Gross Vogel II

By CHARLES CLEMANS . . . An improved version of the author's original design powered flying wing, the Gross Vogel is a real attention-getter. Article includes tips on how to lighten the model for power soaring.

• Gross Vogel II is without doubt a strange sort of aircraft. How many nine-pound, .60-powered, tail-dragging, non-swept flying wings have you seen lately?

Its unusual appearance and flight characteristics have made GV II a popular attraction at model airshow activities in the Seattle area for several years. Its flight envelope includes such outrages as STOL and hovering flight in moderate wind, barrel and snap rolls, and hands-off flight at cruise altitude.

With the engine idling, the aircraft exhibits a very low sink rate, allowing one to cruise for long periods searching for thermals while using little fuel. The muffled engine makes little noise when idling, and GV II has shared a thermal with a hawk on several occasions even though the engine was still ticking over.

The bottom of the wings and fuselage are black for maximum visibility from below. When circling in a thermal, the aircraft is easily mistaken for a buzzard or a hawk. Until, as Tom Richards put it, "I remembered that buzzards don't have square-tipped wings."

FLIGHT CHARACTERISTICS

Any aircraft design is a compromise, and the Gross Vogel is no exception. The taildragger configuration, which reduces drag and gives a distinctive appearance, requires care during ground handling. The dihedral, which permits hovering flight and hands-off cruise, makes crosswind takeoff or landing difficult.

On initial flights, care should be taken to line up directly into the wind. The rudder is quite effective, due to the propeller slipstream, and a rudder-induced skid with the corrective roll induced by the dihedral can result in a ground loop if one wing touches the ground.

On a pattern ship, ground tracking during rollout is accomplished with rudder and nose or tail wheel which, due to near-zero dihedral, results in yaw only. With the Gross Vogel, the corrective rudder required for a crosswind takeoff will invariably result in a skid and steep bank when the aircraft breaks ground.

Prior to the first flight, check the center of gravity. It should be 3-1/4 inches back from the leading edge of the wing, plus or minus 1/4 inch. An accurate method of accomplishing this is to balance the model on the eraser end of two new pencils, one on either side of the fuselage. The pencils should be mounted in holes in a board or clamped in a vise. The fuel tank should be empty during this operation.

The neutral position of the elevator should be set as indicated on the plans; it continues the reflex or upsweep of the airfoil.

As stated earlier, make your initial takeoffs and landings into the wind. On about half throttle, takeoff is about the same as with a conventional aircraft, requiring from fifty to one hundred feet. After a run of thirty to forty feet, the tail will lift and the aircraft will accelerate and eventually lift off in a gentle climb.

Landings pose no special problem. As with takeoffs, landings should be made into the wind. With no wind, there is a tendency to fly right off the far end of the runway. Beautiful three-point landings are possible if flair is begun at an altitude of about two feet, ending with full up at touchdown. Touch-and-go landings can be made with engine at low idle, but are difficult due to ground effect holding the aircraft off.

SPECIAL MANEUVERS

The propeller slipstream passing over the control surfaces provides good control response, even at very low airspeeds. In light wind (6 to 10 kts.), near-vertical ascent and descent and even hovering flight is possible. This flight mode is typified by high engine rpm, with angles of attack usually in excess of thirty degrees, and low relative airspeed. Head into the wind and gradually increase up elevator and engine rpm until the desired relative ground-speed is achieved. Stability is maintained using rudder, elevator, *and* throttle.

Vertical landings are possible if the wind is steady, but are not recommended due to the turbulence usually found near the ground. The whole operation is a bit like balancing on a ball.

With the aircraft trimmed properly, it will fly for extended periods without operator control. As noted earlier, the radio must be left turned on for this stunt. With the engine on idle, full up trim, and rudder set for lazy circles, set the transmitter on the ground and let the Gross Vogel hunt for thermals. This is not recommended at low altitude or at high engine rpm. Remember, transmitter range is reduced greatly when the transmitter is not hand-held!

Extremely small inside loops are possible. Begin from level flight with full power and full up elevator, then cut power at the top of the loop to avoid excessive speed buildup. Remember, with Gross Vogel the throttle is an active control element. Go fast and turn left is for the pylon types. Go to an airshow sometime and listen to the way the engine is used to accomplish the various maneuvers while keeping airspeed and g-loads within bounds. Power-off loops require only a shallow dive to build up airspeed. A power-off loop can be entered with the speed built up doing a power-on loop.

While axial rolls are not possible with the Gross Vogel, some really astounding barrel rolls and snap rolls can be performed. Inverted flight is possible but difficult, due to the reflexed flat-bottom airfoil.

CONSTRUCTION

The construction depicted by the plans is quite rugged, having been designed to withstand the rigors of sport flying and occasional bad landings. If your primary goal is powered soaring, one or more of the following changes can be made for a weight reduction of from 30% to 50%:

A) Use 1/16 sheet balsa in place of the 3/32 specified for wing planking.

B) Build the fuselage sides from 1/4-inch balsa instead of plywood. Use 1/16 ply doublers where the wing spars enter the fuselage and in the forward equipment bay. Another alternative is 1/8 ply mahogany door skins available from your local lumber yard. Try Sig Lite Ply.

C) Eliminate the landing gear and tail wheel. Add a balsa lower cowling and skid. Exit the rudder pushrod from the top of the fuselage. Raise the wing sufficiently to permit a good grip on the fuselage for hand launch.

D) Power with a .19 to .45 displacement engine, depending on the rate of climb desired. Reduce fuel tank size and move equipment forward to balance. Lengthen nose from one to two inches for smaller engines.

RUDDER/FIN

Construct the rudder and fin from soft balsa to control weight aft of the center of gravity. Cover with a paintable material of your choice, such as silkspan or Coverite, and set aside. Hinges may be fitted at this time if they are of the removable pin type, such as Klett, to permit insertion of the rudder tiller during final assembly.

FUSELAGE

Cut the fuselage components using the patterns provided on the plans. Construct the basic fuselage box using a good grade of glue, such as Titebond, adjusting bulkhead locations to suit your equipment. Install the triangular reinforcing where specified. These are required because of the small gluing surface provided by the edge of the plywood fuselage sides. Cut the upper deck and hatch blocks to profile and install, using glue and nylon bolts where appropriate.

Carve and sand the fuselage to shape. Remove the hatch blocks and hollow to suit. Fit the canopy at this time. One of the early Gross Vogel variations was an

#2791

open cockpit, reminiscent of World War I fighter aircraft.

Mount the fin in a slot on the fuselage top, or butt glue using 1/8-inch diameter dowels to reinforce the glue joint. Drill the 3/32-inch diameter hole through the fuselage just aft of the fin for the tail wheel and rudder tiller assembly.

CENTER SPAR BOX

Construct the center spar boxes from 1/8 square spruce and 1/8 birch plywood. Cut the components to length and glue and wrap with silk thread, using a length of aluminum spar as a male jig. I find it faster to build one long box and cut it to length after the glue has cured. Use a slow-drying epoxy, as 5-minute epoxy will not provide sufficient strength. Slide the spar out of the box before the glue sets up!

If suitable aluminum (6063-T6 or equivalent) spar material is not available, 1/4 x 3/4 spruce spars may be substituted. The spars may be laminated from 1/4 x 3/8 Sig spruce, since the bending load along the center of the spar will be near zero.

WING

The wings are constructed in four sections, using lightweight balsa throughout. Construct the wing sections with the lower spars flat on the building board to assure proper alignment. Bevel the lower trailing edge sheet and glue in place, using trailing edge shims cut from scrap balsa. Use a dihedral jig to incline the ribs at the dihedral joint to the proper angle. Add the main spar webbing and upper surface sheeting prior to removing the wing panel from the building board.

When constructing the wing center sections, build with the spar boxes and wing alignment tube in place. Check the root rib with a square to assure a good fit with the fuselage. Add hinge blocks prior to gluing the upper trailing edge sheeting in place. Remember, the spar webs are mandatory!

Proper alignment of the wings will be assured if both wing center panels are built at the same time with the center spars and alignment rod in place.

Cut slots in the dihedral joint ribs to accept the plywood dihedral braces, and sand the ends of the wing sections with a long, flat sandblock. I use a sheet of sandpaper glued to a 1x3x15-inch block of fir with rubber cement. Butt glue the wing sections together with the dihedral braces in place. Add the remaining spar and trailing edge webbing from soft vertical grain balsa.

After the wing dihedral joints have dried, remove the unit from the board and install the lower sheeting. Glue the capstrips and wing tips in place. If you remembered to leave a bit of the rear spar exposed when you added the forward sheeting, it will provide a good base for the capstrips. Make the cutout for the elevator in the center wing panels and add the trailing edge spar. Sand the wings to shape and add the plywood root ribs.

Cut the elevators from light sheet balsa. Add the plywood insert for the control torsion link assembly and sand the elevator bottom to match the airfoil reflex shape. Form the components of the elevator torsion link from brass stock. Sweat solder the square tube to the brass sheet and drill holes for the mounting screws or bolts.

FINAL ASSEMBLY

If the two halves of the wing are not aligned properly, a built-in turn will result which would be extremely difficult to overcome by normal trim procedures. If the wing center sections were built with the spar boxes and aluminum spars in place, the following procedure will assure proper wing alignment.

Cut the center spar boxes to length, and while holding in position inside the fuselage, slide the wing joining spars through the fuselage sides and spar boxes. Do not glue in place at this time!

Slide the wing alignment rod through the holes in the fuselage sides. The rod should extend about one-half inch on either side of the fuselage.

Place the fuselage on a flat surface and add sufficient weight to hold it in place. Slide the wings in place on the aluminum spars and the alignment rod. Measure the distances from the bottom of the wing under the forward spar and trailing edge to the table. Measurements must be the same for both wings. Adjustments may be made by enlarging the fuselage openings slightly and shimming the wing to the proper height.

When satisfied with the wing position, spot glue the center spar boxes and the alignment rod in place using 5-minute epoxy, taking care not to glue the aluminum spars in the process.

After the 5-minute epoxy sets up, remove the wings and slide the aluminum spars out of the fuselage. The center spar boxes should then be permanently glued, using a slow-curing glue.

CONTROL LINKAGE

Except for the torsion link, the elevator linkage is simiiar to that normally used for strip ailerons. Nyrods are not recommended for this application because of the large size of the control surfaces. The pushrod set-up shown on the plans is quite rigid and provides the necessary spring action to keep the torsion links in place.

The torsion links will look a bit odd with the wing off as they just sort of flop about. However, once the wing is in place, they become quite rigid. Check all solder joints prior to final assembly.

The rudder bellcrank may be made from 3/32 plywood, aluminum, or 1/16-inch printed circuit board. The rudder control horn is made from a piece of brass tubing.

The tail wheel and rudder tiller assembly is best made from soft wire, such as that used in wire coat hangers. Bend to shape, leaving the top straight, and solder the control horn in place.

Slide the tiller assembly through the fuselage from the bottom to the exit just behind the fin. Make a ninety-degree bend for the tiller where it will enter the plywood rudder insert. It is not necessary to fasten the tiller to the rudder permanently.

Mount the radio equipment as far forward as possible. In the prototype, a Kraft three-channel was installed with the throttle servo mounted in a plywood tray beside the brick. The antenna was routed externally along the side of the fuselage.

The landing gear is fastened to the bottom of the fuselage using two 3/16-inch nylon bolts with the nuts epoxied inside the fuselage. A drilled and tapped wooden block may be substituted for the nuts.

FINISH

Hobbypoxy finishing resin and enamel were used to finish the fuselage, rudder, and fin on the original. The top and sides of the fuselage are silver, with the bottom black.

The wings were covered with Super Monokote. The upper center panels are silver, outlined with white. The bottom of the wings are black with white tips to simulate feathers when viewed from below. The bird emblem and lettering were cut from trim Monokote and floated into place on a film of soapy water.

CONCLUSION

I hope your GROSS VOGEL will bring you many happy flights! Despite old pilot tales to the contrary, a flying wing with a properly located center of gravity is impossible to tumble.

Remember, while GV is quite easy to fly on medium to low power, it can be a bit of a handful on takeoff or with full power. If you are not an experienced flier, seek help for those first flights. Have your helper read the flight tips so he will know what to expect.

Please feel free to call or write if you have further questions. If the 1/8 x 1/2 aluminum Handi Metal is not available in your area, I can supply it for $3.00 per set postpaid. Chas. Clemans, 14730 SE 45th Court, Bellevue, WA 98006. Phone 206-747-5032 (after 8 p.. PST).

REFERENCES AND ADDITIONAL DATA

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