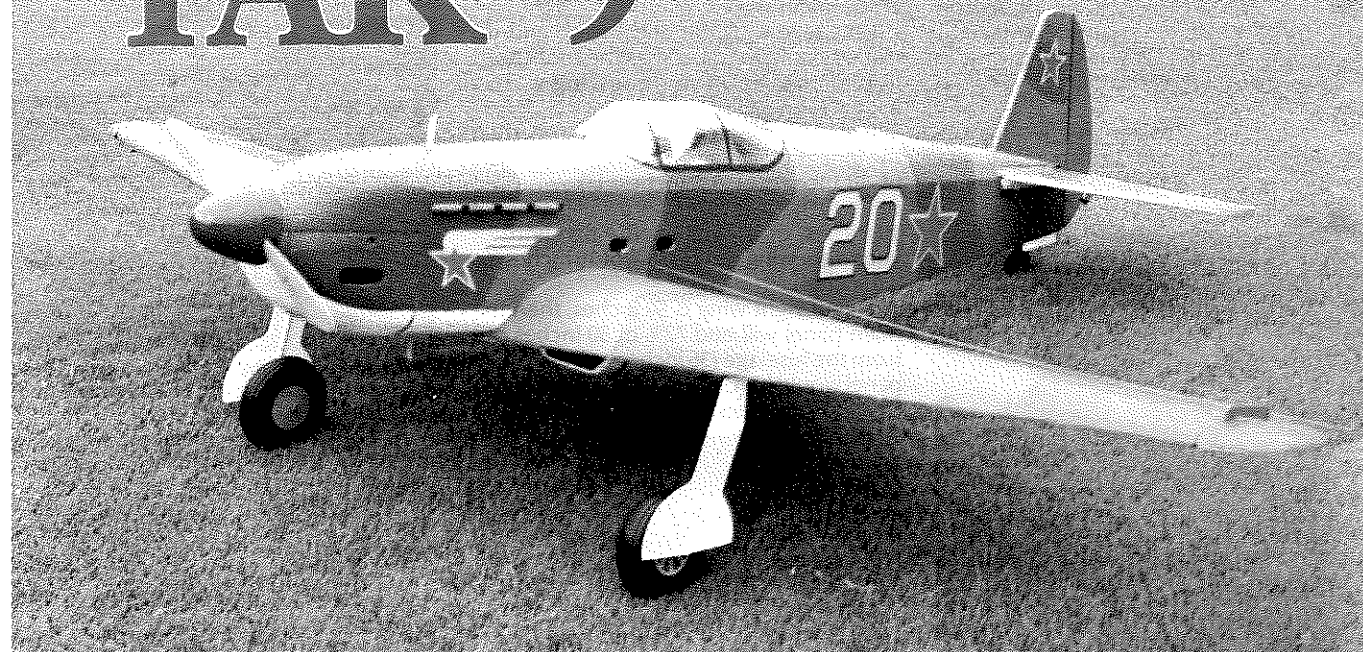


Cardboard control line!

By CHUCK FELTON

YAK 9



An extremely scale-like replica of the famous Russian WWII fighter, built almost entirely of corrugated cardboard, and presented by an acknowledged expert in cardboard construction. The model as presented here is designed for control line, but could also be built as an R/C ship with only a few minor changes.

• The Russian Yak 9 was one of the most popular and successful fighters of all time. Entering service just as World War II began, they continued to serve long after the war was over. They took part in the initial phase of the Korean War, fighting the P-51 Mustangs and F4U Corsairs, its one-time allies. The Yak 9 was built in larger numbers than any other Russian aircraft, and probably in the world, with the exception of the Bf 109. Because of the shortage of basic building materials, and being built under harsh winter conditions, the Yak 9 was crude compared to Western fighters, but extremely reliable. None of its opponents could match its speed or maneuverability below 15,000 feet, where the Eastern Front battles were usually fought.

Most versions of the Yak 9 were of mixed construction, including steel-framed for-

ward fuselage and wooden aft fuselage with plywood and fabric covering. Later versions had fuselages with welded steel tube frames. The wings had two metal mainspars with wooden ribs and a plywood skin. Control surfaces were fabric covered. The Yak 9 had considerable development potential and appeared in many variants, including a bomber with internal bomb-bay for 992 lbs. of bombs, a long range version with increased wing fuel capacity plus fuselage drop tanks, and anti-tank and anti-ship versions with 37 mm and 45 mm cannons firing through the propeller shaft.

The Yak 9 was simple, inexpensive and effective. The Yak 9 model presented here captures these same qualities by using 1/8-inch corrugated cardboard as the primary

building material, which greatly reduces both building time and cost. The design makes use of cardboard's unique features in that it can be used in large sections and can be folded. For instance, the wing is built of two large pieces of cardboard with cardboard ribs and a single spar. The tail surfaces and fuselage are primarily cardboard with little internal bracing. The result is a low cost, lightweight, fast building model that has good scalelike appearance and can take plenty of punishment at the flying field.

Cardboard varies in weight, but any 1/8-inch corrugated cardboard will do. Sources of this material include box manufacturers and local shopping centers where you can find stacks of discarded boxes. Also check

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the yellow pages for wholesale paper suppliers. Look for cardboard with brown paper on one side and a white finished paper on the other. The white paper on the outside of the model results in a smoother finish and neater appearance. The method of folding the cardboard and the use of gummed paper tape to seal the joints and exposed corrugations is explained in the construction hints.

The model is built to a scale of 1-3/4 inches to the foot, resulting in a wingspan of 60 inches and a length of 52 inches. The bottom of the airfoil is flat with a curved upper surface, due to the scoring and folding technique employed. Engines of .30 to .40 size can be used. Its size and stability make it a good sport flying model.

CONSTRUCTION HINTS: Before we begin, take a look at these special tips for working with cardboard.

GLUE: Water base glue, such as white glue or Titebond, is recommended. Contact cement is not recommended, as parts cannot be shifted when gluing surfaces.

FOLDING: The scoring of the fold lines is done with a screening tool available at any hardware store. It consists of a handle with a 1-1/2 inch radius wheel at one end, which is run along a straightedge on the fold line.

WATERPROOFING: Waterproofing of cardboard is quite simple and can be done to the raw material before you cut out the parts of the model. Simply mix 25% clear polyurethane with 75% paint thinner. The latter can be the cheapest hardware store variety, which is thoroughly mixed with the clear polyurethane. Brush the mixture liberally onto the cardboard sheet and allow to dry for 48 hours. This adds no appreciable weight to the material and renders the cardboard completely waterproof. In addition, when you start to cut the treated cardboard, you will find that it is as crisp as wood and cuts sharply and cleanly.

FINISHING: Cardboard gives a solid surface with no open areas to cover and is non-porous. The easiest finishing method is to put on two coats of clear dope, sanding lightly between coats with #400 sandpaper, followed by three coats of color dope. However, a wide variety of finishing materials may be used on the cardboard. Coverings such as Solarfilm, MonoKote and vinyl paper can be used. With any of these, it is recommended that the surface not be doped, which will result in a better bond.

PAPER TAPE: All seams, joints and exposed edges of the model are covered with strips of gummed paper tape. Obtain a one inch wide roll from a stationary store. Simply cut a thin strip to length, dip it in water and smooth it over the seam.

CONSTRUCTION: Cut out all cardboard and wood parts using the template outlines. Be sure to note the direction of the corrugations. Score and fold cardboard parts as indicated on the plans.

EMPENNAGE: The fin, rudder, stabilizer, and elevator are each made from two pieces of 1/8-inch cardboard laminated together crossgrain to give 1/4-inch thick surfaces. Add a 1/8 x 1/4-inch balsa strip to

the fin leading edge and round off. Add 1/8 x 1/4-inch balsa strips to the stabilizer leading and trailing edges and round off. Glue the elevators to the 1/4-inch dowel. Add 1/8 x 1/4-inch balsa strips to the remainder of the elevator leading edge and round off. Seal all raw edges with gummed paper tape. Hinge the elevators to the stabilizer with cloth hinges at four places.

WING: Make the wing spar by capping each 1/4-inch balsa spar half with a 1/4 x 1/4-inch spruce strip top and bottom. Join the spar halves together with 1/8-inch ply joiners front and rear at the centerline. Glue the 1/8-inch ply gear mount into each wing panel. Glue the right side of the wing spar onto the right-hand wing panel. Glue all cardboard ribs into the right wing. Add a cardboard doubler over the ply gear mount between ribs W3 and W4. Glue a one ounce weight to the right wing tip.

Glue the left wing panel to the left spar in a similar fashion. Add the ribs and gear doubler to the left wing. Apply glue to the top of the wing spar, the top of the ribs and the trailing edge of the wing. Fold the top wing surface down and pin securely in place until dry. Add the balsa tips to the wing. Make a line guide from 1/8-inch ply. Cut a slot in the left wing balsa tip and glue the line guide in place. Cover the trailing edge and all seams with gummed paper tape.

FUSELAGE: The fuselage sides are outlined with a triangular symbol on the drawing. Line the upper and lower edges of each fuselage side with 1/8 x 1/4-inch balsa strips, as shown in the fuselage side view. The strips are recessed 1/8 inch from the fuselage edges. Bevel the strips at the aft end of the fuselage so that the cardboard sides will come together. Add cardboard supports to each fuselage side above the fuel tank and below the bellcrank.

Make the firewall, C1, from 1/4-inch ply. Locate the mounting holes for a KM-40 motor mount on the face of C1. Drill the mounting holes and install blind mounting nuts on the back side of C1. Drill a hole in C1 for a fuel tubing exit. Line all four back edges of C1 with 1/2-inch triangular balsa for bracing.

Glue C1 to the right side of the fuselage. When dry, glue the left side of the fuselage to C1. Attach the fuel tank to the 1/8-inch ply support. The fuel tank may be attached to the support with rubber bands. Make a pushrod from 3/32-inch wire and 1/4-square spruce and attach it to the bellcrank along with the leadout wires. Install the tank and bellcrank assemblies by gluing the ply supports to the cardboard supports on the sides of the fuselage. Glue the fuselage sides together at the tail. Glue F1 and F2 in place to cover the top fuselage. Be sure to bring fuel tubing fill and overflow lines out during all covering operations. Cover the bottom fuselage with F3, F4, F5, and F6.

Add bulkheads A through H to the top fuselage, adding 1/8 x 1/4-inch stringers. Cover bulkheads A through D with D1, which has been scored and folded. Cover bulkheads D and E with D2. Cover bulk-

heads E through H with D3. Add the three J bulkheads, with stringer, to the forward bottom fuselage and cover with D4.

The cowl is built-up from 1/2-inch balsa sheet as shown in the top and side views, and hollowed out. The top half has the 1/4-inch ply C2 glued to the front. The removable bottom half of the cowl has C3 glued to the front end. Sand, carve, and hollow the cowl to shape. Eighth-inch ply pieces are added to the inside of both the top and bottom halves at the cowl sides, as shown in the cowl top and side views. A blind nut installed on the inside of the top cowl ply and a 4-40 bolt through the bottom cowl ply form the cowl attach. The top half of the cowl is then permanently glued to the nose of the model. Test fit the engine in the cowl and drill mounting holes in the KM-40 mount. Use a shaft extension to give adequate spinner clearance. Cut holes in the cowl block for the cylinder head, exhaust and needle valve. Apply epoxy to the inside of cowl and front of firewall.

Glue the stabilizer to the fuselage. Add 1/2-inch triangular balsa to bottom of horizontal at fuselage intersection for bracing. Glue the fin to the fuselage. Add scrap balsa bracing between fin and stabilizer intersection and round off as shown in view C-C. Add the rudder to the fin with the trailing edge offset 1/2 inch to the outside of the flying circle.

Make the tailwheel gear from 3/32-inch diameter wire. Bend as shown, place on the 1/8-inch ply support, wrap with nylon thread and smear thread with glue. When dry, glue in place in the bottom fuselage cutout. Add scrap balsa wheel fairings. Make the main gear from 5/32-inch diameter wire as shown. Make gear fairings from 1/8-inch ply and attach to the gear with nylon gear clips. Attach the gear assemblies to the 1/8-inch ply supports in the bottom of the wing with nylon gear clips.

FINISHING: Now is the time to paint and trim the the model before final assembly. The color scheme is camouflage green and brown on the top surfaces with white undersurface. The lettering and insignia are made from Monokote. Make the canopy from thin plastic and epoxy to the fuselage. Outline the canopy with strips of black MonoKote. The aileron and flap outlines are also made of black MonoKote.

FINAL ASSEMBLY: Glue the wing to the fuselage. Make the airscoop from 1/4-inch balsa and glue to the bottom of the wing. Add balsa exhaust stacks to both sides of forward fuselage. Pass the leadout wires through the wingtip line guide and tie off. Attach the nylon control horn to the elevator and hookup the pushrod. Attach 3-3/4 inch diameter wheels to the main gear and a 1-1/2 inch diameter wheel to the tail gear. Attach a 11-6 prop and a 2-3/4 inch spinner to the engine. Your ship is now complete. Be sure to balance the model at the point shown on the plans.

If you have any comments, suggestions or questions concerning the cardboard Yak 9, please write to me at the following address: Chuck Felton, 19009 Laurel Park Road, Space 86, Compton, CA 90220. (213) 639-2711.