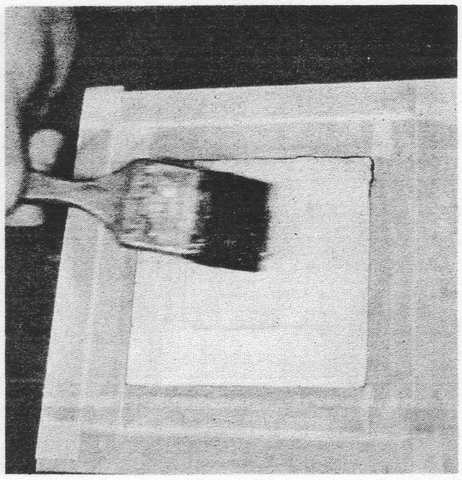
6 Dye penetrant inspection equipment, which consists of dye penetrant, dye penetrant remover and dye penetrant developer, is again required at this point to reveal otherwise invisible flaws. The dye penetrant should be applied to the suspect area with a small brush and immediately removed using a cloth dampened with dye penetrant remover. NOTE: If the area being checked is covered with fiberglas, removal time is not critical. Due to the porous nature of wood, the dye should not be allowed to remain on the wood any appreciable length of time.



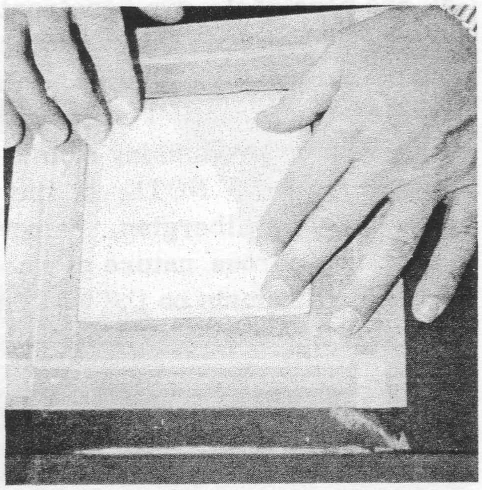
7 When the dye remover has evaporated, spray the developer on the surface. Inspect the blade for cracks or separation. Should the indication prove positive, refer to Air Force T. O. 1H-43A-3, 1H-43B-3 or the Navy Handbook of Structural Repair (AN01-260HB-3) for permissible repairs in the particular blade area affected. Should there still be doubt as to the integrity of the plywood skin or fiberglas, repeat the cleaning process and dye check again. A magnifying glass will assist in the investigation. When the indication is disproved and only when there is no doubt whatsoever, proceed to the next step.



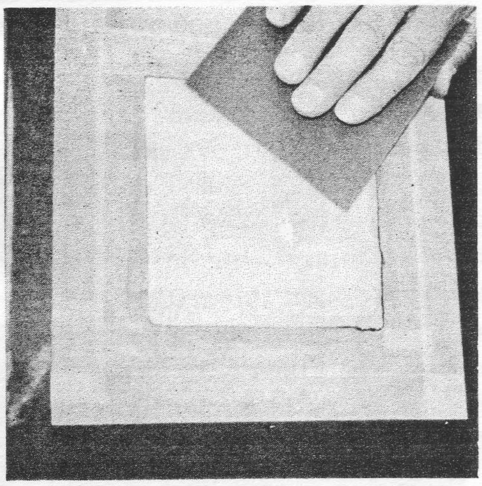
8 Remove the masking tape and remask the area 1 to 1-1/2 inches outside the exposed wood area. Remove the finish from the fabric, being careful not to "soak" the fabric as this may loosen the bond to the wood. Clean off all dye check developer. On fiberglas areas sand lightly and apply two finish coats of matching pigmented dope or lacquer and disregard the following steps.



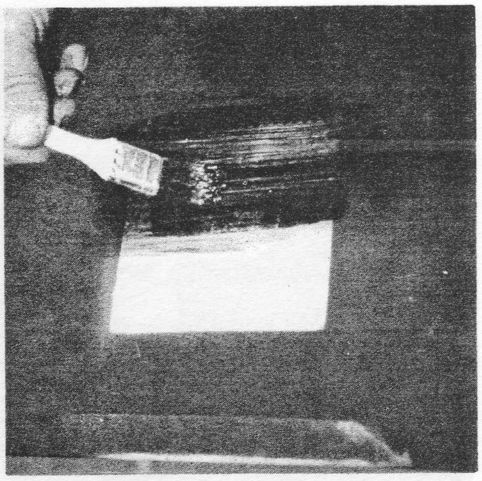
9 Apply three to four brush coats of clear nitrate dope, sanding lightly between coats with fine (320 grit) sandpaper. Use fairly heavy coats and allow each to dry thoroughly before sanding.



10 Cut a patch from balloon cloth (MIL-C-332, Type III, Class I) allowing a 3/4-inch minimum overlap. Be-sure the patch doesn't extend over the masking tape. Pink all edges or unravel the threads slightly. Holding the patch in place and using a clean cloth wet with thinner, soak the patch into the dope "bed" or surface, starting at the center and working toward the edges. Rub to remove all air bubbles and insure the contact of the patch to the plywood.

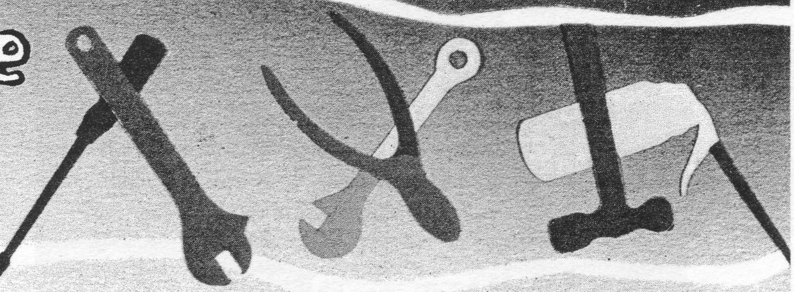


11 Apply two coats of clear dope over the patch and sand lightly with 320-grit sandpaper between coats. Remove the masking tape and lightly sand any ridges which may have built up. Apply a third coat and sand lightly.



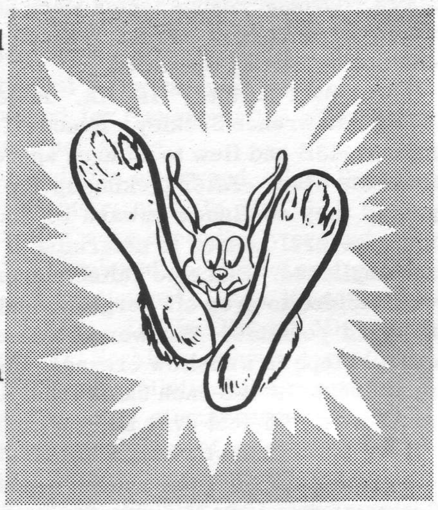
12 Apply two brush coats of matching color pigmented dope with light sanding between coats. A coat of wax after the paint is thoroughly dry completes the job.

Maintenance Mailbag



Dear Fitzy,

Glad to hear about the new baby, but isn't Percy Fitzhugh Williams the III a kinda' heavy load for him to carry through life? Anyway, congratulations. Speaking of kids, awhile back a "lost hunter type" we had picked up with the chopper stopped by with a present for Tommy—two rabbits. As a result of all this gratitude, I now have a beautiful shiner and two loose teeth. I tell you, being belted in the face by a boozed-up bunny is no joke. It happened when I stepped into the garage to check on the 30 or so rabbits which we accumulated since we got the first pair and it was like walking into a hairy snowstorm—the air was full of hurtling hares. Some were running around and around the walls, others were bouncing up and down like ping-pong balls and a constant stream of rabbits kept pouring down from the rafters. It was quite a sight! They all seemed to have a sorta' gay, abandoned "Live for today—tomorrow we may be in der hassenpfeffer" kind of attitude. I had just opened my mouth to holler when this bleary-eyed buck got me right in the face with both feet. I don't know what he'd stepped in, but it tasted real rotten whatever it was. Later, after I quieted them down with the garden hose, I found they'd been lapping up spillage from a case of old hair tonic I'd thrown in the trash. I felt sorry for them the next day though, they all had hangovers and I think some were beginning to grow hair in their stomachs.



Well, enough about the hapless hares. I hear you are getting H-43Bs at your base so be sure and pass the word to the boys to be careful during preflight when they check the rudder movement. Tell them not to move the rudder rapidly back and forth because the quick stops and sudden reverses may damage the output gear train in the rudder actuator mounted in the stabilizer. This actuator is part of the H-43Bs directional stability system and is connected to the rudder by a control rod. When the rudder is moved by hand during preflight inspection, the output gears in the actuator also move and begin turning. Suddenly moving the rudder in the opposite direction causes a sudden stoppage in the gear movement as it attempts to reverse its direction and damage may result. Nothing to worry about if the rudder is moved in the same manner as it would be in flight.

While I'm thinking about it. A good "rainy-day" project is to check the maintenance and other handbooks and make sure they are all up to date. Of course, the latest dope should be entered as it arrives, but a double check sure doesn't hurt any and it can save a lot of unnecessary work by all concerned.

Gotta' go, it's feeding time for our 84 rabbits.

Jim

TPR PROGRAM PAYS OFF

McCHORD AFB, WASH.... TRAIN, PREPARE, READY (TPR)—A few months ago the Rescue Section at McChord AFB received its first H-43B and immediately began a period of training and preparation in order to get the greatest possible utilization from the turbine-powered helicopter. How "ready" they were and how this training and preparation paid off may be judged by the following mission reports.

RESCUE MISSION REPORT NO. 1 (Unofficial) - 1st Lt. William Luther was notified by a county sheriff that a 46-year-old woman mountain climber had fallen 40 feet from a ledge on Mt. Baker and broken her right leg near the hip. She had been lying on the mountain nearly six hours. Ground rescue teams were standing by but, because of the rugged terrain, rescue would have been an extremely lengthy operation.

Lieutenant Luther, 1st Lt. Robert Michelsen and M/Sgt. Lawrence Seckley, Rescue Technician; took off in an H-43B and flew to an area approximately 75 miles from the base. After picking up the woman's son as a guide, they continued onward to the accident site and made several passes to determine if a landing could be accomplished. Since no suitable area was available, it was decided to drop off Sergeant Seckley to render any first aid possible. The woman was on the side of a 60-degree slope in a shallow crevasse under an overhanging rock ledge, a two-inch cable from an old mine was approximately 75-feet over her position.

Lieutenant Luther brought the H-43B to a hover over the snow field near the woman's position and Sergeant Seckley jumped into the snow from one of the helicopter's bear paws. He immediately began sliding on the hard crust, unable to get a foot hold. He slid 70 feet down the mountain whose sides continued downward for another 4,000 feet to the valley floor. Finally he managed to gain a hold, but could maintain his perilous position only by not moving. Lieutenant Michelsen then climbed over the left seat to the hoist operator's position. After several attempts and many tense minutes due to the gusty wind condition and the steep incline, Sergeant Seckley managed to catch the swinging hoist lowered to him and was lifted into the helicopter.

After making this hoist pickup, it now seemed there might be a possibility to hover up to the woman and hoist her out. The aircraft was slowly inched higher up the slope into the glacial crevasse with Lieutenant Michelsen clearing Lieutenant Luther on the left as to the nearness to the rock wall and Sergeant Seckley keeping him clear of the cable overhead. The helicopter was now in a position where it could not be maneuvered any higher because of the cable, or brought further forward because of the overhanging cliff. In this position the hoist was approximately seven feet from the woman's husband, who was with her, and he couldn't reach it.

Sergeant Seckley took a coil of the hoist cable, climbed onto the bear paw and swung the horse collar forward to the husband. The helicopter was now hovering with the blades approximately 18 to 20 inches above the overhanging cliff and 10 feet from the rock face on the left. Maintaining this hover was very difficult due to the turbulent winds blowing up and across the face of the cliff. Lieutenant Luther continually went from full left to full right rudder to hold his position at this 5,000-foot elevation.

After some difficulty, the woman was placed in the sling and Lieutenant Michelsen began slowly hoisting her up and out of the crevasse until it was noticed she

TRAIN AND PREPARE—Two H-43Bs from the McChord Rescue Section were used during a course on water survival in which 96 officers and airman from the 325th Fighter Wing and 22nd Air Refueling Squadron (SAC) participated. Helicopter crews included Lts. Keith Spencer, James Crocker, James Cantey, Wayne Ward, Robert Michelsen, William Luther and M/Sgt. Lawrence Seckley. Twenty-five cargo drops were also made from the H-43Bs during another exercise. (USAF photos) still had three climbing ropes tied around her waist and secured to the rocks above her. Unsuccessful attempts were made to attract the husband's attention, but he had begun to climb back up the mountain. Sergeant Seckley then crouched down on the bear paw and managed to cut the ropes. After getting her in the door, the chopper was slowly backed out from the cliff and slid under the cable to a clear area where a 180-degree turn could be made. She was then flown to Paine AFB and a waiting ambulance.

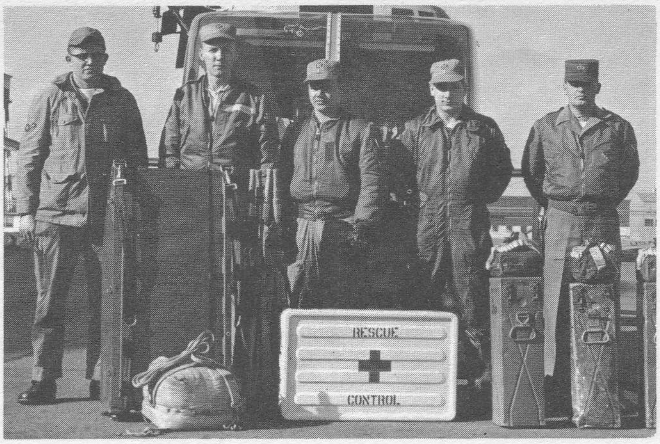
RESCUE MISSION REPORT NO. 2 (Unofficial) - An H-43B crew played a key role in survivor rescue after a C-124 Globemaster crashed two miles from the base shortly before 3 a.m. Lieutenants Luther and Michelsen and Sergeant Seckley, who were on call, manned the HUSKIE and flew to the site where the giant plane had crashed in heavily wooded terrain. Crewman T/Sgt. Samuel A. Mehling, Medical Technician; was also aboard as well as Lt. Col. Albert Keels, 325th Fighter Wing Deputy Commander for Operations. McChord was under IFR conditions at the time due to a layer of haze and ground fog.

The report reads: "When we reached the accident scene we looked for a suitable landing site, but were hampered by the low visibility which was intensified by hanging smoke from the aircraft fire. The wind condition was calm. The C-124 had crashed in a densely wooded area, setting fire to several trees which cast a pale light over the area. This light, together with the excellent landing and flood lights of the H-43B, aided us in finding a small clearing guarded by trees and power lines approximately 100 yards from the wreckage. A zero air-speed vertical approach was made into the confined area."

After the helicopter landed, Sergeant Seckley prepared two of the Army casualties for evacuation. They were loaded aboard the H-43B and a maximum performance, vertical takeoff was accomplished in order to clear the 100-foot trees surrounding the area. Sergeant Mehling remained behind to aid the other injured. The H-43B flew directly to nearby Madigan General Army Hospital. During the flight, the injured were given first aid by Sergeant Seckley.

After dispatching the injured personnel, the helicopter returned to the crash scene and accomplished another vertical approach with the aid of a spotlight on a ground

CONGRATULATIONS—H-43B crew which made night-time landing to pick up survivors are shown with John Elliott, KAC representative. Left to right are 1st Lt. William Luther, 1st Lt. Robert Michelsen, Elliott, M/Sgt. Lawrence Seckley and T/Sgt. Samuel A. Mehling. (USAF photo)



READY—Posing with their rescue equipment are A2/C Richard Horsch, 1st Lt. Robert Michelsen, 1st Lt. James Crocker, 1st Lt. Keith Spencer and M/Sgt. Lawrence Seckley. (USAF photo)

vehicle. The light was directed at the power lines bordering the clearing. After landing, the H-43B stood by for further evacuation. Three other casualties had been dispatched to the hospital a few minutes earlier. The helicopter was then used for transportation of supplies and equipment to the crash scene.

In a letter of commendation afterward, Col. Donovan F. Smith, Base Commander; said, in part, "All members of your organization were exceedingly prompt, cooperative and above all, displayed the highest professional competence.". . . . "I particularly wish to commend 1st Lt. William A. Luther, 1st Lt. Robert Michelsen and M/Sgt. Lawrence G. Seckley, rescue technician. Lt. Luther and Lt. Michelsen, pilots of the rescue helicopter, did an outstanding job of airmanship and displayed coolness and courage in the face of what appeared to be an impossible task of landing their helicopter adjacent to the wreckage area. M/Sgt. Seckley, as rescue specialist, did an outstanding job in assisting in this rescue operation."

The squadron received a similar letter from Lt. Col. Albert A. Keels, Jr., Deputy Commander, Operations; and congratulations were extended to Lieutenant Luther by Major Lowell D. Wilson, Squadron Commander.

RESCUE MISSION REPORT NO. 3 (Unofficial) - After notification that a T-33 had flamed out, McChord AFB dispatched an H-43B to the area to search for the two pilots who had bailed out. Lts. Luther and Michelsen and Sergeant Seckley again happened to be the ones on call at the time. Also aboard the helicopter was Colonel Keels. The Olympic Mountains separated the base from the crash scene and the pilots had to skirt the edge of the mountains to remain VFR under a heavy cloud deck. Icing conditions at higher altitudes prevented the H-43B from climbing and flying directly to the scene under radar control.

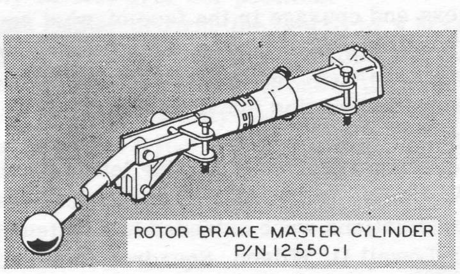
The HUSKIE flew 150 miles to reach the area and arrived two hours after takeoff. Contact was established with a Coast Guard helicopter and two fixed-wing aircraft from Port Angeles Naval Air Station which were circling one of the downed pilots. The H-43B then made an approach into a tree-stump area and landed on a dirt logging road. The downed pilot was helped to the stump area by a sheriff and logger and given first aid by Sergeant Seckley. The helicopter crew then flew the pilot to a civilian air field where the other T-33 pilot, also injured, had been taken by automobile. 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. WHAT TYPE OIL MAY BE SUBSTITUTED FOR THE TYPE "A" TRANSMISSION FLUID OR MIL-L-2104 GRADE 10 OR 30 USED IN THE CLUTCH? (Applies HOK-1, HUK-1, H-43A)

A. There is no approved substitute. The clutches used on the above aircraft were qualified using Type "A" transmission fluid or MIL-L-2104 grade 10 or 30. All attempts to use any other type of fluid has led to conditions which ultimately cause clutch malfunctions affecting engagements or disengagements. See T.O. 1H-43A-2 (H-43A) or AN-01-260HBA-2 (HOK-1, HUK-1). — C. W. J.



ROTOR BRAKE MASTER CYLINDER
P/N 12550-1

Q. WHAT IS ONE CAUSE OF A BINDING ROTOR BRAKE MASTER CYLINDER, P/N 12550-1, WHEN CHECKED AFTER INSTALLATION? (Applies H-43B)

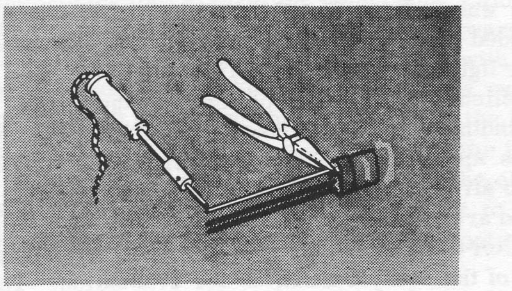
A. Overtorqueing of cylinder attaching bolts may cause binding. The rotor brake master cylinder can bind if the bolts attaching the master cylinder to the cabin structure are overtorqued. The squeeze on the lugs can distort the body of the cylinder and result in interference between the piston and cylinder walls. Care should be taken when installing a master cylinder to ensure that the standard torque of 50-70 pound-inches is not exceeded. — W. J. W.

Q. WHAT IS A PROBABLE CAUSE FOR FAILURE OF TACHOMETER GENERATOR, P/N MS28054-2? (Applies H-43B)

A. Field experience has shown that this tachometer generator is subject to failure due to vibration of its free lengths of internal lead wire. After a period of operating time this condition causes the wires to break where they are soldered to the tachometer generator's output plug.

The recommended method to prevent this condition from occurring is to tie the internal lead wires together with lacing cord. This action will minimize the effect of vibration on any individual wire.

This problem has been referred to the USAF for coordination with the instrument manufacturer. — W. H. Z.

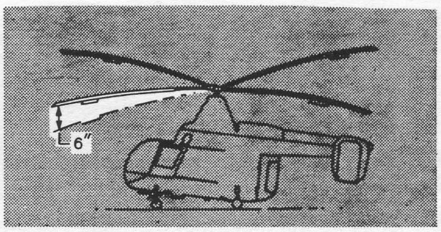


Q. ARE THERE ANY SPECIAL SERVICING TECHNIQUES REQUIRED FOR REMOVING OR REPLACING TRANSISTORS? (Applies HOK-1, HUK-1, H-43A, H-43B)

A. Yes. Since heat is one of the enemies of transistors, great care must be taken when installing or removing them with a soldering iron. The iron should be rated about 35 watts, and the soldering job should be done as quickly as possible. A ground lead should be connected from the iron tip to the equipment chassis to ground any leakage voltage from the iron. The transistor pigtail leads should be left as long as possible and long-nosed pliers should be employed to grip the pigtail tightly, and as closely as possible, to the body of the transistor until after the connection has completely cooled. The pliers will act as a heat sink to prevent the interior of the transistor from becoming hot. — M. W.

Q. WHAT STANDARD IS USED BY KAC IN DETERMINING WHEN CANNON PLUGS OR ELECTRICAL CONNECTORS MUST BE SAFETY WIRED? (Applies HOK-1, HUK-1, H-43A, H-43B)

A. KAC complies with specification MIL-20-5088 and T.O. 1-1A-14 or NAVAER 01-1A-505 when determining if an electrical connector must be safety wired. As required by specification, only those connectors in engine nacelles, areas of high vibration (excluding those on shock-mounted equipment), and in areas which are normally inaccessible for periodic maintenance inspection of the aircraft, require such a safety provision. — W. H. Z.



Q. TWO FIGURES ARE MENTIONED REGARDING ROTOR BLADE BENDING LIMITS. ONE PROVIDES THAT, DURING TIE-DOWN, THE BLADE SHOULD NOT BE DEFLECTED MORE THAN SIX INCHES BEYOND NORMAL DROOP; IN THE OTHER, 12 INCHES ARE SET FOR THE MAXIMUM. WHICH IS CORRECT? (Applies HOK-1, HUK-1, H-43A, H-43B)

A. The limit of blade deflection when mooring rotor blades has been established as six inches. This deflection is considered ideal for blade tie-down to best combat the strains imposed by gusty winds which may, in effect, cause an additional six-inch deflection. This information is covered by the Handbook of Maintenance Instructions, in Section I, under "Ground Handling."

The Flight Manual for some models specifies 12 inches as the bending limit. The stresses created by a pilot or crewman deflecting the blades 12 inches while preflighting are, theoretically, no greater than those created by gusts with the rotor blades moored at six inches. — N. E. W.

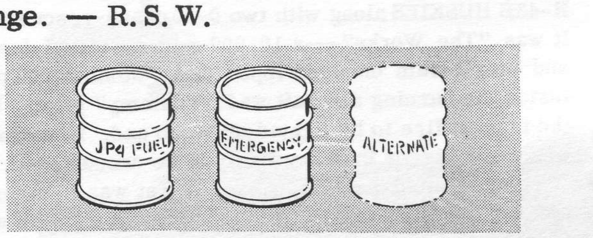
Q. WHAT IS THE LATEST TORQUE REQUIREMENT FOR THE INTERBOOM STRUT ATTACHING BOLTS? (Applies HOK-1, HUK-1, H-43A)

A. Recent reports of suspected overtorqued bolts at the center fin leading edge attaching clips have prompted the establishment of torque limitations for the attaching bolts. New torque values are:

(a) For the HOK/HUK models; at center fin clips, attaching nuts P/N AN365-428 should be torqued to 50-70 pounds-inch.

(b) For the HOK/HUK/H-43A models; at boom attaching fittings, nuts P/N NAS679A5 should be torqued to 80-90 pounds-inch.

Future handbook revisions will reflect this change. — R. S. W.



Q. WHAT IS THE ALTERNATE FUEL FOR THE H-43B? (Applies H-43B)

A. No fuel has been designated as an approved alternate. Use of other than JP-4 fuel is authorized only as an emergency requirement, as outlined in T.O. 42B1-1-14. Emergency fuels that can be used for a one-time flight only are: JP-5, aviation gas or automotive engine grade gasoline (white gas) which does not contain TCP. Whenever an emergency fuel has been placed in the fuel tanks a form notation is required to include the type, grade and name. Before the next flight, the fuel system will require complete draining and flushing. If any one of the emergency fuels is used less than two hours, draining and flushing is all that is required. A one-time flight of two hours or more may be made with AVgas 80/87 octane or unleaded automotive grade gasoline and requires only this follow-up action. If, however, any other emergency fuel is used on a flight in excess of two hours, then a complete hot section inspection will be required within 25 hours following the emergency flight. — A. A. W.

KAMAN SERVICE ENGINEERING SECTION—*R. J. Myer, Supervisor, Service Engineering; E. J. Polaski, G. S. Garte, Assistant Supervisors.* **ANALYSTS**—*R. A. Berg, A. D. Cutter, P. M. Cummings, P. A. Greco, C. W. Jenkins, G. M. Legault, J. McMahon, C. J. Nolin, A. Savard, W. J. Wagemaker, N. E. Warner, A. A. Werkheiser, M. Whitmore, Jr., R. S. Wynott, W. H. Zarling.*

Report From Webb Air Force Base

H-43Bs Team Up In Fire-Rescue Test

WEBB AFB, TEX., Office of Information.... Exercises at Webb AFB, have proved that two H-43B HUSKIES are "ten times" more effective than one in firefighting.

In clinching the effectiveness of the H-43 in aircraft firefighting and crash-rescue operations, demonstrations at Webb proved that no aircraft fire may be too large to be controlled by ground units (with the help of the downwash from helicopter rotors).

A series of routine fire exercises were conducted for this purpose and the final climax included the use of two H-43B HUSKIES along with two 0-10 crash-rescue trucks. It was "The Works"—a 10,000-pound spill of fuel, oil and magnesium on a stripped B-47 bomber. Trapped inside the burning aircraft was a "dummy" pilot. It was the biggest fire to be lighted at Webb and, in magnitude, was much bigger than any likely to be encountered.

The operation was two-phase. First was to determine the penetration the 0-10 fire truck could make in an inferno this size—with the help of helicopter ground sweeps.

As soon as the HUSKIE took position, the 0-10 was able to move to the wing root of the B-47. The cockpit was sprayed with foam and then the truck was withdrawn after 30 seconds. No heat was felt by the crewmen, they reported; and it was observed the hand linesmen could have gone into operation at that point. Also, someone from the aircraft could have jumped on the fire truck during the 30 seconds.

In Phase Two, one helicopter took position to the right of the aircraft and the other to its left, a few seconds apart. The fire was controlled immediately; simulated rescue was effected in 90 seconds; and the entire blaze (including magnesium) was put out in 7 minutes.

"The whole thing is fantastic," remarked Capt. Tom Seebo, OIC of the Helicopter Rescue Section. As far as controlling the fire is concerned, Captain Seebo observed, "Two choppers are 'ten times' more effective than one."

For Webb Fire Chief Peter J. Perring, "It was out of this world." In going all out with the "big fire," authorities were only testing the maximum capabilities of this type operation. The cooling effect of the helicopter's downwash is of tremendous importance, not only in crash rescue but in the ultimate saving of aircraft. In big fires, Chief Perring explained, the foam is usually "fried" against the fuselage. The downwash, he affirmed, renders the foam effective. Chief Perring stated that future fire fighting developments should employ a system not unlike the H-43B.

Since Webb became operational with the HUSKIE support system on April 22, over 30 practice fires and demonstrations have been conducted with complete success. Aircraft time has been used primarily for fire fighting and night operations. At one crash, the HUSKIE was used as a jack-of-all-trades: making rescues, firefighting, taking aerial photographs, searching for and locating a missing turbine wheel.

Rescue functions at Webb have been enhanced with the switch-over to the first ATC composite flying base to receive the HUSKIE. FIRE—the greatest hazard to pilots in aircraft crashes—is almost eliminated for on-base crashes or those occurring within a 10-mile radius of the base.

The six-man helicopter section is on alert during all scheduled student flying—day or night, and on 30 minutes notice at other times. Two firemen also pull alert duty with the section. The chopper crew includes Captain Seebo, 1st Lts. William F. Glover Jr., James L. Butera, Larry C. Evans, and 2nd Lt. Keith H. Ricks.

The five-man crew performing maintenance on the HUSKIES at Webb includes S/Sgt. Donald W. Haines, NCOIC; S/Sgt. Marx T. Richardson, crew chief; S/Sgt. John J. Rushford, S/Sgt. Marcus E. Russell, and S/Sgt. Morris L. Mixon.

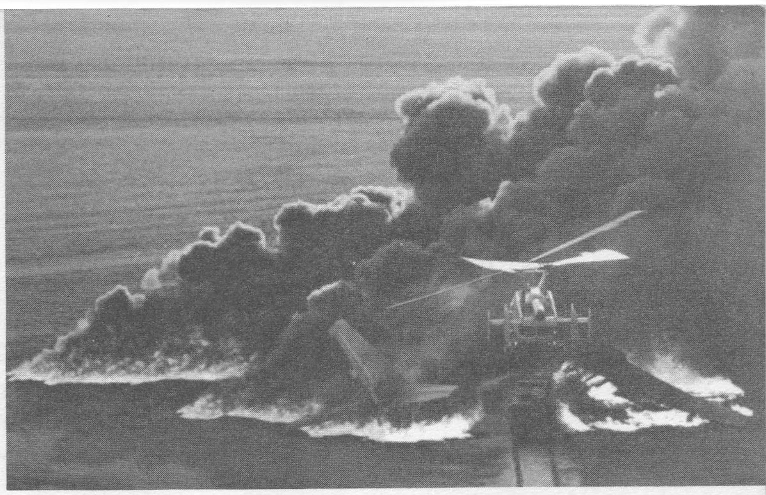
Six airmen from the Base Fire Department are assigned duties with the chopper section and pull alert duty in two-man shifts. They are: M/Sgt. Charles E. Robinson, T/Sgt. Dan W. Long, S/Sgt. Charles R. Hardy, S/Sgt. William R. Ford, A/1C Robert L. Duncan, and A/1C Elbert E. Hillhouse.

All civilian firemen at Webb are authorized to go on missions with the chopper. Two assistant Fire Chiefs—Lowell C. Duke and Billy J. Bowers—have attended the 2-week H-43B Crash-Rescue School at Stead AFB, Nev., and have been busy passing on the training to others here.

Knowing the HUSKIE support will be there if needed is a reassuring factor to the F-102 interceptor pilots, pilot training instructors, and students taking primary in the T-37 and basic in the T-33 at Webb.

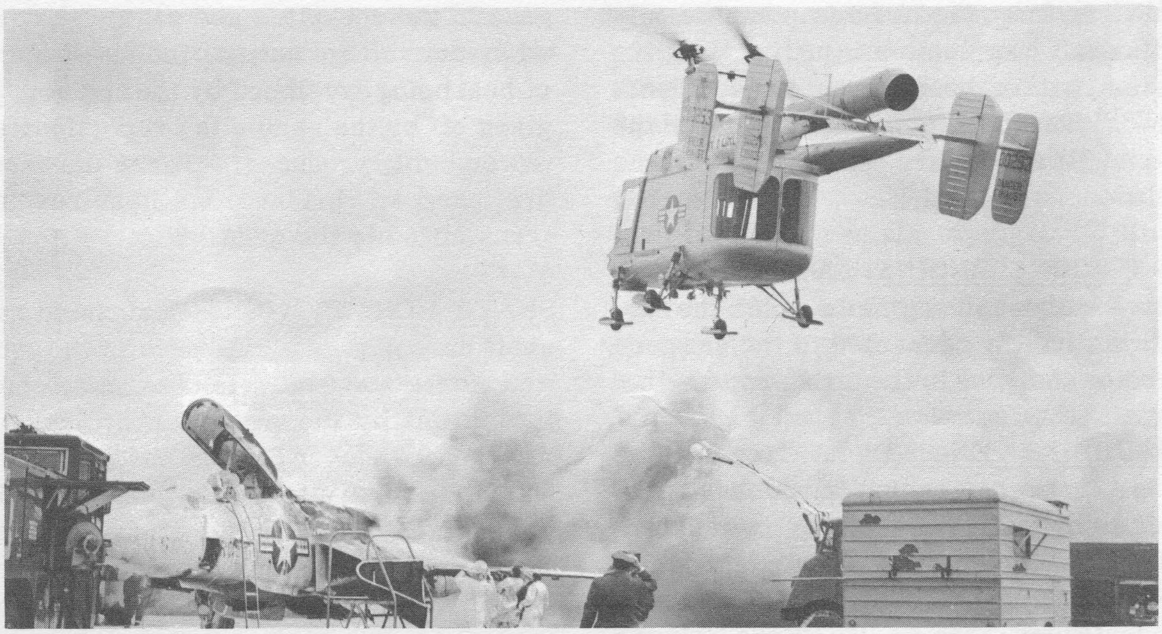
PHASE I—The H-43B is in position—the O-10 is to use ground sweeps and turrets to penetrate fire. Note the magnitude and intensity of the fire and that flames are being pushed down.

PHASE I—The O-10 using ground sweeps and turrets on stream penetrated immediately to wing root of B-47 and foamed the cockpit area. Fire has been going for 45 seconds. No attempt to rescue was made. Firemen could have used hand lines—made rescue from atop fuselage—or continued to use turrets. O-10 was withdrawn after 30 seconds in fire.



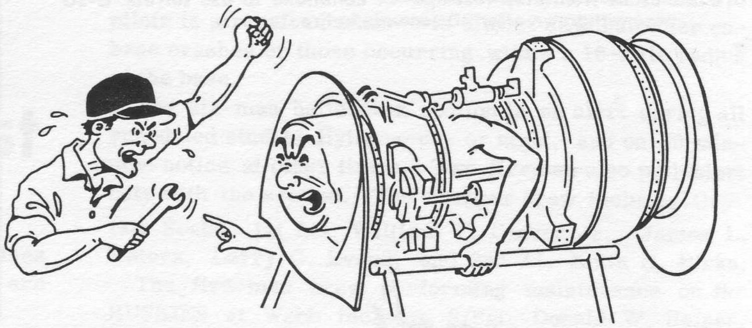
PHASE II—O-11 and O-10 move into fire on either side of tail. Second H-43 approaches position and immediately fire is controlled. Best procedure is helicopter into position first, thus allowing better penetration with fire trucks. Note how flames and smoke have dissipated. Time is two minutes thirty seconds from ignition. Aircraft was allowed to burn while photographer was let off second H-43. Pilots, Captain Seebo in 91559, Lt. Glover in 91560 on left. Note how turret stream is solid and aimed downward.

PHASE II—Time—one minute thirty seconds since start of Phase II. Thirteen firemen participated in this exercise. (USAF photos)



ON THE JOB—1st Lt. Gordon Hall, attached to the Rescue Section at Griffiss AFB, N.Y., was turning up an H-43B when an F-101 nearby caught fire during ground run-up. Quickly the lieutenant took off and, using the rotor downwash, aided ground firemen in controlling the blaze. (USAF photo)

TURBINE TALK



The introduction of the turbo-jet engine into the rotary-wing field has also introduced "jet-talk," a language with which many of our readers are probably already familiar. A refresher of basic physics terms in this issue will help to visualize how the principles are used in the turbine-jet engine. Questions from readers are always welcome.

TURBOJET ENGINE: A gas turbine engine which develops its thrust or power by passing the energy remaining, after turbine power extraction, through a jet nozzle.

TURBOPROP ENGINE: A gas turbine engine which is designed to produce shaft horsepower for driving a propeller. This is done by connecting the propeller shaft directly to the power turbine shaft by means of a speed reduction gear. Supplementary thrust may be produced as in the turbojet engine.

TURBOSHAFT ENGINE: A gas turbine engine which differs from the turboprop engine only in that its shaft horsepower is utilized to drive any system within the airframe other than a propeller. Turboshaft engines, found in the H-43B and HU2K-1, are used to power the rotor blades.

FIXED-TURBINE ENGINE: A fixed turbine engine is a turboshaft engine in which the output shaft is directly connected to the gas generator rotor shaft, as in the turboprop engine.

FREE-TURBINE ENGINE: A free-turbine engine is a turboshaft engine in which the output shaft is driven by a separate power turbine. This turbine shaft is mounted coaxially with the gas generator turbine, but rotates independently or free of it. Free turbine engines are used in both the H-43B and HU2K-1.

THERMOCOUPLE: A junction of two wires of unlike metals which, if subjected to heat, produces an electromotive force (voltage). When the free ends of the thermocouple wires are joined through a sensitive instrument to form a complete circuit, the instrument will then show the amount of heat being produced. The amount of voltage produced depends on the amount of heat applied. On the H-43B, three thermocouples resembling pencil-shaped probes, are located just aft of the power turbine wheel at different points in the exhaust stream coming from the turbine wheel. Leads from the thermocouples are connected to a gage in the cockpit. The gage, when activated by the voltage output, indicates the amount of heat being developed by the engine. The heat given off by the engine is proportionate to the power being produced. (Three thermocouples are used so that average heat readings are transmitted to the gage.)

SHAFT HORSEPOWER: Designated as SHP, shaft horsepower is delivered to the propeller or rotor blade shaft before being converted into thrust by the propeller or rotor blade. The gas producer drives the power turbine which, in turn, transmits this power through gears to the rotor shaft. The power delivered by the turbine is designated as horsepower but once it has been transmitted through the engine gear box, it is called shaft horsepower. The engine in the H-43B delivers 860 SHP.

DESIGN ASPECTS OF THE HU2K-1 FLOTATION HULL

by E. A. PALMISANO
Group Leader, HU2K-1
Structural Design

Design criteria for the HU2K-1 flotation hull were established with the prime objective of deriving an aircraft which will fulfill the stringent requirements of a high-speed, long-range, all-weather operational helicopter. Since the helicopter will operate over open seas under adverse conditions for the majority of its flight time, major consideration was given to its capabilities for an emergency water landing and for ditching.

The fuselage has a lower watertight compartment which provides the required buoyancy. The structure for this section is stressed to withstand landing loads; ditching loads have also been applied to the structure during test to assure sufficient strength to prevent any structural failure occurring on contact with the water. This provision allows adequate time for crew evacuation if necessary. The basic structure of the hull consists of aluminum frames on each side of a keel beam. The frames are spaced close together in the forward fuselage but the spacing is increased between them as they extend into the aft fuselage compartment. The aluminum keel beam is of constant depth in the forward and center fuselage but, as it goes aft from the main cabin, it tapers to the depth of the frames. All through-hull fittings are kept watertight with rubber seals or sealing compounds. When skin splices occur, they are overlapped, sealed, and secured with double rows of rivets.

HU2K-1'S WATERTIGHT COMPARTMENT and flotation gear are located in area indicated by broken white line.

The problem of draining water which might have collected in the hull from condensation was solved by adding several drain holes in the bottom of the helicopter which were located in such a manner that all compartments would be drained. Each hole was capped by a special valve-type retainer which allows the water to drain out but prevents it from entering when the helicopter is floating.

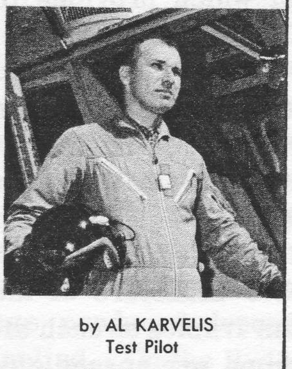
The volumetric distribution of the hull was designed to provide approximately a 4-degree nose-up trim in the water, thus keeping the cockpit floor clear and improving ease of egress for the crew. The main cabin provides a partial bulkhead at its aft end which would prevent any water, if it should enter the cabin, from going into the aft fuselage compartment.

An appreciable measure of rolling stability has been achieved by the addition of two inflatable rubber air-bag sponsons located one on each side of the forward fuselage opposite the cockpit openings. When not in use, the sponsons are stowed in the forward extension of the landing gear fairings. This arrangement provides positive lateral stability up to 30 degrees of roll and will enable the helicopter, which in addition also inherently possesses adequate lateral and longitudinal stability, to remain upright if ditched in moderate sea states. It will also be practical, under certain conditions, to actually effect an operational water landing, make minor repairs or adjustments, and then resume the flight. In instances where ditching must be made in sea states of such severity that capsizing is inevitable, the sponsons will keep the aircraft afloat to facilitate rescue of the occupants.

In summation, the HU2K-1 possesses good ditching capabilities and, because of its flotation hull, is capable of water operation in an emergency. K

Report FROM THE READY ROOM

THE HEART OF THE TURBINE ENGINE



by AL KARVELIS
Test Pilot

The CECO TA-1 fuel control used on the Lycoming T-53-L-1 in the H-43B is a compact unit which measures approximately 9 by 12 inches and consists of 850 parts. Proportionately, this is almost the same size and weight as the heart is to the body. Functionally the fuel control does the same thing—it pumps, meters and controls the life blood of the turbine.

To get maximum performance from a gas turbine engine, the fuel control must be in proper rig and adjustment. Once set, it is not advisable to "chase" the fuel control by making small adjustments because of climatic variations. The exception, of course, is when the helicopter has been transferred to a base at a different altitude and/or climatic conditions. Then, and only then, will a functional check and adjustment be required on a normally operating fuel control. At no time should anyone attempt to adjust a fuel control without consulting the T. O. 1H-43B-2 Maintenance Manual.

In this article I will outline the methods used at Kaman Aircraft in checking out the fuel control during the production flight testing of the H-43B, and trust this information will be of some aid to designated maintenance test pilots at bases where an engine or fuel control change has been made.

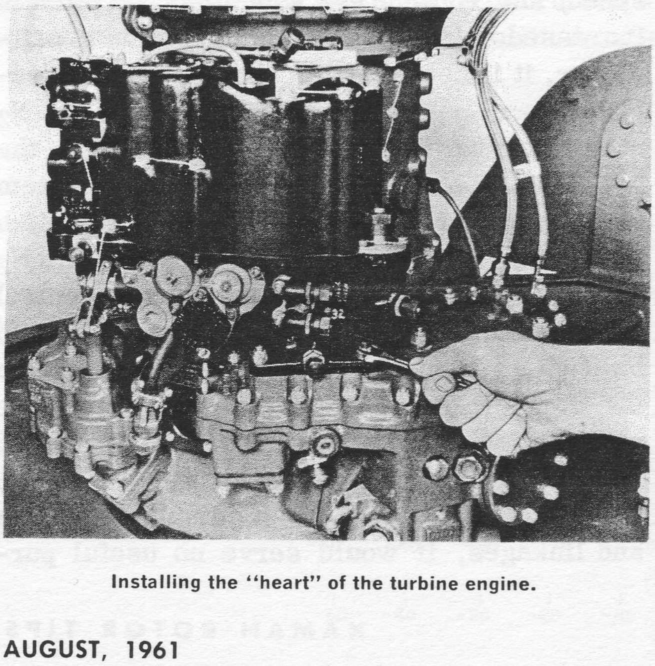
In this fuel control discussion we will have to assume that all throttle linkages and fuel control indexes are rigged to the -2 manual, as this in itself can throw off all cockpit-to-fuel control response.

GROUND IDLE: Before the first start of a newly installed engine or fuel control, make sure the rotor blades are unfolded and all obstacles and personnel are clear. There is a possibility of the ground-idle adjustment being high (44-48 percent), causing the rotor brake to slip. Should this occur, release the rotor brake. Allowing the rotors to turn with the rotor brake on will overheat the brake disc and cause excessive puck wear. There is no danger of damage to any other component of the turbine or helicopter in allowing it to run at a high ground-idle speed.

The desired ground-idle speed of 42 percent N_1 is recommended by the engine manufacturer as the lowest setting and still allow adequate acceleration time to military power. Kaman Aircraft limits the maximum ground idle to 43 percent, where there is no likelihood of rotor brake slippage with a satisfactorily functioning rotor brake. An important factor, when setting ground-idle RPM and rigging the twist grip, is to check at what point the turbine flames out during the rotation of the throttle from ground idle to cutoff. The rigging should be such that the flameout occurs during the last third of throttle rotation from ground idle to cutoff.

I find that a more consistent N_1 gas producer ground-idle speed reading is attained by waiting until the turbine has warmed up and all the temperatures stabilized and then approaching ground idle from the flight-idle position. It is not necessary to stop the rotors to take a reading as it will be the same whether the rotors are turning or stopped.

EMERGENCY CONTROL CHECK: The emergency control portion of the fuel control is given a functional check on the ground to test for proper operation of the solenoid valve and the fuel-metering system. To start the check, rotate the throttle to flight-idle position before actuating the switch to the emergency position, at which time a sudden drop off in N_1 RPM speed should occur. Exercise the throttle through the rotor speed range; acceleration and deceleration of the rotor speed should follow the throttle smoothly. Rotate the throttle to flight-idle position again and actuate the switch back to the "auto" position. Do not, and I repeat, do not purposely actuate the fuel control switch to the emergency position with the throttle in the full-open position. If this is done, it might cause a flameout, or the tail-pipe temperature and structural limitations may be exceeded by overspeeding the turbine, drive and rotor system since there is no automatic fuel governing while operating in emergency.



Installing the "heart" of the turbine engine.

An inadvertent actuation of the switch to emergency position while in the full-open position is readily discernible by the staccato-like bark of machine gun fire which is turbine stall. The quickest way to overcome this is to immediately rotate the throttle to the flight-idle position. A practice we had in the past in checking autorotation speed was to switch to emergency while in flight idle for a clean needle split. Considering the possibility of compressor stall, we reverted back to rotating the throttle toward ground idle, till a clean needle split was made, somewhere in the neighborhood of 50 percent N_1 speed. THIS SHOULD ONLY BE DONE DURING TEST FLIGHTS TO GET THE AUTOROTATION SPEED, AND SHOULD ONLY BE PERFORMED BY PILOTS WHO HAVE BEEN CHECKED OUT IN THE PROPER PROCEDURE.

Checking out the emergency system in the air is accomplished in much the same manner as you do on the ground (checkout on the ground first). Checkout in flight should be made over an area where a safe landing can be made in the event of a flameout.

Extreme care must be taken to avoid rotor overspeed while flying in the emergency position, as there is no compensating linkage from the collective nor any governor control. All rotor-speed control must be done with throttle rotation by the pilot. Sudden application of large amounts of throttle in the emergency position can cause compressor stall, over-temperatures, flameout, and/or rotor speeds over operating limits.

Although it is recommended that flying in the emergency position be restricted for test and proficiency purposes only, it should not be misconstrued that there is anything dangerous in flying the helicopter in the emergency position as far as the mechanics of the helicopter are concerned, when handled properly. The hazard is that the pilot becomes as accustomed to flying a turbine-powered, throttle-governed helicopter without need of throttle application, that he may overcontrol and, therefore, may exceed some of the limitations.

GOVERNOR STABILITY: During the process of checking out the fuel control, the N_2 or power-turbine governor should be checked out for stability. Here at Kaman Aircraft this is accomplished in the following manner:

In hover, approximately 10 feet from the ground, pump the collective at about 2 to 3 cycles per second through a range of 2 to 3 inches so as to get collective movement out of phase with governor lag. This will induce a surging through the drive system, causing a fluctuation in the N_2 governor and rotor tachometer, and might even cause the needles to split. Recovery can be made simply by stopping the collective motion. Should the oscillation become divergent, retarding the twist grip to a lower RPM than selected should correct this condition. If it persists, however, land immediately and retard the throttle to flight idle.

A normal functioning N_2 governor should stabilize in 3 to 7 seconds. Of course, an unstable governor should be replaced. Do not get rambunctious, or forget yourself and think you are "back at the old homestead pumping water from the well," for long strokes of the collective will induce excessive surging and give a false impression of governor instability.

Normally, it is not necessary to go to the emergency position if the governor becomes divergent in flight. This can be accomplished by rotating the throttle toward flight idle to get out of governed range followed by beeping to the full increase position. Rotor speed can then be controlled by throttle rotation as in the old-fashioned, reciprocating engine-type helicopters but with controlled rates of acceleration and deceleration. If this does not stabilize your rotor speed, then switch to emergency position on the fuel control switch.

MINIMUM AND MAXIMUM N_2: The N_2 governor has a growth characteristic that shows up on the initial runup of the aircraft when it has been shut down for several hours. This characteristic often prevents the pilot from obtaining rotor speeds greater than 103 percent for the first 3 to 5 minutes of governor operation.

Time to recover from this low rotor speed (103 percent) may be decreased by cycling the governor through its RPM range 3 or 4 times, using the beep actuator or by hovering the aircraft and operating the collective up and down several times.

It has been established by tests that this problem is peculiar to the CECO TA-1 governor. Present opinion is that this growth condition is caused by the fuel seeping out of the governor during long shutdown periods. Initial runups are therefore accomplished with the governor flyweights operating in portions of air. After a period of time, the air is worked out of the governor and the operation becomes normal. Immediate takeoff performance with up to 9000 pounds gross weight is not compromised by this short-time inability to obtain full rotor speed.

Before checking your maximum and minimum N_2 governor range, operate the engine for 10 or 15 minutes. Then, on the ground and with full down collective, check the full range of the governor. The desired maximum rotor RPM is 108 $\pm$ 1/2 percent and the minimum desired governor RPM is 87.5 +1 percent. If the check run shows the minimum rotor RPM to be above 90.5 percent or the maximum to be below 105 percent, the governor should be rerigged for the density altitude at the field from which the aircraft is being operated.

DROOP COMPENSATION: To get started in this discussion of droop and droop compensation, possibly a definition of the meaning of these terms, as used in the discussion of free turbines in helicopters, would be useful.

Droop is a drop off of N_2 (power-turbine speed) and rotor RPM as collective pitch is increased. (Although undesirable in a helicopter, it is necessary in the design of a free-turbine engine. Basically, droop in the N_2 compensating linkage is designed into the helicopter from the collective control system to the governor.) Increased collective pitch movement is immediately signaled to the N_2 governor, repositioning the governor control arm eliminating the lag and droop there would be if the governor waited for a signal from the N_2 turbine as it lost speed, that more power is required. Droop is not compensated for through the full collective travel range. Though it could be, through complicated cams and linkages, it would serve no useful purpose. It is compensated through the normal flight range up to 60 percent of collective travel. Rotor speeds in power ranges outside of these are easily adjusted for through the use of the RPM increase-decrease (beep) switch.

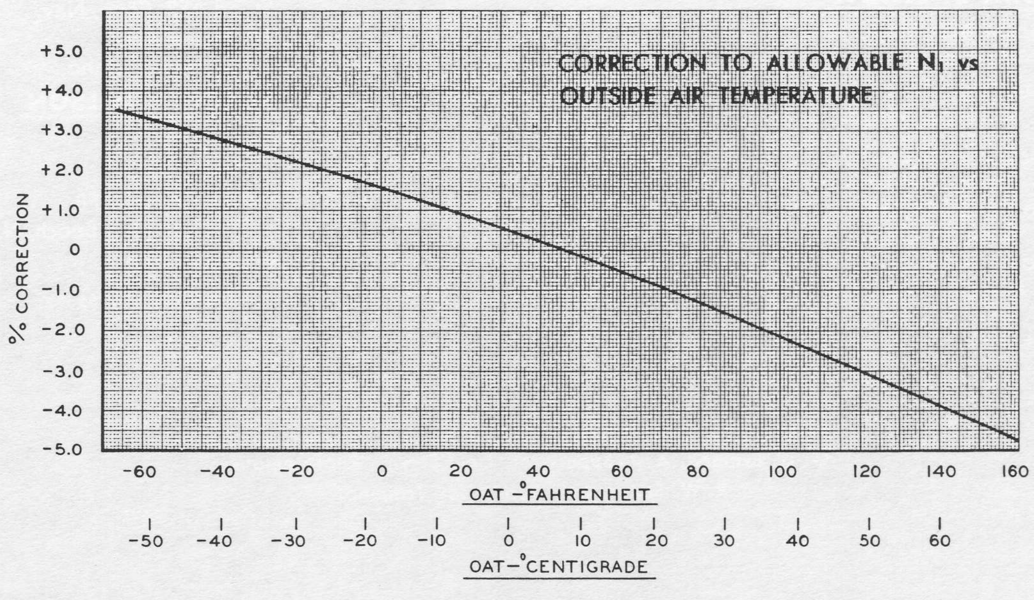
The check for proper compensation is easily made in the following manner: Set your torque at 20 PSI and rotor speed at 100 percent. Use any indicated airspeed from 0 to 70 knots. Maintaining a constant indicated airspeed, slowly add collective to 30 PSI. The rotor speed should have remained at a constant 100 percent without any tolerance. If the fuel control is overcompensated, the rotor speed will increase with added collective through the 20 to 30 PSI torque range; if undercompensated, the rotor speed will decrease through this same range. Readjustment per the T.O. 1H-43B-2 manual should be made if either condition exists and flight check again.

MAXIMUM N_1: The T-53-L-1 Lycoming gas turbine engine has a guaranteed military rating of 860 shaft horsepower. It is readily capable of developing more. To have this excess horsepower available at high altitudes, the N_1 or gas-producer turbine speed is adjusted to the "Do Not Exceed" RPM.

The "Do Not Exceed" N_1 or gas-producer speed varies from engine to engine. The controlling factor here is the T5 or gas-producer turbine inlet temperature which is 1610 degrees Fahrenheit. This "Do Not Exceed" speed is obtained from the Turbine Performance Rating Sheet packed with the engine, it is a referred speed and must be corrected for ambient temperature at the test altitude. Before making a max N_1 check, the "Do Not Exceed" speed must be obtained from the Turbine Performance Rating Sheet.

To make the check, it is necessary to climb to an altitude where the torque limitation of 37 PSI cannot be exceeded, which is in the neighborhood of 7500 feet density altitude. Climb at an airspeed of 50 to 60 knots at 104 percent N_2 and 37 PSI. When 104 percent N_2 cannot be maintained and the N_1 reading remains constant with increased collective, the engine has "topped out." At this point, take your N_1 and outside air temperature reading. From this information the amount of adjustment to the fuel control can be determined. During the climbout, if the outside air temperature is above 7 degrees Centigrade, the temperature correction chart should be referred to and the N_1 speed and outside air temperature should be monitored. The "Do Not Exceed" N_1 speed minus the temperature correction factor should not be exceeded.

Depending on the outside air temperature, you may have a plus or minus correction to the N_1 reading. Here at the factory the maximum N_1 speed is adjusted to 99 percent, regardless of the correction factor. For example, our "Do Not Exceed" speed is 97 percent, our temperature correction factor is plus (+) 3.0 percent, we adjust the fuel control for 99 percent, NOT 100 percent. For a minus (-) 3.0 percent correction factor with the referred "Do Not Exceed" speed of 97 percent, the adjustment would be made for 94 percent. If this speed deviates by more than minus (-) .2 to plus (+) .3 percent, a fuel control adjustment and retest is required.



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on field assignment

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