SAI KZ-IV
BY IVAN PETTIGREW
CONSTRUCTION NOTES

"SAI" stands for "Skandinavisk Aero Industri", the company in Denmark that built the KZ IV. The designers were Kramme and Zenthen, hence the "KZ."

The KZ-IV was designed as an air ambulance, and in addition to the flight crew of two, the plane could take two casualties on stretchers and two attendants. The KZ-IV was an all wood construction and only two were built. The first flight of OY-DIZ took place on May 4th, 1944, and OY-DZU´s first flight was on January 10th, 1949.

OY-DIZ was named "Folke Bernadotte" after the Swedish peace negotiator. He had used the plane as a courier plane, when he flew to Germany in 1945 to negotiate the release of Danish and Norwegian prisoners from concentration camps.

From 1964 the OY-DIZ was used by Aero-Kort in Dragør as a surveying plane. The aircraft was badly damaged in 1979, while making an emergency landing near Aarhus. After that the plane was donated to Danmark's Flymuseum by Aero-Kort. After a complete restoration to flying condition and in its original ambulance appearance, OY-DIZ is now the "flagship" of the museum's collection.

It is expected that the builder of this model will have previous experience in constructing build up models, so these instructions will not dwell on the obvious, but deal with the items of special interest. The greatest challenge in building this model is getting the tail surfaces right. Hooking up two rudders is always a challenge, and the dihedral on the stab does not simplify things. But the plane has character in the air, so patience in the construction stage will be rewarded with a very nice flying model.

FUSELAGE

The fuselage is a simple framed up box with bulkheads added to the top . First build the two sides of the fuselage over the shaded section of the plan, and join together. When this section of the fuselage is framed up, the bulkheads for the curved section on the top are added and sheeted with 1/16" balsa. The bottom section of the fuselage is also sheeted from the nose black back to the leading edge of the wing after the appropriate bulkheads are glued in place.

TAIL SURFACES

These are of conventional construction. In making these, it is recommended that the spars for each of the surfaces is made, shaped, and hinged, before starting assembly of the rest of the tail surfaces. There are aerodynamic advantages to having a symmetrical section in the tail surfaces, besides which, the resulting deeper spar gives added strength over a flat surface. The result is that the tail surfaces can be built very light, and are also less prone to warping. The horizontal stab and elevator have dihedral, so it is necessary to run separate control rods to the elevators. Start construction of the stab by building up the spar, then prop one half up while building the other part on the board. Continue likewise for the other half. If using lightweight nyrods for the tail surfaces, be sure to brace them at the stations in the rear of fuselage in order to keep them from bowing when pressure is applied. The linkage for operating the rudders is shown on the plans. Care is required in mounting the fins and giving sufficient clearance to the push rods where they pass through the tip rib of the stabilizer, at the same time leaving enough wood to prevent the structure being too weak.

WING CONSTRUCTION

The wing is built in one piece. The basic airfoil is a Selig 7055, but outboard of the aileron break it uses a NACA leading edge cuff to reduce tip stall tendencies. A full depth 3/32" sheet balsa spar is continuous throughout the wing The ribs are cut where they meet the main spar, and are butted to the front and rear surfaces of the spar. Cut the main spar from 3/32" sheet balsa and splice the pieces together over the plan. This sets the correct dihedral for the outer wing panels. Now glue the hardwood strips to the top and bottom edges of the spar as indicated. These strips should be bass or spruce.

Cut all the ribs in two at the point where they join the spar. Assemble just the rectangular (non tapered) section of the wing first. Pin the spar on its edge over the plan. It is easiest to start by gluing the rear part of each rib in place first, then attaching the trailing edge. Next glue the front part of each rib in place and then the first inner strip of 1/8" balsa which forms part of the leading edge. The outer strip of 3/16" sheet that completes the leading edge is not added until the sheeting has been applied to the top and bottom surfaces of the wing from the leading edge back to the main spar.

When the rectangular section of the wing has been assembled, one end is propped up a little so that the lower edge of the outboard section of the spar at the other end is flat on the work bench. That section of the wing (the tapered part) is now built in the same manner as the rectangular part, making provision of course for the aileron. An option here is to build the wing complete at first as if there were no ailerons, then cut the ailerons out later and complete the necessary construction to hinge them in place. When on outer wing panel is complete, the procedure is repeated to build the tapered outboard section at the other end

Sheeting is now applied to the lower surface only of the wing from the leading edge to the main spar. At this point the wiring should be installed for the motors. It will be noted that the wing is still not torsionally strong, meaning that it can easily be twisted. After the sheeting is applied to the upper surface of the same area, the wing will be very rigid and difficult to twist. Hence it is very important, when applying the sheeting to the upper surface, to weight that section of the wing down on a surface that is perfectly flat.

The sheeting of the upper surface is done in stages. First the flat parallel section of the wing is done, making sure there is no wash out. Next the inner part of the outboard sections is sheeted, but just from the start of the taper to the break in the leading edge (also the start of the ailerons). Again, there is no washout in this section. Finally the outboard parts of the outer wing panels are sheeted, and from the point of the leading edge break to the tip there should be 3/16" washout. After the top sheeting has been completed, the remaining strip of 3/16" sheet balsa that forms the point of the leading edge is now glued to the strip in place and contoured to shape. Finally sheeting is added to the centre section and areas of the engine bay.

ENGINE NACELLES, MOTOR MOUNTS AND UNDERCARRIAGE

The engine nacelles are built by first gluing the hardwood motor mounts in place, securing them firmly to the leading edge of the wing and bottom surface of the main spar. Then the strips of hardwood that locate the undercarriage should be attached. These pieces are numbered on the plan according to the sequence in which they are attached. They need to be glued very well with epoxy glue since they are subject to more stress than any other part of the airframe. Complete the construction and mounting of the undercarriage. Next the nacelle bulkheads are glued in place, and the nacelles planked with 1/16" sheet balsa. Notice that bulkhead N-1 at the front of the engine nacelle is cut from ¼" balsa, but the covering of the nacelle just comes to the mid point of that bulkhead. This leaves a 1/8 inch shoulder at the front of this bulkhead which serves for holding the cowling in place.

The engine cowlings are built in place with the motors installed. Before starting the construction of the cowling, two small pieces of hardwood are glued to the front surface of N-1, one at each side. These are for locating the #2 wood screws that hold the cowlings in place.

Next the nose blocks are made, but the hole for the propeller shaft should at this point be made just large enough for the nose block to be a snug fit over the prop adaptor. If the motors are mounted a little back from their correct location, the prop adaptor will hold the nose block in place while the cowlings are built. Afterwards the hole for the propeller shaft can be enlarged and the motors correctly located. With the nose block thus held in place by the propeller shaft, start making the cowls by cutting out the side panels of each cowling. These are attached to the hardwood blocks on N-1 with screws, and glued at the front to the nose block.

Next apply the top and bottom parts of the cowling, gluing these to the nose block and adjacent side panel sections, but not of course to N-1. When the glue is dry, take out the screws and remove the cowlings. Now the hole in the nose block for the propeller shaft can be enlarged to give adequate clearance. Before covering the cowlings, small washers should be made from 1/64 ply and placed under the heads of the #2 screws that hold the cowlings in place. If using the MP-Jet gearboxes as shown in the plans, be sure that the hose clamp that secures the motor is over the black plastic sleeve of the gearbox. This type of gearbox is not held to the motor with screws as is done with most other gearboxes, so it is important to have the hose clamp over the sleeve of the gearbox to keep it from separating from the motor.

CONTROL THROWS

The control throws are shown on the plan. Aileron differential will really help with aileron control at slower speeds, especially as on approach to landing. In order to provide for this, the aileron servo arm should be made as shown in the plan. This can be cut from the circular disk that comes with most servos.

BATTERY LOCATION

The battery pack that is shown in the plan is an approximate location. There is plenty of space for moving the packs forward or backwards to achieve the correct C of G location. The battery is secured to the platform with Velcro strips, but a back stop should be made so that it does not move backward under acceleration on a rough strip.

COVERING AND FINISHING

The prototype is covered with low temperature film. It is slightly lighter than high temp film, and less likely to shrink the balsa covering of the fuselage into undesirable hollow panels. The windows of the prototype are covered with clear monokote. This should be applied before the regular film covering.

FLYING

There is nothing unusual about flying this model. It is a delight to fly. On take off, apply power VERY slowly. If the grass is long, keep back pressure on the stick until the model is rolling. Otherwise a small amount of back pressure is all that is needed throughout the take off. Just apply about 25% power at first until the model is rolling straight, and rudder control is positive. Then slowly apply more power. Landings can be done with no power, but are more realistic, and safer under windy conditions if a little power is carried. A powered approach should be somewhat flatter, and power kept on through the flare. All landings should be three point at minimum speed. There is no fear of tip stall if the wing has the correct washout. If there is any indication of tip stall just prior to a full stall landing, a little more washout should be added to the wing that stalled. The prototype KZ IV model is quite aerobatic and does nice big loops, Cuban eights, and aileron rolls. Set up as shown on the plans, the model will not spin, so is very safe to operate at slow speed. It has never shown any tendency to tip stall, but this could change if the wing does not have the correct wash out. Other factors that could cause tip stall are having the C of G too far back, or too much elevator throw.

Final weights

Fuselage ready to fly, with radio, servos and ESC. 18 ounces
Wing ready to fly with motors and props. 34 ounces
Battery: Nine cell CP-1700 SCR 16 ounces
Flying weight 68 ounces

Good luck flying your KZ4.

SUMMARY

KZ-IV March 2006. Scale 1/7.8 Span 80 inches. Wing area 765 sq. in. Length 48 in. Airfoil: Selig 7055 with NACA leading edge cuff on outboard section. Flies on eight or nine cells. Weight with nine CP-1700 SCR nicads is 68 ounces for wing loading of 12.8 oz/sq.ft. Two Jamara Pro 480 HS BB motors wired parallel. MP-Jet Speed 400 gear boxes, 4.1:1 ratio drive 10 x 7 APC electric props. Static current draw with nine cells is 26 amps (13A each motor) giving 38 ounces thrust at 6,200 RPM. The KZ-4 is a lively performer and is quite aerobatic.

Ivan Pettigrew

Alternative Motors

Several of my earlier twins were designed to use Magnetic Mayhem motors in parallel, but those motors are no longer easy to find. In looking for alternative motors is was found that the Jamara Pro 480 HS BB and Permax 7.2 volt Speed 480 motors could give a similar performance as when using the Magnetic Mayhem motors. These Speed 480 motors are sometimes referred to as "long can speed 400" motors, but should not to be confused with the Graupner series of Speed 480 motors which have a different configuration and thicker shaft, apart from being quite a bit more expensive. If spending as much as is asked for the more expensive brushed motors, it may be better to think of going with brushless motors. They are not doubt the way of the future, but there are things to watch out for when using them in multi motor applications. For a start they should be operated from independent speed controllers. Then the aim should be to use the same size prop as recommended for the original model. A smaller diameter prop, or a prop of finer pitch, will not give the same efficiency as the scale size course pitch props that I recommend in most of my models. Often the better efficiency of a brushless motor is lost in the use of a smaller less efficient propeller.

My first experience with the 480 motors was in the Sealand 480 which uses the Jamara 480 BB motors. The performance was really impressive and I was immediately hooked on these motors. If you want to burn up the sky, the Sealand 480 out performs its big brother with its much heavier Magnetic Mayhem motors. Following the Sealand 480 experience I converted my model of the Albatross flying boat from Magnetic Mayhem motors to a pair of 7.2 volt Permax 480 motors using a 4.1 ratio gearbox and 12 x 8 props. I knew that power would be down, but countered against this was a considerable weight saving. The Speed 480 motor is 4 ounces lighter than a Magnetic Mayhem which means a saving of eight ounces in a twin. I wondered which factor would win out. The Albatross is considerably larger than the Sealand 480, and is not quite as lively with the Permax 480 motors.
Because of the weight saving by changing to the lighter 480 motor it can fly much slower and more scale like, and the slower landings are much nicer by far. The big difference however is the flight time. On an eight cell NiMH pack the endurance has gone from about 17 minutes to 28 minutes. There are some variables such as the number of cells, and whether or not the flux ring is left on the motor. With the flux ring removed the motor gives more power, but uses more current. The efficiency is not as good. Notice also that the prop sizes given are for APC Electric props. Other makes may give different loading, and APC SLO-Flyer props definitely draw much more current, giving a little more thrust, but resulting in a considerably lower pitch speed and shorter flight endurance.

If using the Permax 480 on a smaller model like the KZ-4, there will not be propeller clearance for the larger 12 x 8 prop. A lower gearbox ratio like 3:1 should be used with a 10 x 7 (or possibly 11 x 7) prop. Several offset BB gearboxes are available for Speed 400 motors at 3:1 such as the one that Tower Hobbies lists for $14.99. Because the shaft thickness and diameter of the motor can for the Jamara 480 and Permax 480 motors are the same as for Speed 400 motors, they use any Speed 400 gearbox. It is claimed by some that these Speed 480 motors can be run up to 170 watts input. In the applications given for the Sealand 480 and Albatross, the input is closer to 120 watts which is a conservative figure that results in better efficiency and longer motor life. The Permax motor has more turns than the Jamara, but of thinner wire. Hence if maximizing the performance, the Permax could be run on more cells than the Jamara, but the Jamara with its winding of thicker wire can take more amps. It would seem that the Permax 480 motors can be operated quite safely with up to 12 amps and 10 cells and the Jamara to 14 amps and 9 cells. If measuring the current at the battery when using these motors in parallel, the amp reading will of course be twice the figures given here for individual motors. I believe the efficiency of the Jamara motor is higher than that of the Permax.

. The Jamara motors are available from John Swain of www.fanfare.f9.co.uk at Eight Pound each. He sends overseas orders by airmail at a reasonable cost, and can supply the MP-Jet gearboxes and 3mm “long shaft” prop adaptors that are necessary with these gearboxes. Multiplex Permax 7.2 volt Speed 480 motors are available in the USA from Tower Hobbies for $9.50.

Any model listed as suitable for nine or 10 cells can be upgraded by using 3S Li-Poly battery packs. The weight saving will enhance the performance of the model considerably.