RYAN NAVION
Designed By: Walter A. Musciano

TYPE AIRCRAFT
Stand-Off Scale
(2" = 1')
WINGSPAN
67½ Inches
WING CHORD
Root 14¼", Tip 8"
TOTAL WING AREA
660 Sq. In.
WING LOCATION
Low Wing
AIRFOIL
Semi-Symmetrical
WING PLANFORM
Double Taper
DIHEDRAL EACH TIP
4¾ Inches
O.A. FUSELAGE LENGTH
54½ Inches
RADIO COMPARTMENT SIZE
Various
STABILIZER SPAN
27 Inches
STABILIZER CHORD (incl. elev.)
6¾" (Avg.)
STABILIZER AREA
178 Square Inches
STAB AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Top of Fuselage
VERTICAL FIN HEIGHT
8½ Inches
VERT. FIN WIDTH (incl. rud)
6½" (Avg.)
REC. ENGINE SIZE
.40-.60
FUEL TANK SIZE
6 Ounces
LANDING GEAR
Tricycle
REC. NO. OF CHANNELS
5
CONTROL FUNCTIONS
Rud., Elev., Ail., Throt.,
Nose Wheel

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa & Ply
Wing	Balsa & Ply
Empennage	Balsa & Ply
Wt. Ready To Fly	**144 Oz.**
Wing Loading	**31.4 Oz./Sq. Ft.**

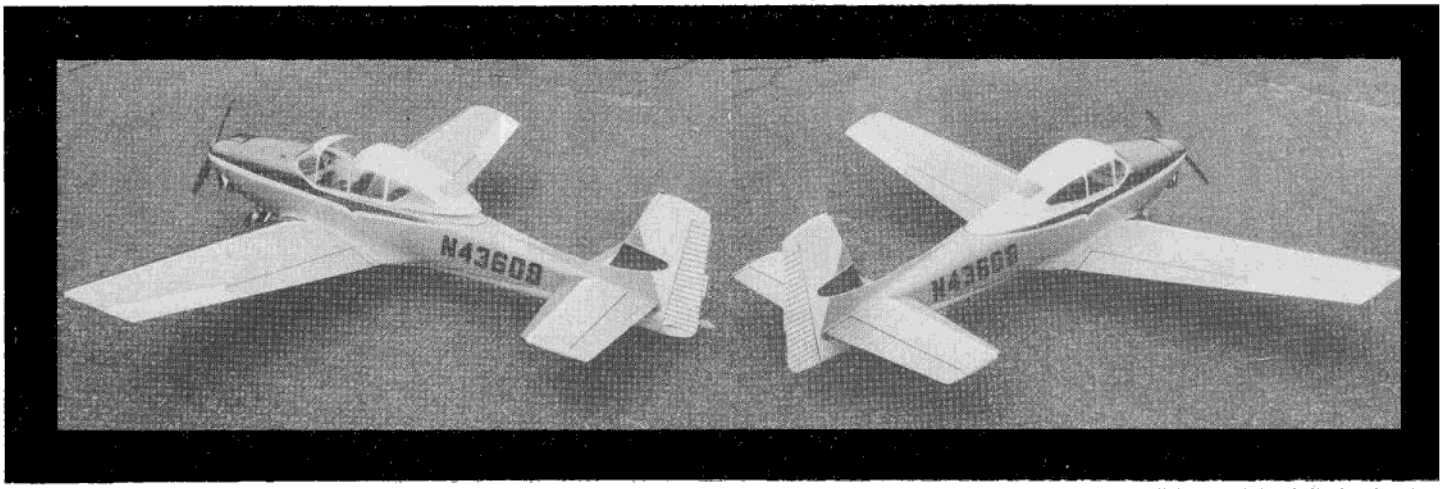
THE CLASSIC RYAN NAVION

By Walter A. Musciano

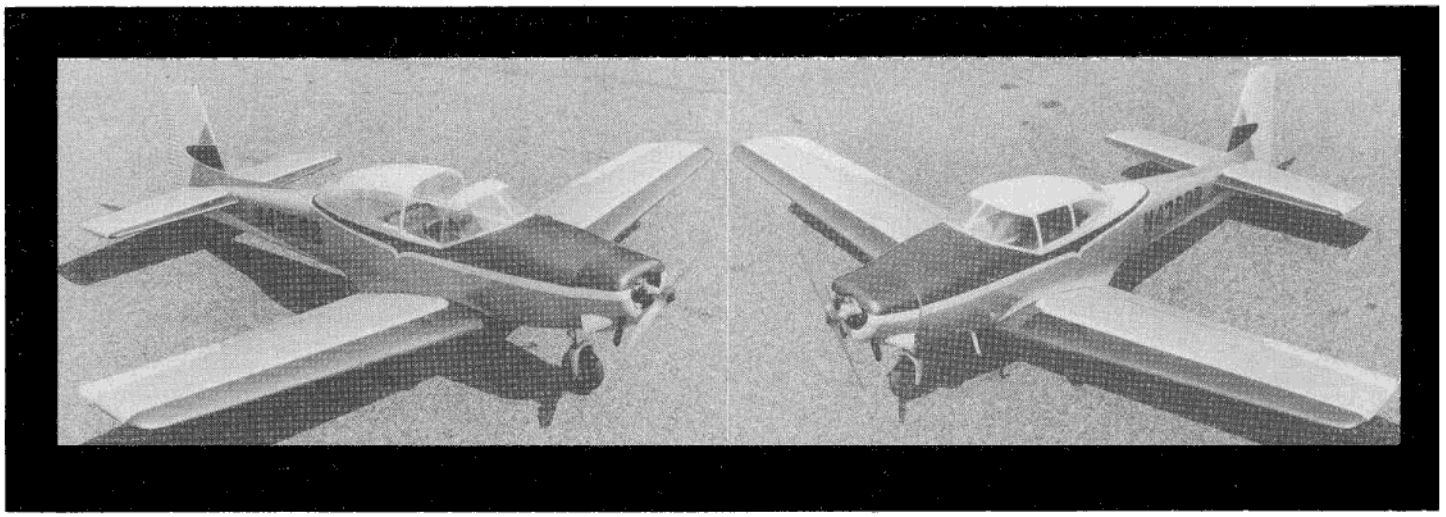
Part Two

The Full-Size Navion has always been a fascinating model project and, after years of procrastination, we finally developed a 2 inch to the foot or one-sixth size Stand-Off replica of this outstanding four-place private plane. Impressed at the onset by the enormous bubble canopy and the roominess of the cabin area, we at once visualized a sliding canopy for access to our R/C equipment tucked neatly between the seats on the cabin floor thus eliminating the need for unsightly and annoying hatches. The trike gear was mandatory and the snappy appearance and wide selection of color schemes certainly didn't turn us away. The story of the full-size Navion complete with photographs, both civil and military, interior and exterior, appeared in last month's issue of R/C Modeler.

R/C equipment in the prototype model was an Aristo-Craft Microprop



These rear quarter shots of our Navion show off the DJ striping on the control surfaces to simulate the stiffening ribbing of the full size Navion. Simplified construction features sheet balsa fuselage sides with planked top and bottom.



The wide cowl completely conceals the side mounted K & B .40 engine. Note the cooling air outlet fairing, which is a functional scale item, and the long "walrus tusk" dummy exhaust pipes in the cowl. The step and black sandpaper wing walk are on the left side only. Fuel tank is located forward of the firewall.

72.250 MC six channel transmitter/receiver, however, only five channels are active. The five rotary servos actuate the rudder; elevators; ailerons; engine speed; and nosewheel steering. We elected to use a separate servo for the nosewheel steering instead of coupling it to the rudder control after witnessing a heartbreaking wipe-out in which a trike job cartwheeled across the field when the flier kicked the rudder, which was coupled with the nosewheel, just as the wheel made contact with the ground. Even if the odds are against this ever happening again, why take the chance? If we had it to do over again, flaps and/or retracts would have been installed in our model but not at the expense of the steering nosewheel because that is a must when taxiing a trike model.

The construction of our model is essentially conventional using time proven balsa, plywood and fiberglass materials. Of course this does not prohibit the substitution of other materials such as foam, etc. Two basic construction philosophies have been applied to model construction for many years; both successful and each with its die-hard followers: The first, used since the pioneering days of R.O.G. tractors, twin pushers and bent bamboo, depends upon a complex structure utilizing a multiplicity of relatively hard, small cross-sectioned members such as multi-spar wings and longeroned and stringered fuselages. The second and more recent structural development is the application of larger cross-sectioned members of a medium or soft texture using fewer pieces and, thereby, simplifying the structure. The most recent development in the latter philosophy is the use of foam. Our model adheres to the latter philosophy using a single spar, thick leading edge wing coupled with sheet balsa fuselage sides and top and bottom planking which thickens toward the nose for strength where it counts. The all-up weight for models built with each system is basically the same. The use of thick, soft textured materials makes routine nicks and dents easier to repair and less apt to seriously damage the thick structural members whereby, although stronger for a given cross-section the thin member resists minor impacts until it gives way and snaps. Then the repair becomes a problem. Further, we feel that the softer high cross-section construction is more fun to build and is easier to develop into a scale replica. It is assumed that the builder of this model is somewhat experienced, therefore it is not intended to touch on every construction detail.

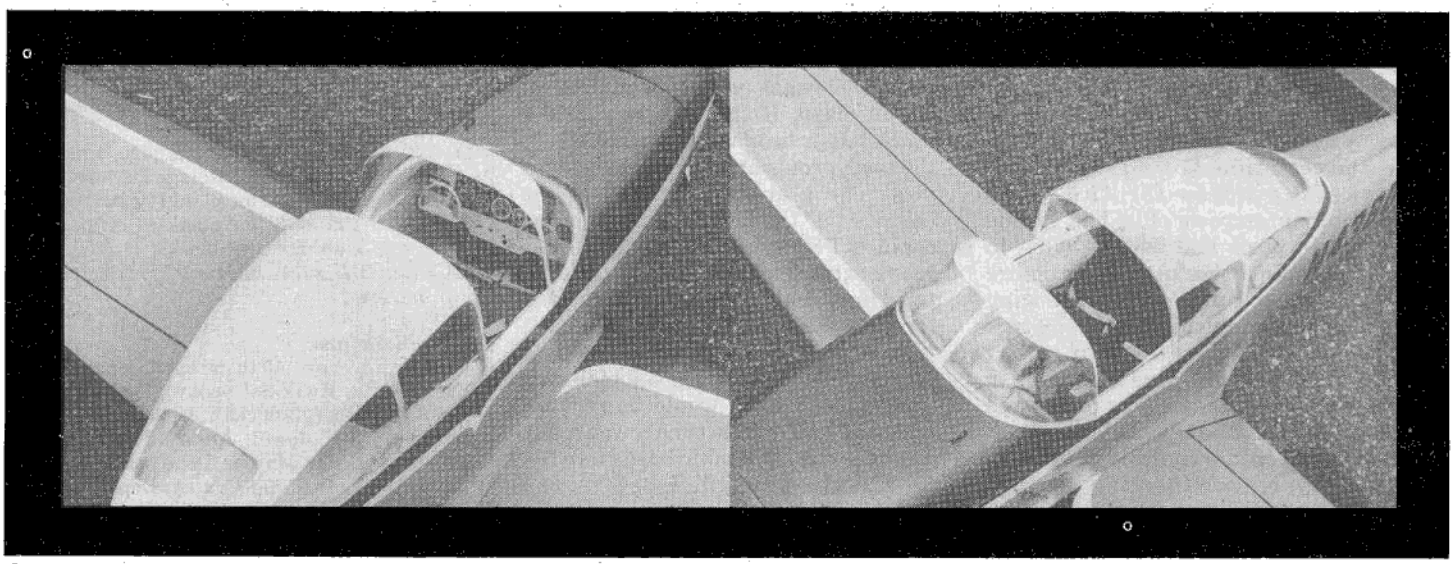
The powerplant can be from .40 to .60 cu.in. diplacement. Initial flights were made with a .60 and, although very successful, we weren't ready for all that reserve power and it sort of took us by surprise. We like to retain the character of the prototype airplane when we fly its miniature replica so it amazed us when the Navion climbed like a Messerschmitt! We decided to try something smaller and it was a simple matter to modify the mounts for a .40. The flight characteristics were then more in line with our expectations by behaving much like the real thing except that it made us

handle the controls a bit more judiciously because that reserve power wasn't there to help us out of awkward predicaments when we were "playing to the spectators." Therefore, in effect, either powerplant can be used in this model and the selection depends upon which type of flying you plan to be doing. We feel that most fliers will be happier with the .60 engine with engine control.

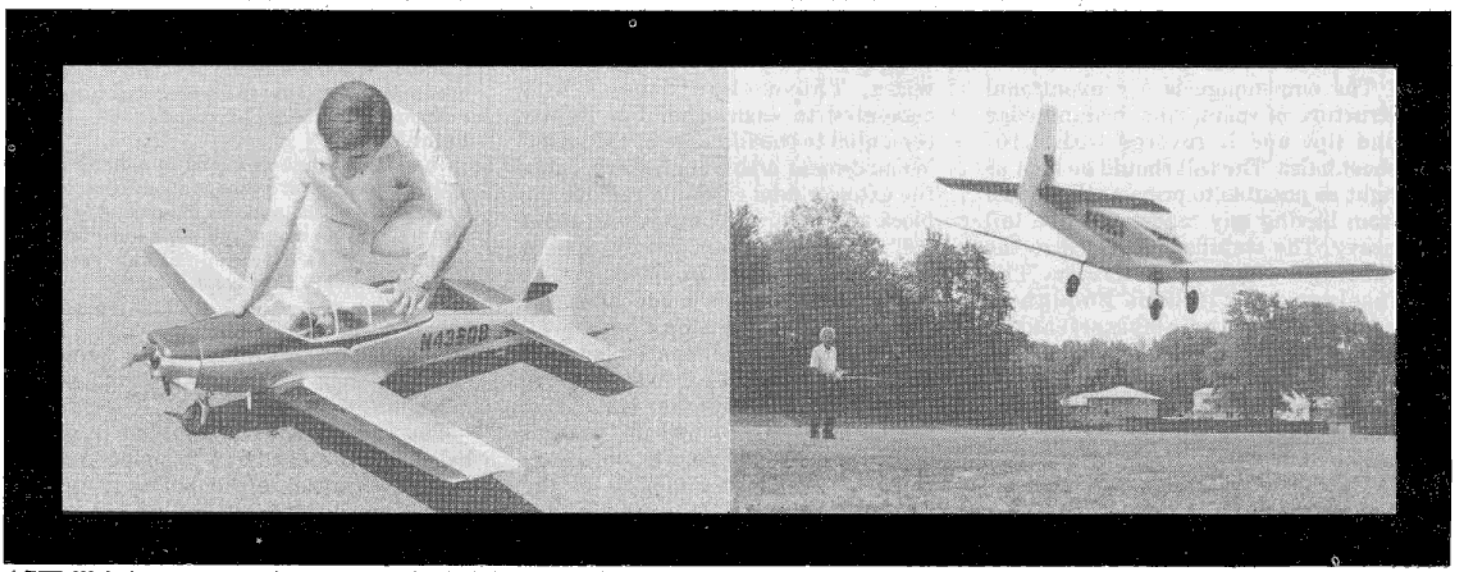
The force arrangement consists of two degrees positive wing incidence with slight tip washout and about one degree positive stabilizer incidence. Zero down thrust was used, however, flights indicated a slight amount of right thrust was needed.

The wing was constructed first. The single spar is full wing thickness and should be hard balsa. This should be epoxied between the plywood joiners using plenty of the adhesive and held together with clamps until the glue is dry. Note the joiner lightening holes. The leading edge is laminated with three layers of 1/2" medium soft balsa. These are assembled staggered as shown on the plans to create a 1/4" x 1/2" slot. This not only lightens the leading edge without weakening it but provides a recess for the wing rib tabs which results in a very secure rib/leading edge joint. Ribs are slipped into the spar notches, egg-crate fashion and the leading edge helps with the alignment of wayward ribs. The trailing edge is formed with two balsa sheets; top and bottom, of 1/16" x 2" balsa. Be sure to bevel one of the sheets before the second trailing edge sheet is cemented in place. Most of the wing is covered with 1/16" sheet balsa; the exception being a small central area in the outer panels and the area over the aileron servo. We used a "pushrod bellcrank horn aileron" control system rather than a torque tube because the real Navion was fitted with external aileron horns on the underside of the wing. After the controls were installed and tested the entire wing was covered with Super Coverite. As we look back on our decision to leave the central area uncovered by the 1/16" sheet balsa (with the objective of saving weight), we wouldn't repeat that decision were we to build another Navion. The entire wing can be sheet covered if desired, but it is suggested that a covering material such as Silkspun Coverite and Balsarite or 3/4 oz. fiberglass cloth and resin, be applied over the completed sheet covered wing for added strength and appearance. The old standby of silk and sanding sealer always worked well too!

The fuselage structure is a basic side frame design but instead of a framework we used 1/4" sheet balsa. This must be spliced and butt joined from several pieces due to the limitations of balsa wood sizes. Splices must be long. It is advisable to attach



Spacious cabin and sliding canopy provides plenty of room for servos under instrument panel and behind rear seat plus battery pack and receiver between the seats. Front seats have been removed to reveal the batteries and receiver. All seats are removable.



LEFT: Walt demonstrates the proper method of closing the canopy to avoid distortion due to binding on the runners. Canopy should resist sliding rather than slide easily, therefore, a firm grip and steady pressure is recommended.
RIGHT: Jerry Marks brings the author's model past the photographer prior to landing on this grassy field. The tricycle landing gear plus the model's size and enlarged wheels enables it to negotiate landing fields much rougher than this close-cut grass.

the nosewheel and wing attachment brackets to the bulkheads now. Add epoxy to the nuts to keep them from loosening. Cement the fuselage sides to the bulkheads very firmly; recementing at least twice. The engine mounts are epoxied into the holes in the bulkheads and should be braced with vertical grain 1/4" sheet balsa between bulkheads and with pieces of engine mount material "stoppers" epoxied and doweled to the mount at the firewall. At this point the doublers are firmly attached to the fuselage sides and bulkheads using Duro Contact Cement or similar adhesive. Note the side doublers in front of the wing as needed reinforcement to absorb wing impact against the fuselage during hard landings. Now, cut the two halves of the wing saddles with the grain running spanwise. This should be cut 1/4" oversize in the spanwise direction. Fit against the bulkheads and fuselage sides, bending gently to the shape of the airfoil. It may be necessary to wet the saddle with a solution of one part ammonia to ten parts water to aid in bending. Cut away at the saddle halves until the fit at the centerline is good. Be sure to make the holes for the wing attachment screws. Pin the saddle halves in place and use the wing to hold it against the fuselage structure in the proper curve. Install the wing for this purpose using the dowels and nylon screws. When the fit is perfect and the wood is dry, glue the saddle in place and when the epoxy is dry add the 1/4" balsa triangle saddle braces. Add plenty of adhesive all around and, when dry, remove the wing and glue the fillet foundation to the fuselage and saddle. Bend, assemble and install the nosewheel strut very securely to the bulkhead fittings. Before the control rods are installed in the fuselage the tail surfaces should be fabricated and installed.

The empennage is a conventional structure of spars, ribs, leading edge and tips and is covered with 1/16" sheet balsa. The tail should be kept as light as possible to prevent the model from having any tendency to be tail heavy. The stabilizer is glued to the fuselage sides very firmly. The fuselage rear is wide enough to accommodate the elevator control horn and clevis so we located the horn inside the fuselage, however, if can be mounted off-center, placing it outside the fuselage if preferred.

The control rods should be installed in the fuselage before it is completed. The type of rod (or flexible cable) that is used is up to the builder's preference. The nosewheel control should be a strong and rigid rod attached to a firmly anchored servo. The engine control rod length can be accurately made by temporarily bolting the engine in place and connecting the rod and clevis to the controls. When complete, remove the engine. We used the old (but tried and true) hard balsa strip bound with thread and glued to clevis/wire rod assemblies at each end for the rudder and elevator. The results were as satisfactory as they were when we first used this method almost three decades ago.

The planking is next as we return to fuselage construction. A decision must be made before the fuselage is sealed regarding the fuel tank location. As previously mentioned we decided not to use unsightly and annoying hatches for anything — fuel tank or R/C equipment — so our tank is mounted under the engine forward of the firewall. We had success with a 6 ounce sheet brass tank, however, there are many commerical plastic bottle-type clunk tanks which will fit in this space. This is not only convenient but helps keep the nose down somewhat and keeps fuel out of the fuselage. If the builder wants a much larger tank which will not fit in the cowl, provision must be made for it now. The planking forward of the cabin is 1/4" thick while that aft of the cabin is 1/8" thick. The objective was to use extra thickness in the nose area tapering to light weight aft of the wing for proper strength distribution. It was also assumed that, with a thorough sandpapering, the planking and fuselage sides would be reduced by about 1/16" by the time it was ready for the sealer. The cabin base piece No. 29 should be added before the planking is applied. Don't spare the adhesive during the planking operation. The fuselage bay aft of the wing is built up with scrap pieces of soft 1/2" balsa in order to transition from the flat fuselage side over the wing to the elliptical section aft of the wing. These should be firmly cemented to each other but lightly cemented to the fuselage at the onset. When cement is thoroughly dry, carve the exterior, and carefully remove the block and hollow the interior to about 1/8" thickness. Then, firmly cement the completed block in place.

The wing fillet is made after the completed fuselage has been well sandpapered and all spaces between planking strips filled. We used Sig Epox-O-Lite but any other material of the builder's choice will do, such as resin and micro-balloons or Duro Easy Does It. The latest models of the bubble canopied Navions had a straight single-curvature fillet; when viewed from the front or rear the fillet forms a straight line instead of a curve from fuselage to wing. See photograph in Part One. If this is selected, the fillet can be made from 1/8" sheet balsa reinforced with fiberglass cloth and resin because it must be strong enough to endure the impact of landings transmitted through the wing. During the forming of our fillet we placed Saran Wrap over the center of the wing and made the fillet while the wing was in place. When thoroughly dry, the wing is removed and the fillet sandpapered and filed to shape. Be sure to taper the wing saddle to fair into the wing with a minimum step.

The cowl can be assembled from balsa blocks and carved to shape and sandpapered, or it can be layed up with fiberglass cloth and epoxy or resin. The cowl can be held to the fuselage by means of 90 degree clips. Epoxy the screws and clips to the

List Of Material For Prototype Model (All material is medium balsa unless otherwise noted)

(6) 1/4" x 3" x 36" for fuselage sides, doublers, spar, and wing ribs.
(5) 1/8" x 3" x 36" for ribs, and bulkheads.
(12) 1/16" x 3" x 36" for wing and empennage covering, ribs, and cabin interior.
(4) 1/8" x 12" x 24" plywood for wing ribs, bulkheads, bellcrank mounts, bulkhead doublers and spar joiners.
(1) 3/8" x 1/2" x 36" for stabilizer L.E.
(2) 1/2" x 1/2" x 36" for stab. & elev. spars.
(2) 5/32" x 12" x 24" plywood for firewall and landing gear mounts.
(1) 5/32" dia. x 36" music wire for landing gear struts.
(4) 1/2" x 3" x 36" for leading edge, wing tips, wing fairing, fuselage fairings.
(30) 1/8" x 1/4" x 36" for planking strips.
(12) 1/4" x 1/2" x 36" for planking strips.
(1) 1" x 3" x 36" for cowl blocks.
(1) 1/2" x 3/4" x 24" hardwood for engine mounts.

Miscellaneous:

Super Coverite; .40 to .60 cu. in. engine; Epox-O-Lite; Kwik-Set epoxy glue; resin and 3/4 oz. fiberglass cloth; wheels; wheel retainers; 3/8" dowel; Ambroid cement; pint Sig Metallic Maroon Dope; quart Sig White Dope; 4 oz. Sig Orange Dope; and small amounts of Sig Red, Chocolate Brown, Diana Cream, Jet Black, and Silver Dope; straight pins and lills; Sig large head nylon wing screws and brackets; nosewheel brackets and steering arm; assorted clevis and control rods; 90 degree bellcrank and control horn fittings; medium, fine, extra fine and No. 400 wet-or-dry sandpaper; 1/8" brass tubing; instruments; rubbing compound; Goldberg D-J stripes.

Paint Mixing:

The salmon pink is mixed by adding a little orange dope at a time to about 16 oz. of white dope. If this appears too pale, add a few drops at a time of red dope until the proper color is attained. Shake very thoroughly every time color is added.

bulkhead and epoxy nuts to the clips for the cowl bolts. Cut a circular recess in the cowl and epoxy a metal or fiber washer into the recess as a pressure surface for the cowl hold-on bolt. Bolt the cowl in place wrapping the bolt heads with Saran Wrap. Fill the space around the bolt head with fillet material and, when thoroughly set, it should be sandpapered flush with the bolt head. The cowl should be removed before the model is primed for painting.

Sealing and priming should be done after the entire model has been covered as noted under the "Wing" description: 3/4 ounce fiberglass cloth and resin; Silkspun Coverite and Balsarite; or Silk and Sanding Sealer. The Primer Sealer can be Sig Sanding Sealer, Super Poxy Primer; Loctite Sanding Primer Sealer or similar products. Final sanding should be wet with 400 wet-or-dry paper.

Painting the Navion can be fun; not only in the actual operation, but in the selection of a color scheme which can be either military or civil. Two military Navion photographs from the Korean Conflict were included in Part One; one natural aluminum and one camouflaged. Regarding civil schemes; we selected one of the most interesting used on this plane and have included a table of possible color combinations. In addition; Part One included photographs of two other civil color patterns. We used Sig Butyrate Dope on our model. The prototype model color scheme uses white to separate the light and dark colors. The plans are marked "L," "W" and "D" in a hexagon to indicate the extent of each color. The simplest way to paint this scheme is to first color the entire model white and then mask off the white; painting the light and dark colors on either side of the white.

The canopy for this Navion is not available commercially and must be molded by the builder or one of his modeling buddies as in the case of the author's model. Of course, once the mold is completed, any vacuum-forming shop will be able to handle this task with ease and should also be able to supply the .030" to .035" thick plastic sheet material. Vinyl, acetate, acrylic or butyrate can be used. The mold or plug should be carved from basswood or white pine to the exact shape and size of the canopy by fitting it on the fuselage. We added a beading of soft 1/16" baling wire to our basswood mold to frame the windows. First trace the window outlines onto the plug and then carefully cut a trench as deep as about one third of the wire thickness. Bend the wire accurately and epoxy into the trench when the fit is perfect. Then add about 1/2" wood to the bottom for trimming to fit the fuselage. The clean plastic should be bolted between two wood frames made from 1" x 2" lumber and heated in a 350 degree oven and suspended between two small pots or other non-flammable objects so the plastic has room to sag when soft from the heat. The wooden mold should be very firmly mounted on a pylon or two 6" wooden broomstick dowels which are, in turn, firmly attached to a 1" x 6" x 12" wooden base. Heat the plug a little, but don't scorch it. When the plastic has sagged about 3" remove it from the oven using potholder mittens and very quickly push it firmly over the warm mold. Don't remove it until the plastic is cool. Fit to the fuselage, trim as necessary, mark off and carefully separate the windshield from the bubble.

The operating canopy mechanism is simple but must be strong and not operate too easily, i.e., there must be a good amount of friction during the opening and closing operation to keep the canopy closed during flight. If not, a method of securing the canopy in the closed position must be installed. Epoxy the canopy frames to the canopy and windshield and set aside. Now the wire runners are bent to shape. The brass tubing must be slipped on the side runners before the wire is bent. Because of the intricate bends we used heavy coat hanger wire instead of music wire for the runners. This must be at least 1/8" wire and the brass tubing must not be a sloppy fit. Trial fit the runners and, when all is well, the brass tubes are very securely mounted onto the canopy base (piece No.30) using epoxy and cloth. When this is thoroughly dry (overnight is preferred) the wire runners are then rigidly attached to the bulkheads and cabin base (piece No. 29) using epoxy and cloth. They must be parallel with each other. Be certain that the cloth is well-saturated with the adhesive. When dry we applied two more layers of epoxy over the attachment. Take care not to get any adhesive between the brass tubing and the runners. Let dry overnight before attempting to slide the canopy base. Canopy base is white.

The cabin interior should be completed before the canopy and windshield are installed. The cabin sides on our model were lined with 1/16" sheet balsa and painted white. The instrument panel is rigidly installed while the seats are removable in our model. When completed, two planks of balsa were cemented to the underside of the seats, forming a slot which fits very, very snugly on the bulkheads. After the bulkheads and seat slots are painted, do not sandpaper them because the rough nap of the painted wood assists in holding the seats in place. If desired, clips can be fitted to hold the seats in place. The servos, switch, battery and receiver racks, should also be installed at this time and, when all is in order, the canopy is epoxied to the canopy base. Lay a protective covering of Saran Wrap over the fuselage underneath the canopy to protect the fuselage during the canopy installation. Small pins or lills can hold the canopy to the base until the epoxy sets. It is advisable to apply more epoxy to the canopy installation along the inside seam all around. This can be applied with a strip of scrap balsa or a 1/16" dowel. When thoroughly dry, the canopy should be slid to the closed position and the windshield fitted in place to be certain they meet without gaps. The windshield is epoxied to the fuselage, temporarily taped to the canopy until the glue dries.

Details can be added using decal sheets and striping tape. We simulated the control surface stiffeners with strips of tape which proved very effective. The landing gear strut and fork scale embellishments can be added now if they are desired. We feel they add a lot for very little effort. The fuel line/surgical tubing is slit on one side and slipped onto the wire, one over the other in varying sizes as shown. The fork is carved from hardwood fitted on the wire and backed by sheet aluminum. When dry, the entire landing gear strut assembly is wrapped carefully with fiberglass cloth and resin or whichever material was used for covering the fuselage wood surfaces prior to Primer Sealing. Landing gear struts are painted silver and canopy is white.

Flying can be safely accomplished from grassy fields because of the large wheels and tricycle landing gear. Remember: the nosewheel is the first to leave the ground and the last to touch the ground. High speed ground runs should be on the main wheels when at all possible.

Happy Flying! □

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