by Jim Young

The Meteor is a seldom-modeled aircraft and its construction requires advanced building techniques. The author offers a short kit that includes laser-cut parts and a vacuum-formed canopy.

Gloster Meteor

Britain's first jet fighter

THE GLOSTER METEOR was Britain's first jet fighter, and the Allies' first operation jet. It started service in 1944 and served the Royal Air Force and other air forces for several decades.

Initially, the Meteor was used to knock down V-1 flying bombs. The Meteor was forbidden to fly over German-held territory for fear of it falling into enemy hands. Later, its mission was armed reconnaissance and ground attack, where it took out enemy aircraft still on the ground.

A few Meteors were lost to friendly fire because they were mistaken as Me-262s. A new, white paint job was specified to help with this. The Meteor also saw action in the Korean War at the hands of Australian pilots.

When not in combat, the Meteor set speed records and was piloted in an original aerobatic maneuver: the Zurabatic Cartwheel. Acting Chief Test Pilot, Janusz Zurakowski (a story in his own right), perfected the maneuver using the asymmetrical thrust available from the widely spaced engines.

More than a dozen variants of the Meteor were developed. The T.7 version was developed as a two-seat trainer to support the many air forces converting to jets. The T.7$^{1}/_{2}$ I modeled is owned and operated by Martin Baker. Martin operates two Meteors out of Chalegrove, United Kingdom, as test beds for ejection seats.

Martin's WA638 Gloster Meteor T.7 is believed to be the oldest operational jet in the world. Its restoration was completed in 2001 with a new high-visibility, glossy, black paint scheme. It was the perfect Meteor to model.

The Meteor is a seldom-modeled aircraft and presented several engineering challenges in its design. The cruciform tail and engine nacelles embedded in the wings had to be designed to be strong, but also easy to build.

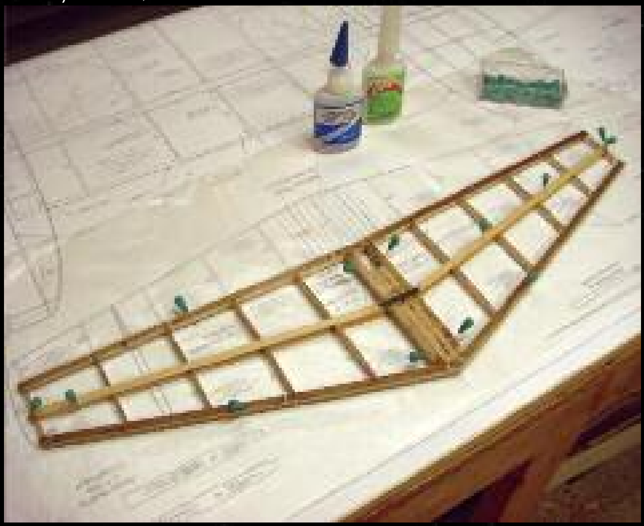
Using CAD and laser-cutting, I designed several features into the parts and several jigs to aid construction. This design is not for beginning builders or fliers. Its construction requires some advanced building techniques including planking, fiberglassing, and retracts installation. A short kit of laser-cut parts and a vacuum-formed canopy is available from the author. (See "Sources" for contact information.)

Tail Feathers: The stabilizer is built-up on top of the plans. Position two basswood spars on the plans and glue the ribs in place. The spar will not be flat on the board. Glue the top spars, the LEs, and the TEs to the ribs. Sand the TE to match the ribs.

Sheet the top of the stabilizer with $^{1}/_{32}$-inch balsa. Remove the assembly from the board, flip it over, and use jigs 5 and 6 to support it while the bottom is sheeted. Remove the sheeting between the S4s and S5s. Glue the stabilizer tip blocks in place and sand to shape. Recess the stabilizer's TE to accept the crossbrace.

Cut the elevator LE to length and save the extra material. Cut the rudder's LE into three pieces, and save the center piece. Cut $^{1}/_{32}$-inch balsa for sheeting the elevators and rudders and pin it onto

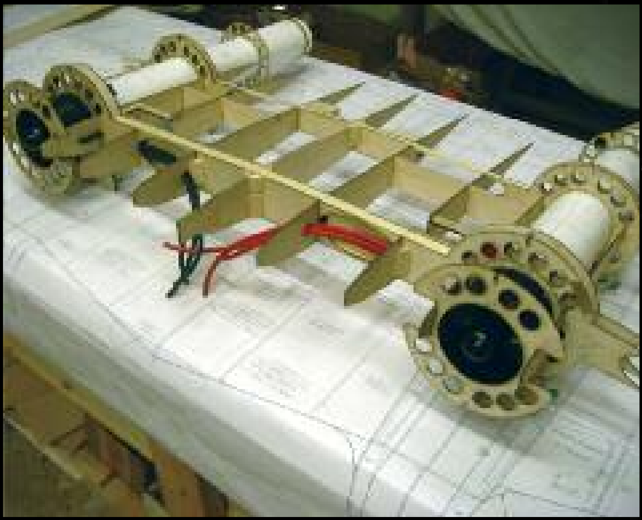
Photos by the author, unless noted



Left: The stabilizer is traditional built-up construction and features a symmetrical airfoil. The center ribs create a pocket for the internal elevator linkage.

Below left: The wing spars feature spruce spars sandwiched between plywood formers. Balsa sheer webs are used to stiffen the structure and transfer the flight loads around the engine nacelles.

Below: The fan units were relocated from the front of the spar to behind it to allow for easier service and keyed into the wing ribs for support. The three motor wires are routed through the main spar. Jigs support the wing and keep it flat during construction.



the plans. Build the elevators and rudder on top of the sheeting.

Bend the elevator-control rod from 1/16-inch diameter music wire. Solder a control rod to the center and affix a ball joint to the end. Cut an elevator pushrod to length as shown on the plans. Bend the rudder linkage from 1/16-inch music wire.

Start the vertical fin by gluing V3 and V4 together, and V5 and V6 together. Glue balsa to each side of V4 and V5 and sand it to match V3 and V6 respectively. Glue two ¼-inch square balsa sticks to the bottom of V1 and drill a hole through them for the elevator control linkage. Pin V1 and V2 on top of the plans.

Glue the ¼-inch square LE and the V9 to them. Mark the location of the remaining ribs and F13 on the TE. Mark the location of F12 on the LE. Remove the structure from the board. Fit the elevator control rod into position and glue the crossbrace V23 in its position. Glue the V3-V4 assembly in place.

Position the stabilizer assembly and glue it on the fin assembly. Make sure it is square to the fin. Connect the elevator linkage and make necessary adjustments for smooth operation. Glue the V5-V6 assembly and remaining ribs in place. Sand the TE to match the ribs.

Notch the center piece of V10 to accept the rudder linkage and glue it in place. Position and glue V17 through V20. Sheet the fin with 1/32-inch balsa. Glue the fin tip block in place and sand to shape.

Glue the leftover pieces of S3 to the TE of the stabilizer. Position and glue S11 through S14 and sheet this structure.

Top: The canopy plug was built-up from balsa and plywood. The plug was glassed, primed, and sanded before casting a permanent plug to form the canopy cover.

Above: The fuselage formers are glued to the crutch. A jig sets the proper angle. Balsa stringers tie everything together and jigs hold the structure straight on your building board.

Top right: The nacelle hatch is planked with the rest of the nacelle and then cut free.

Right: The entire airframe is glassed with 0.5-ounce cloth.

Rough sand the T1 tail reinforcements to shape, and glue them on each side of the fin.

Glue F12 through F15 to the tail assembly. Fit the rudder control linkage. The control linkage should be firmly supported above and below the control arm. Fill the space aft of F13, between F14 and F15 with ¼-inch balsa. Balsa block completes the tail after it is joined to the fuselage. Set aside the tail assembly.

Wings: Build the outer wing panels first. Pin the lower spar on top of the plans and frame up R6 through R9, the top spar, and LEs and TEs. Glue R6A to the rear of the TE. Glue the servo hatch mount in place. Add vertical grain sheer webs between the R6 through R8 spars.

Cut the top sheeting for the ailerons from 1/16-inch balsa. Assemble the ailerons upside down above the top sheeting. Prepare the 1/16-inch balsa sheeting for the center and outer wing sections.

Begin the center section of the wing by constructing the main and rear spars. Mark the locations of R2 and R3 on the plywood spar pieces. Cut the main 1/8- x 1/2-inch spruce spars as shown on the plans. Pin the MS1s and a WJ1 on top of the plans and glue the spars in place. Glue 1/8-inch balsa vertical grain sheer web between the spars between R2 and R3.

Cut several strips of 1/16- x 1/2-inch balsa for sheer webs between MS1 and MS2. Glue them into position and sand them flush with the spruce spars. Glue MS2A to MS2. Glue the MS2s and the other WJ1 in place. The rear spar is assembled in a similar fashion with 1/8- x ¼-inch spruce spars. Leave the main spar pinned to the board.

Left: The composite gear doors are cut and trimmed to fit. Control surface hinges were used to hinge them in place. An over-center spring holds the inner door open and closed. A wheel hits a lever to trip it.

Below left: After the top is fully planked, you can unpin the fuselage from the board to complete the bottom.

Below: The author couldn't resist trial-fitting the wing.

Glue R1 through R5 in the proper positions on the main spar. Glue the landing gear plates and R3C in place. Glue the rear spar assembly into position with RS2 up. Glue triangle stock around the landing gear plates and R1. Glue vertical grain balsa blocks to the rear of the rear spar for the wing mounting bolts.

Remove the wing assembly from the board. Temporarily shim the radius in wing jigs 1 and 2 with 1/16-inch balsa to compensate for the lack of nacelle sheeting. Support the wing assembly, upside down above the plans in the wing jig blocks. Cut two forward ducts from plastic or cardboard. Assemble the front of the nacelles with R4A, R5A, N3, N4, N5, and N9B.

With everything aligned, glue the nacelle framework together. Trim the duct flush with N3 and MS2. Install the fan units and route the motor wires through the main spar. The fan fronts are held by MS2A, and the rear tabs are captured by R4 and R5. Glue R1A through R4A and the balsa LE in place. Glue R1B, R4B, and R5B to the rear spar.

The landing-gear installation is laid out for Robart 510W1 retracts. These air-up/spring-down units require less plumbing and have the safety feature of extending the gear in the event of an air leak. Install the main retract units and route the air lines. Glue ¼-inch square balsa from R3 to the main spar where the gear doors are angled.

Sheet the wing's bottom center section with 1/16-inch balsa. Flip the wing assembly over, and support it in the jig blocks. Poke pins through the sheeting to mark the corners of the landing gear doors. Do not cut the door out at

Gloster Meteor

General Specifications

Type: RC Scale

Skill Level: Intermediate builder, intermediate pilot

Wingspan: 51.6 inches

Wing Area: 668 square inches

Length: 61.45 inches

Weight: 100 to 130 ounces

Power: Two Mega 16/15/3s motors and two WeMoTec Mini Fan 480 ducted fans, two 45- to 50-amp ESCs, two 4S 5000 mAh batteries

Radio: Four-to six-channel, five servos with retracts

Construction: Balsa, plywood, glass cloth

Finish: Heat-shrink film or paint finish

this time. Route the aileron servo leads through the holes in R2 and through the rear spar. Sheet the top center section of the wing with 1/16-inch balsa. Carve and sand the LE to shape.

With the wing assembly securely supported in the jig blocks, fit the outer wing panels. The bottom of the wingtip jig 3 is supported 3 1/2 inches above the board. The rear spar is beveled to mate with TE 1. With everything aligned, glue the outer wing panels into position. Sheet the tops of the outer wing panels with 1/16-inch balsa.

Flip the wing over and use jig 4 placed ½-inch above the board to support the wingtips while the bottom of the wing is sheeted. Locate the aileron servo opening and use the servo hatch cover as a guide to cut the sheeting away.

Cut two rear ducts and fit the remainder of the nacelle pieces—N6, N7, N8, and N9—in place. Protect the N6 pieces from the spars and wing sheeting with wax paper.

Plank the nacelles with 1/16-inch balsa. To help with this, a "gore" template is included on the plans. The shape of the gores will reduce the amount of trimming and fitting required. As the bottom is planked, cut between the main spar and N6A, and the rear spar and N6B, to free the hatch. Glue N1 and N2 to the front of the nacelles and sand to shape. The inlet edge should have a smooth, round cross section to ensure good air flow into the fan.

Depending on your flying field, you may want to omit the gear doors. I fly mostly off of grass; the Meteor sits low on the gear, and main doors catch in even the shortest grass. The nose door helps it slow down on landings, so consider fabricating it.

The gear doors are made from fiberglass and carbon laid-up on the bottom of the wing. The Meteor has a bump above each gear door and it is shown on the plans.

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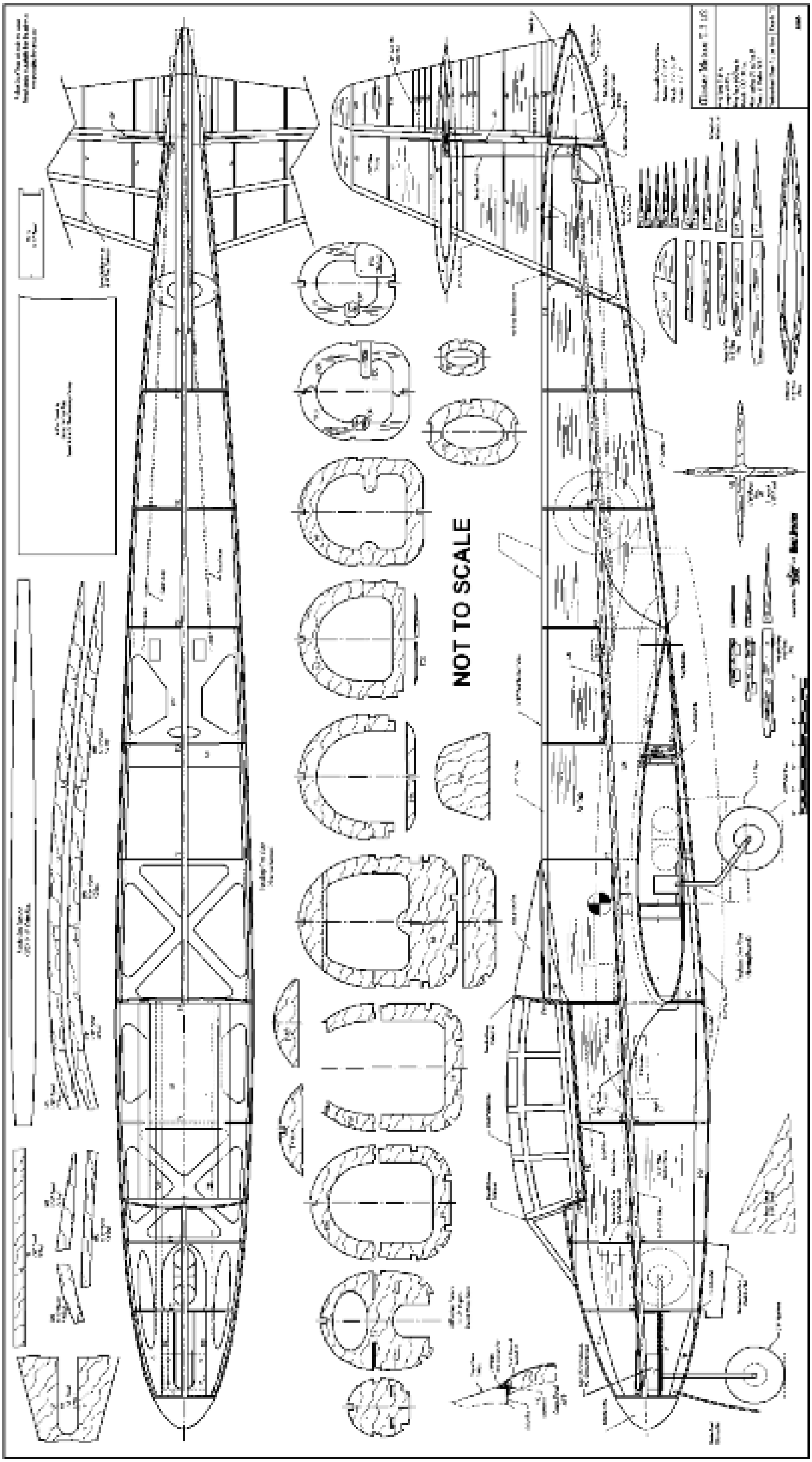

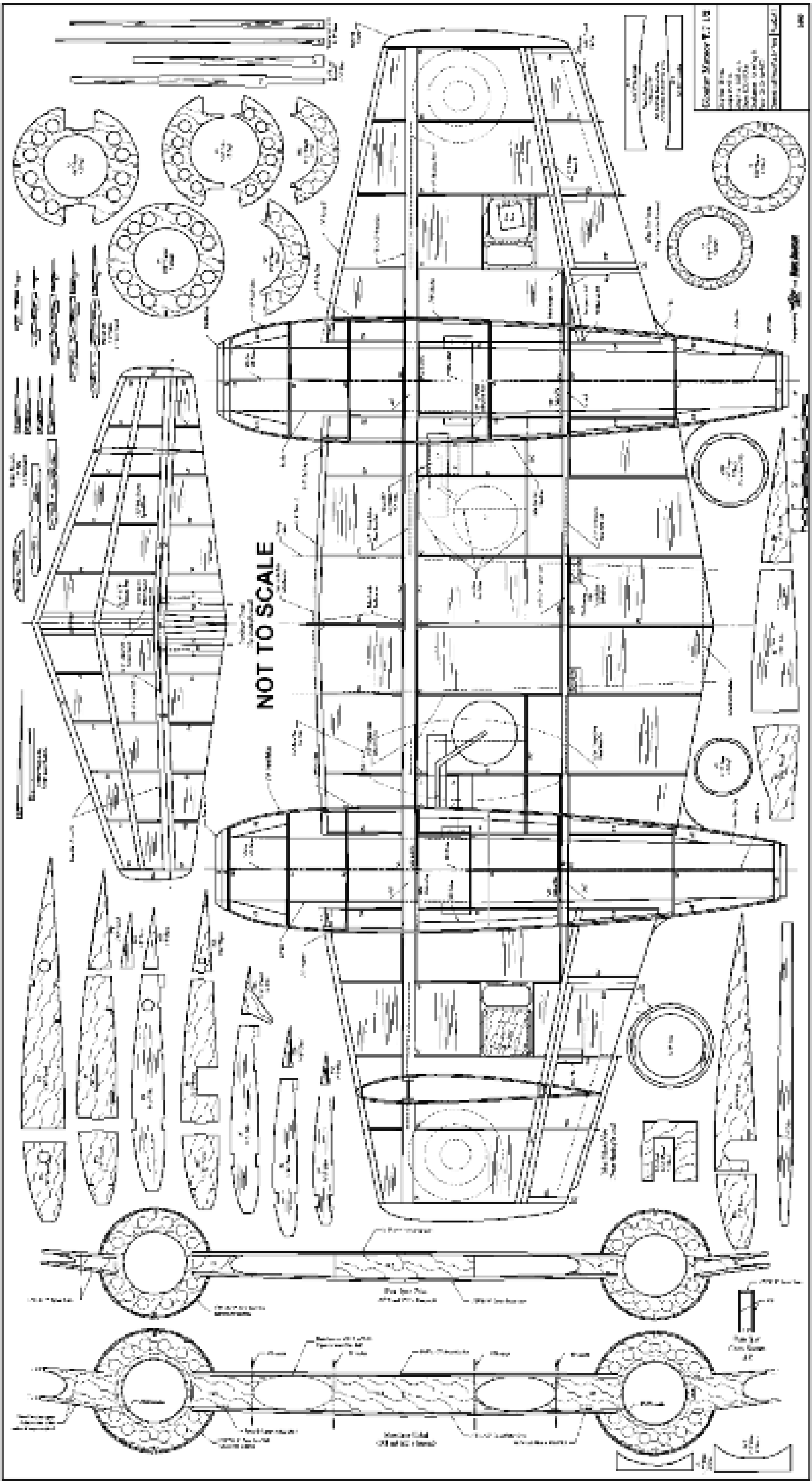

Full-Size Plans Available—See Page 171

This can be made from balsa block or filler, and most will be cut off.

Temporarily cover the bottom of the wing with iron-on covering. Wax the covering and lay-up the gear doors. I used two layers of 1-ounce fiberglass with one layer of 6-ounce carbon sandwiched between them for stability. Use peel-ply or 100% polyester cloth over the lay-up to reduce the final sanding and finishing time.

After the lay-up has cured, it should pop off cleanly giving you a perfect-fitting gear door. Cut the gear openings from the bottom sheeting. Cut the gear doors to shape and temporarily hinge them. The outer door will be secured to the gear strut; the inner door uses an over-center spring to hold it open and closed. The wheel hits a lever glued to the inside of the inner door to open and close it.

Fuselage: Laminate the LG1s, WM1s, and WS1 and WS2 together. The fuselage is started by constructing the internal crutch. Position CR1 and CR2 on top of the plans; CR2 should be approximately 1/16 inch behind the location shown on the plans to account for the angle of the crutch relative to the board. Glue 1/8- x ¼-inch balsa stringers to the bottom of CR1 and CR2.

Glue F1 through F9 to the crutch, using the gauge to set them at the correct angle. Glue the LG mount in place and reinforce it with triangle stock. Glue F1A, F1B, F2B, F4A, F4C, WS1, and WM1 into position.

Using the building jigs at F2, F6, F9, and F12, secure the fuselage assembly on top of the plans. Thread F10 and F11 onto the crutch. Cut ¼-inch square balsa stringers to fit from F6 to F12 and from F9 to F12 and fit them to the top and bottom of the fuselage. Square the formers to the plans and glue them in place. Bend the top of F6 at the score line and glue F6B to F6 and the top stringer.

Cut 1/16-inch basswood to fit from F4A to F6 along the edge of F4C. These pieces should extend above the edges of the formers and will be sanded down after you sheet the fuselage.

Cut two stabilizer support jigs from foam board to support each side of the stabilizer during construction. Slide the tail assembly onto the fuselage assembly. F14 and F15 should butt up against F11. Glue V11 and V12 in place and fill in between V11 and F14 with balsa. Install the rudder and elevator control rods.

Plank and/or sheet the fuselage with 1/16-inch balsa. This will take some time. Use F6A to frame up and plank the turtledeck. When the top and sides are done, the fuselage is removed from the board to finish the bottom. Glue balsa block to the front of the fuselage and sand to shape. The front landing gear doors are laid-up from fiberglass and carbon similar to the main gear doors.

Square the wing to the fuselage and drill a hole for the mounting bolts. Glue F6C, F7A, and F8A to the bottom of the wing. Add ¼-inch square balsa stringers and sheet and/or plank with 1/16-inch balsa.

Cut a floor for the cockpit and install the canopy as shown on the plans.

At this point, the Meteor should be ready for finishing. The prototype was fiberglassed with 0.5-ounce cloth and painted. It is a short step on paper, but it took several weeks of sanding, filling, and priming to get ready for paint.

I've come across several color schemes for a T.7, including scarlet red, Israeli camouflage, and the glossy black one that originally inspired me. This design could easily be bashed into one of the many other variants of the Gloster Meteor.

For the radio setup, I used HS-85s on the rudder and elevator, HS-65s on the ailerons, and an HS-55 on the retract valve. I chose to use separate power packs and ESCs for each motor. I used ESCs that have switching BECs; one was used to power the receiver.

It is not wise to connect the outputs of two switching regulators together. Power comes from two Mega 16/15/3s motors, each running on a 4S 5000 mAh pack. There are many possible motor and battery options that will work in the miniature fan units.

Flying: The Meteor is an honest airplane, and needs to be flown as such. It can be flown from grass or a paved runway. For takeoffs, the Meteor tracks straight and the nose will get light when it is ready to fly. A moderate amount of elevator gets the nose off the ground. The gear adds considerable drag, so I try to retract it as soon as it is solidly in the air.

The Meteor climbs out with authority. As you level out you can hear the twin fan units get on step. There is a definite pitch change. Once on step, hang on as this slick airframe starts to cook.

The stall is gentle. With the throttle off and full up-elevator, the stabilizer stalls before the wing and you get a series of "micro porpoise" motions until you relax the elevator or add power.

The Meteor is not a "bank and yank" type of airplane, so I try to fly it smoothly with large turns and maneuvers. The model flies fine at half throttle, so you don't have to waste all of your power just staying in the air. On high-speed passes, it is extremely stable. Mild aerobatics are well within its capabilities, including loops, Cuban 8s, and point rolls.

I haven't attempted a Zurabatic Cartwheel yet, but I'd be lying if I said I don't have the mix setup for it. Inverted flight requires roughly 25% down-elevator. Other than that, I love watching it cruise by.

For landings, drop the gear on the downwind leg. The controls get slightly soft with the gear down, so be aware of that. Make a long, low approach and you can cut power once you're on final approach. The Meteor does come in a bit hot, but it will stay down once it touches down. If you have to abort a landing attempt, retract the gear. It takes a considerable amount of power to get the Meteor back up to speed with the gear extended.

I'd like to thank Keith Shaw for his expert help in developing this design and taking the controls for the maiden flight. A special note of thanks goes to Roy Thompson for providing some close-up photos of the actual Meteor WA638. **MA**

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Sources:

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