HOW TO ADJUST THAT HIGH-POWERED AMA GAS FREE FLIGHT

BY RALPH PREY

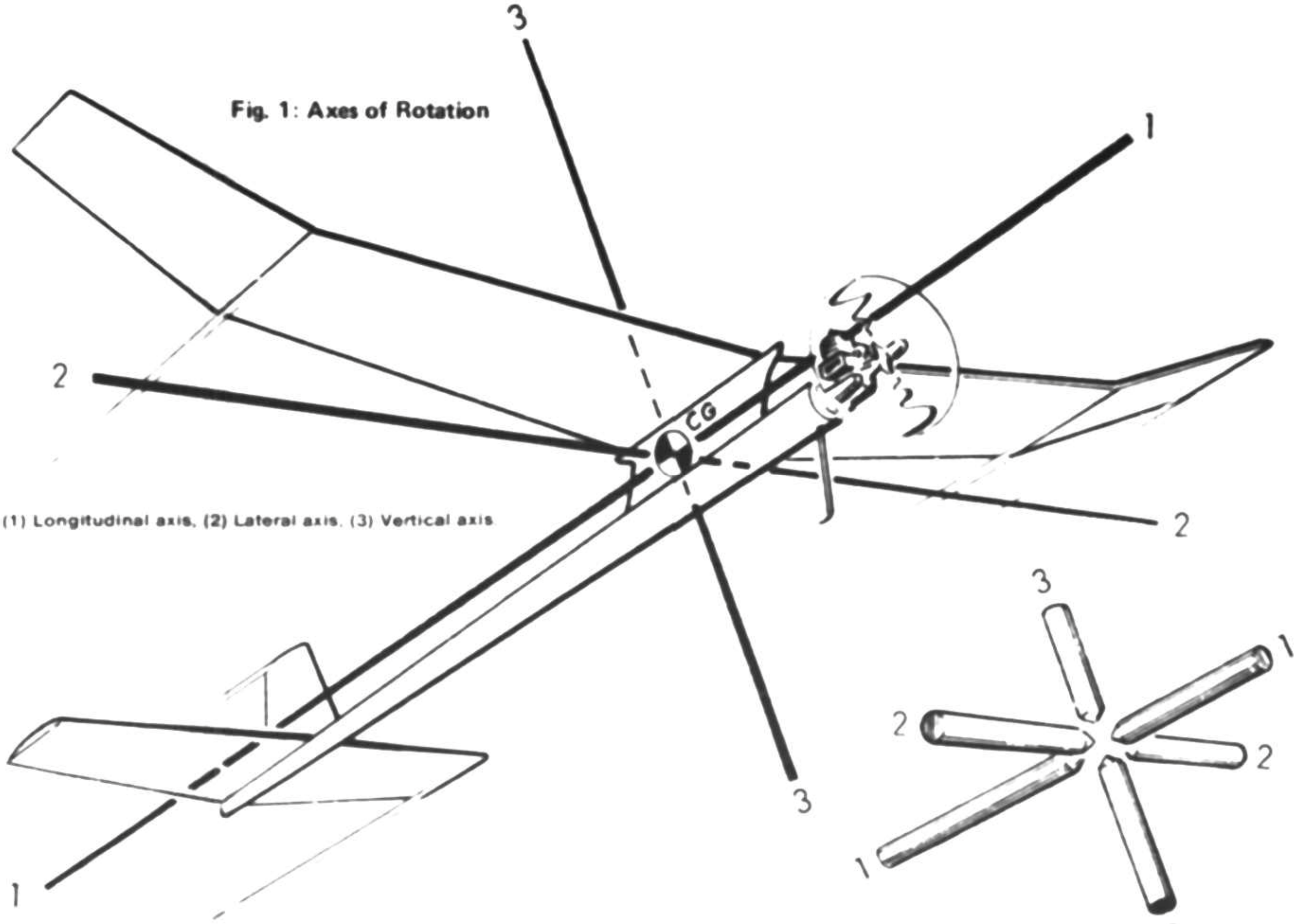


Fig. 1: Axes of Rotation

(1) Longitudinal axis, (2) Lateral axis, (3) Vertical axis

Illustrations by Jim Newman

PART ONE

TWO words sum it all up. . . “Very Carefully." Experienced free flight fliers, representing untold numbers and hours of flight testing echo these words, . . “Very Carefully.” I’d like to share with you this experience, and much needed know how, to help you adjust high powered, high performer“ models. Whether you’re a sport flier, or already competition minded, if you understand the aerodynamic theory, and apply the construction and adjusting techniques, you‘ll be spared traumatic test flights, fatal crashes, and even improve the caliber of your competitive flying.

To begin with. let’s put the problem in perspective. What is a high-powered, high-performance AMA Gas free flight model? High powered refers to the engine. For example, it has features such as: Schnuerle porting; ABC (aluminum bronze chrome) piston and sleeve; uses fuels containing more than 50% nitromethane; operates only on a pressure fuel system; no muffler, and turns in excess of 20,000 rpm. High performance refers to the model’s climb and glide, which is consistently capable of maxing out in dead air. AMA Gas refers to the AMA Gas classes, such as A, B, C, etc., for free flight models, flown according to the free flight categories with either 2 , 3 , or 5 minute maxes.

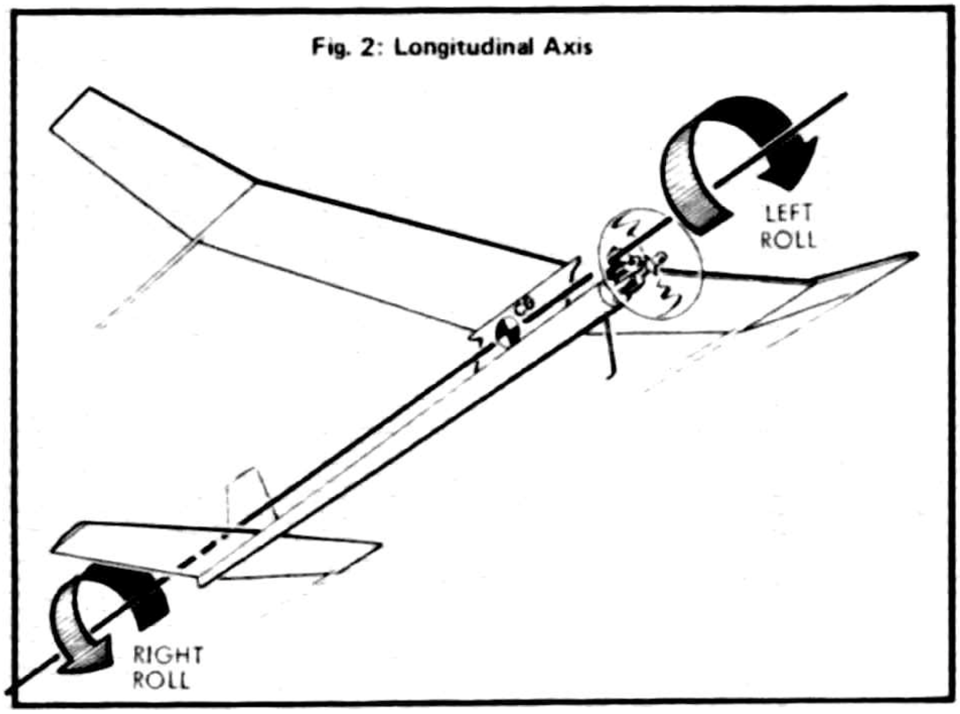
Let's also face the fact that a high- powered, high performance free flight model is more demanding than earlier generation free fight models. Consider too, that a model of this type has characteristics such as:

A very fast steep climb. Responds very quickly to the slightest adjustment Is less forgiving to unnoticed, minor warps or misalignment. Critical with regard to Center of Gravity location on the plans compared to actual construction. Requires quick DT for flight testing. May require auto rudder, or auto stabilizer, or both.

As you ponder what adjustments to make, you will see there's a lot at stake to achieve a better climb or glide. In the final analysis before you can logically proceed to adjust your new generation model, you *must* understand basic aerodynamic theory. Also try to anticipate the model's flight paths and build in adjustments to control the anticipated flight paths.

Aerodynamically, the model flies around three axis of rotation that pass through the Center Of Gravity (CG, or balance point) of the model. These axes of rotation are known as Longitudinal, Lateral, and Vertical axis (see Fig. 1).

Fig. 2: Longitudinal Axis



The Longitudinal axis (Fig 2.) runs lengthwise. front to rear passing through the Center of Gravity. It is sometimes called the "Axis of Roll" since it affects the roll of the model to the right, or left when viewed from the rear. Factors that will cause the model to roll are:

1**)** ***Stabilizer tilt***. When the stabilizer is tilted the model will bank toward the high stabilizer tip, and the more the tilt, the more the bank. As a general rule, do not tilt the stabilizer more than dihedral angle of the main wing panels. Tilt is effective during the glide, and has no effect on the climb. The greater the stabilizer area relative to the wing area, the more effective the tilt becomes. Stabilizers with less than 25% of the wing area are not effective to control banking by tilt. The banking force generated by stabilizer tilt also needs to twist the fuselage. Therefore, the fuselage must be built rigid to resist twisting which could change the effectiveness of the stabilizer tilt.

2) ***Wing tilt.*** Wing tilt tends to roll the model into the high wing tip, and is used to trim the glide circle, particularly when only a very small increase in turn is desired.

3) ***Wing wash-in or wash-out***. A wing panel is said to have wash-in when it is twisted so that the trailing edge is lower than the leading edge The lift is increased on the washed in wing, panel. causing the model to roll away from the washed in wing panel. For example, when viewed from the rear the

right main wing panel is washed in, the model will roll to the left. The amount. and rate of roll, depends upon the degree of wash-in and the speed of the model. The more wash-in. the more roll, As speed increases. the rate of roll increases. Conversely. as speed decreases, lift decreases, and rate of roll decreases

Wash-out is just the opposite of wash-in, The trailing edge is higher than the leading edge. reducing the lift. causing the model to roll into the washed in wing panel. The amount. and rate of roll. depends upon the degree of wash-out, and the speed of the model. The more wash-out. the more roll, and as the speed of the model increases, the rate of roll increases.

The most generally accepted method of controlling the right roll caused by the propeller slipstream is with wash-in or wash-out. on a main wing panel. Prefer ably. the wash -in or wash-out should be built into the main wing panel during construction, rather than twisting or warping with heat after covering and doping, The later practice affects the wing tip panel, which must then be warped to its former position.

To build in wash -in into the right main wing panel. place shims of the desired thickness, i.e. 3/32, 1/8", etc.. under the leading edge at the outboard dihedral joint. Then proceed as usual with ribs. spars, etc. Also. as a general practice, wash-out is used in both wing tip panels to improve the wing stall characteristics, and reduce drag in the glide. caused by the wingtips. Wash-out should be built into the tip panels during construction. Shim up the trailing edge of the tip panel to the desired thickness and complete as usual.

4***) Stabilizer wash-in or washout***. Like wing wash-in, stabilizer wash-in will cause the model to roll away from the wash-in. Stabilizer wash-out will cause the model to roll into the washed out side. Speed affects the amount of roll, and as speed increases, the roll increases.

5) ***Propeller slipstream***. On a right hand rotating propeller. when viewed from the rear. slipstream tends to bank the model to the right. The slipstream effect increases as engine rpm increases. Slipstream effect is greater on a pylon model than on a high thrust model.

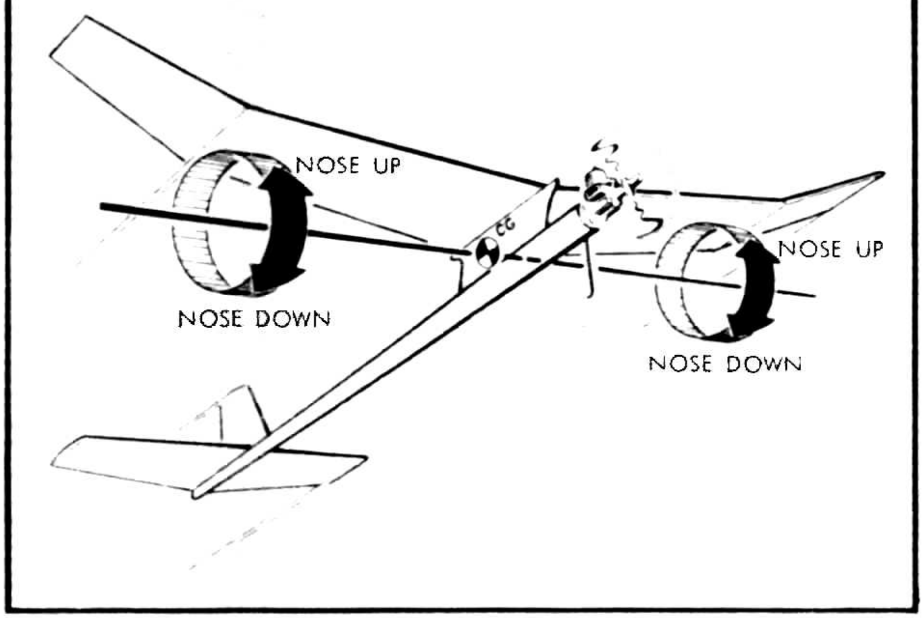
6) ***Propeller torque***. Torque is the reactive force generated by the turning propeller. that tends to revolve the model opposite to the direction of rotation of the propeller. On a conventional glow engine with right hand rotating propeller. when viewed from the rear, the propeller torque tends to roll the model to the left. As engine rpm increases. torque also increases. Propeller pitch affects propeller torque. As the pitch, or blade angle is increased. propeller torque also increases.

7) ***Cocking the wing*** off perpendicular to the center line of the pylon so that one side leads the other, will tend to roll the model into the trailing wing half. Likewise. placing the wing asymmetrical. off center on the pylon so that one side has more area than the other will tend to roll the model into the wing half with less area.

8) ***Wing heaviness*** The wing should be balanced so that both sides are equal in weight. if one side is heavier than the other. the model will tend to roll into the heavy side.

9) ***Dutch roll***. This is a term describing the rolling followed by a yaw to the right, a stable

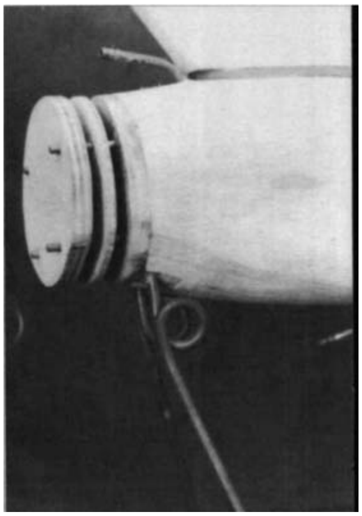
Fig. 3: Lateral Axis



return taking it past neutral into a yaw. and roll to the left in pendulum fashion. Dutch roll is caused by insufficient rudder area. and too much dihedral. The lateral axis (Fig. 3) runs span wise to the wing passing through the Center of Gravity. It is also called the Axis of Pitch since it affects the nose up(climb), and nose down (dive) movement of the model. Factors that will cause the model to nose up, or nose down. are:

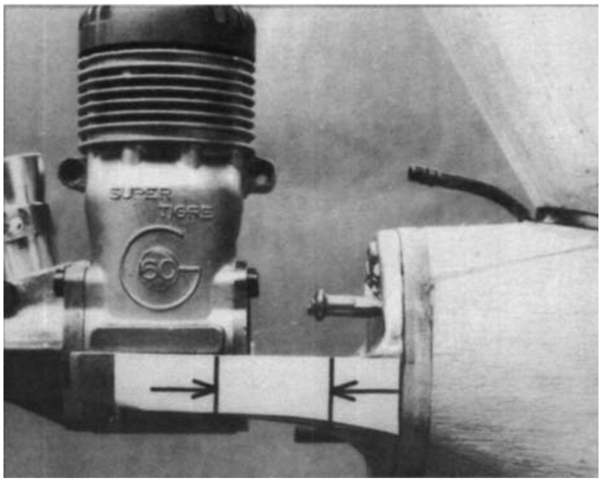
1. **Center of Gravity** (balance point) location. Since the three axes of rotation pass through the Center of Gravity, its location is the single most important point in the model. Under power, the farther forward the Center of Gravity (towards the leading edge of the wing), the more the model will tend to nose up. While the farther rearward (towards the trailing edge of the wing), the more the model will tend to nose down. Conversely, in a glide. the farther forward the Center of Gravity, the more the model will tend to nose down. While the farther rearward. the more the model will tend to nose up. For this reason. no attempt should be made to flight test the model until the location of the Center of Gravity is exactly as shown on the plans.

The Center of Gravity can be found by balancing the model. completely assembled. on the index lingers placed under a wing rib on each side of the wing mount. It may be necessary to add weight to the tail, or nose. to bring the Center of Gravity to the exact location on the plans. Plywood spacers between the firewall and the engine mount will shift the Center of Gravity forward. Also. positioning the engine farther forward on the metal engine mount will shift the Center of Gravity forward.



Center of gravity can be shifted forward with 1/8 or 1/4 spacers between firewall and engine mount. Large size bicycle spokes epoxied into fuselage and extending through firewall 1 inch, permit use of various size spacers. (See text for details.)

If the model is of the pylon type, the Center of Gravity can be accurately built into the model by installing the pylon during the final stage of construction. To do this, attach the stabilizer (covered and doped), the engine, propeller, timer, etc., onto the fuselage. The fuselage should be covered on 3 sides. Secure the pylon (including wing platform) to the wing, which is covered and doped, and secure the pylon to the fuselage with rubber bands. Now shift the pylon back and forth until the Center of Gravity is exactly as shown on the plans, by balancing the model on the index fingers. Mark the position of the pylon on the fuselage. and complete the installation of the pylon to the fuselage.



Center of gravity can be shifted forward or back by locating engine on mount with 1 Inch range between arrows. Note large size bicycle spoke and nut to hold mount to fuselage. (See text.)

If the model is of the high thrust line type, or has a pylon that uses bulkheads as part of the fuselage, which can't be shifted. then keep checking the Center of Gravity position during construction. Always assemble the entire parts of the model to the fuselage to check the balance point. Substitute spruce for balsa wood, add more dope to the stabilizer, step up to the next size piano wire for the landing gear, or change models of engines. These are a few of the many ways to shift the Center of Gravity. The added weight will not matter as much as the wrong location of the Center of Gravity (see Note 1 on page 9.)

Unfortunately, not all plans show the Center of Gravity location. In that case. there is a “ball park rule" you can use as a starting point to locate the Center of Gravity to start flight testing. This rule assumes an average stabilizer moment arm of 40% (distance from Center of Gravity to 25% of the stabilizer chord) of the wing span. And it compares stabilizer area with wing area. For example, if the stabilizer area is 25 to 40 percent of the wing area. the Center of Gravity can be located 65 to 80 percent from the leading edge of the wing. The greater the stabilizer area, the farther the Center of Gravity can be located from the leading edge. Stabilizers with area 25 percent or less than the wing area should have the Center of Gravity located closer to the leading edge of the wing, i.e. 55 to 70 percent. With a longer stabilizer moment arm, the Center of Gravity can be shifted rearward. This rule also takes into account the stabilizer has a lifting airfoil.

2. **Angle of incidence**. The angle of incidence (Fig. 4) is a fixed angle built into the model. It is the angle formed by the wing chord line (or stabilizer chord line), and an arbitrary reference line. If the leading edge of the chord line is raised higher than the trailing edge, in relation to the reference line, the angle of incidence is positive. Conversely, if the trailing edge of the chord line is raised higher than the leading edge, in relation to the reference line, the angle of incidence is negative. Positive incidence in the wing will tend to nose the model up, whereas positive incidence in the stabilizer will tend to nose the model down. Negative incidence in the wing will make the model nose down, whereas negative incidence in stabilizer will make the model nose up.

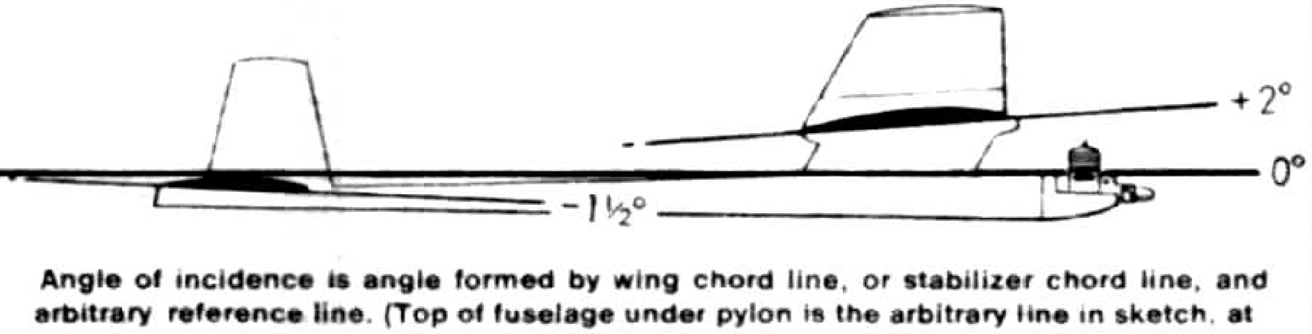
Here is a key point to remember when changing incidence in the stabilizer, especially when tilt is used in the stabilizer for glide turn: when you remove shims from under the trailing edge, it also removes some of the turn: or when you add shims under the leading edge it also increases the turn.

3. **Decalage**. Decalage is the angular difference between the wing and stabilizer. The greater the angular difference, the more the model will tend to nose up. Conversely, the less angular difference, the more the model will tend to nose down. (See Note 2 on page 9.)

4**. Engine down thrust and up thrust**. Down: or up thrust. when viewed from the side. is the angle formed by the thrust line (centerline of the crankshaft). and an arbitrary reference line. If the thrust line points down. the angle is negative, causing the nose to go down. If the thrust line points up, the angle is positive, causing the nose to go up.

5. **Engine power**. Engine power will cause the model to nose up as the power is increased.

Fig. 4: Angle of Incidence



Angle of incidence is angle formed by wing chord line, or stabilizer chord line, and arbitrary reference line. (Top of fuselage under pylon is the arbitrary line in sketch, at zero degrees.)

Depending upon the Center of Gravity location, if the Center of Gravity is too far back from the leading edge of the wing, the increased power will tend to nose the model down into a dive. If the Center of Gravity is too far forward. the increased power will cause the nose to go up.

6. **Stabilizer airfoil section**. If the shape of the stabilizer is similar to the wing airfoil. the stabilizer will also generate lift. The thickness of the airfoil, and the shape of the airfoil. determine the lift characteristics. As a general rule, the stabilizer airfoil thickness should be less than the wing airfoil thickness, and not more than 2 percent difference between them. For example, if the wing airfoil thickness is 10 percent of the wing chord, then the minimum thickness of the stabilizer airfoil should be 8 percent of the stabilizer chord.

7. **Angle of attack**. The angle of attack (Fig. 5) is the angle formed by the wing chord line and the line of flight. Therefore. the angle of attack is changing according to the wing attitude to the line of flight. The angle of attack determines the amount of lift. It follows, then, that the lift is also changing according to the change in the angle of attack. For example, as the angle of attack increases, lift increases until the stall angle of attack of the airfoil. The angle of attack should not be confused with the angle of incidence. These two angles have different reference lines. Namely, the line of flight is the reference line for the angle of attack, and is constantly changing. While the reference line for the angle of incidence can be an arbitrary line with the angle built into the model.

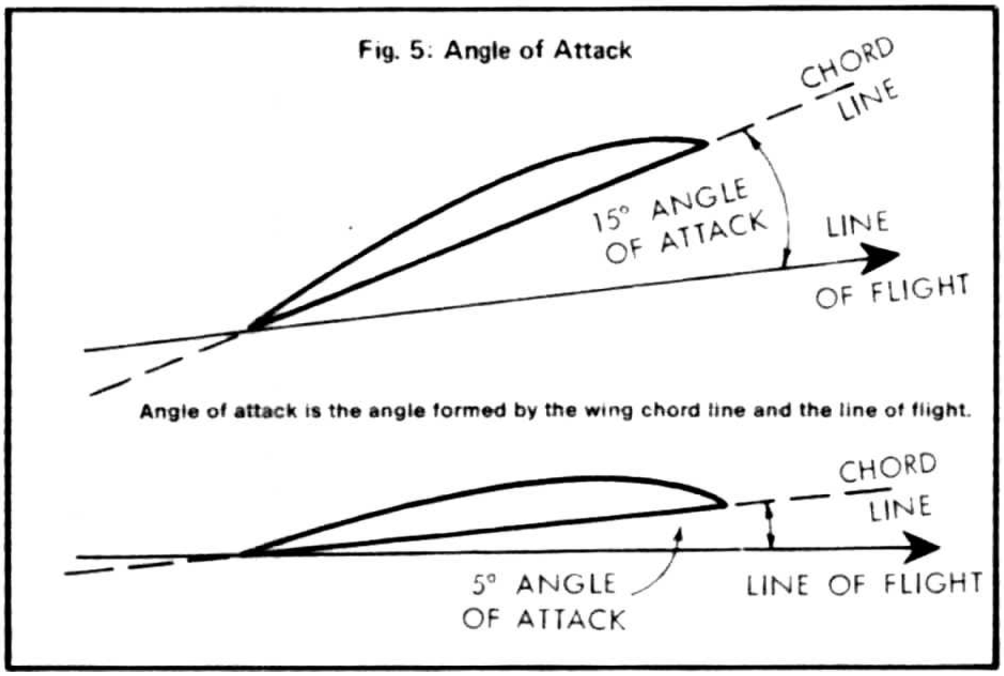


Fig. 5: Angle of Attack

Angle of attack is the angle formed by the wing chord line and the line of flight.

8**. Pylon height and thrust line position**. Lowering the pylon height or raising the thrust line position produce the same effect to reduce the nose up tendency during the climb. Raising the pylon height. or lowering the thrust line position, will tend to increase the nose up attitude.

9. **Stabilizer position in relation to wing downwash**. Positioning the stabilizer in the wing downwash will cause the model to nose up in the climb, This is due to the downwash striking the top surface of the stabilizer. forcing the stabilizer down and the nose up. The longer the stabilizer moment arm (distance from the wing), the less effective downwash becomes on the stabilizer, For this reason, a smaller size stabilizer can be used.

The Vertical axis (Fig. 6) runs vertical from top to bottom, passing through the Center of Gravity. It is also called the "Directional, or Turn" axis since the model turns around this axis either right or left. Factors that will cause the model to turn right or left are:

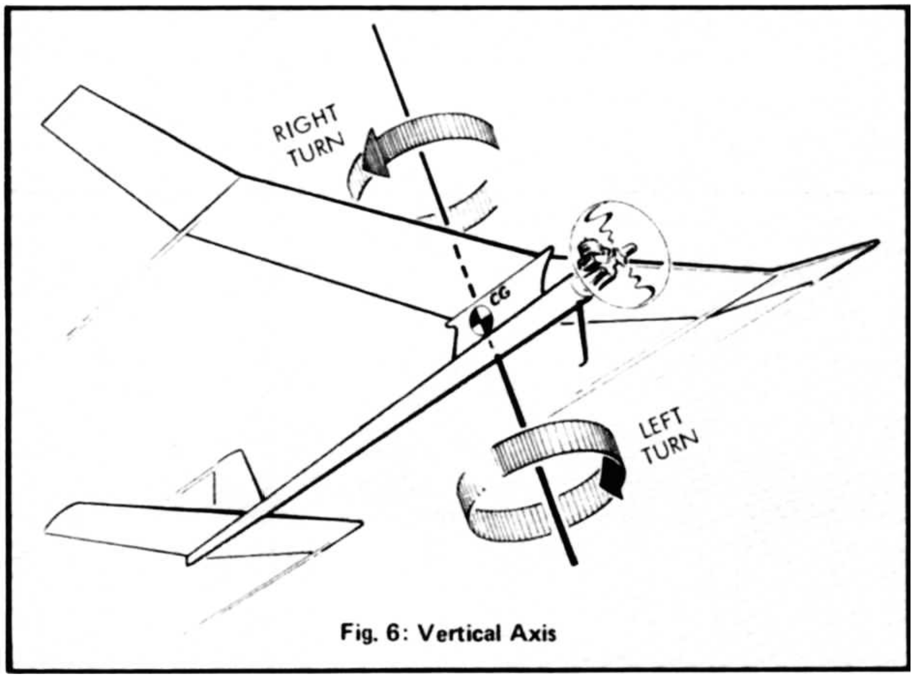
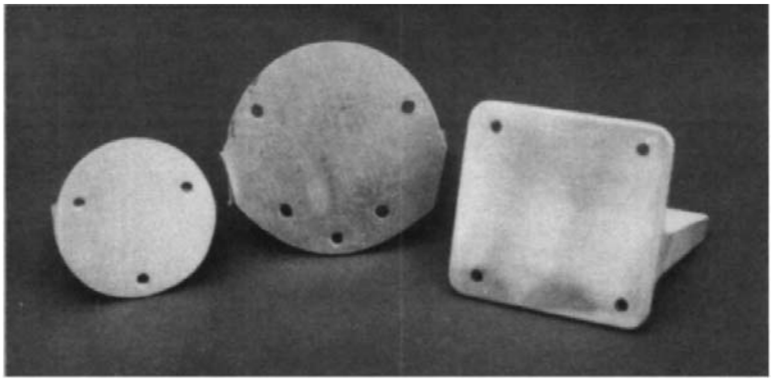


Fig. 6: Vertical Axis

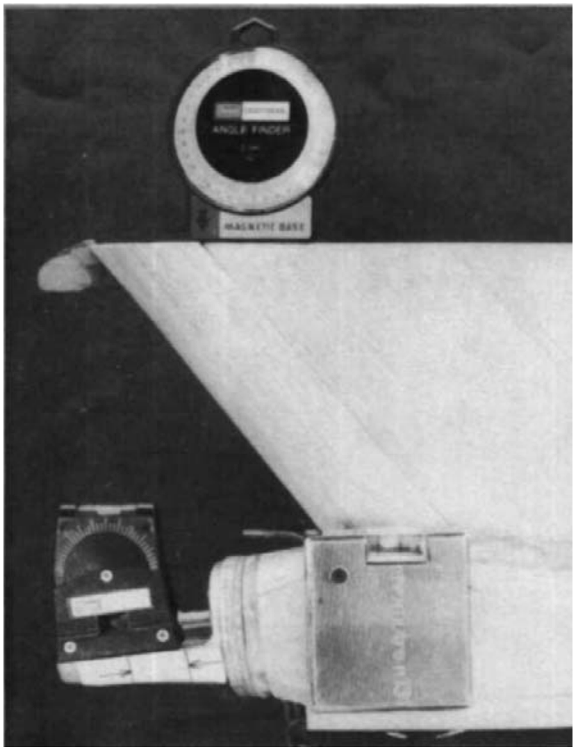
1) ***Vertical fin or rudder tab offset***. Positioning the vertical fin or rudder tab off center to the centerline of the fuselage, when viewed from the top, will cause the model to turn. Offsetting the trailing edge of the vertical fin, or the rudder tab to the left of the fuselage centerline will turn the model to the left. As the speed of the model increases, the effectiveness of the offset fin or rudder tab increases, Therefore, when flight testing, make very small movements to the vertical fin or rudder tab. Not more than 1/32" each flight. A piece of trailing edge stock glued to the trailing edge of the fin makes an excellent tab instead of cutting into the fin. Different thicknesses of balsa wood can be glued to the trailing edge stock to increase the turn, or wood can be shaved off the trailing edge stock to decrease the turn.

If a tab is to be used for turn adjustment, and no specific location is shown on the plans, locate the tab near the base of the trailing edge of the vertical fin. Locating the tab near the top of the vertical tin will tend to cause a rolling effect, around the Longitudinal axis, as well as a turn, and thereby not achieve the desired results.

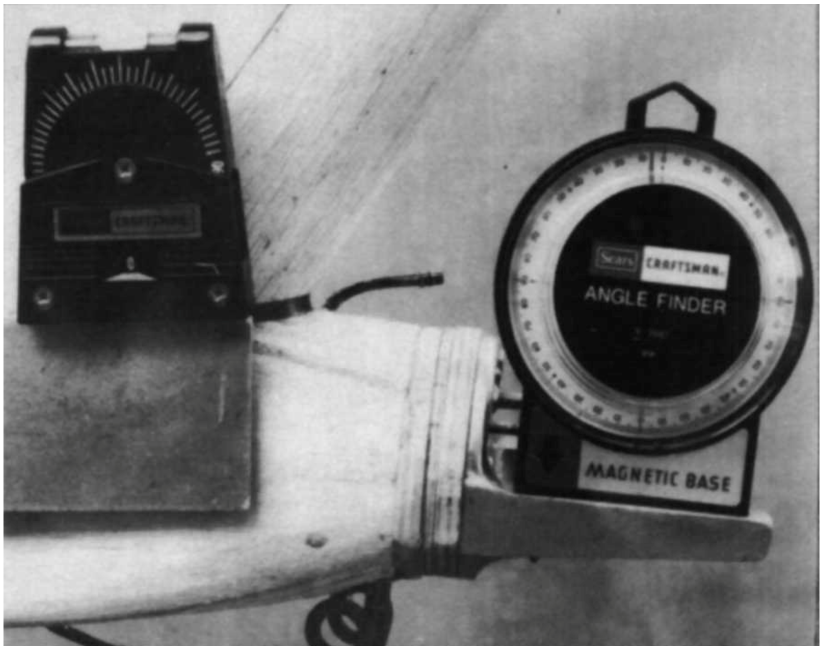
2) ***Right or left engine thrust***. Right or left thrust, when viewed from the top, is the angle formed by a line drawn lengthwise through the center of the crankshaft, and measured either right or left of the centerline of the fuselage. Cocking the engine thrust line on off center will cause the model to turn in the direction of the engine thrust line. Engine thrust offset is effective at low speeds, and as speed is increased, thrust offset becomes less effective. For this reason, thrust offset is used primarily to control the initial part of the climb, and vertical fin or rudder tab offset is used to control the remainder of the power climb.



Off-the-shelf engine mounts: Mount on right square with four holes, best for oflsetting engine side-thrust. Mount in center, similar to mount on left, modified by adding two holes at bottom for more accurate side-thrust settings. (See text for details.)



Left: Measuring down-thrust with Sears Protractor Level; and wing angle of incidence with Sears Angle Finder. Reference line is set at zero degrees at level with use of regular spirit level. (See text.) **Below:** Measuring down-thrust with Sears Angle Finder. Note pointer at 5 degrees. Sears Protractor Level set at zero degrees of level, using metal scale set parallel to top of fuselage. Note zero reading in window of protractor level resting on metal scale, and bubble between marks indicating level. (See text for details.)



Selection of bubble protractors to measure down-thrust and angle of Incidence of wing or stabilizer. Reading clockwise from left: Surplus prop blade angle protractor; Sears Protractor Level: Sears Angle Finder: precision protractor (can be used with 12 in steel scale). See text.

Finally, the model must have stability. Without stability around each axis of rotation it is doomed to self destruction. Stability is the ability of the model to resist changes from normal flight. It is also the ability when upset by an outside force, such as a gust of wind, to recover, and return to normal flight. The designer of the model determined certain stability factors, such as dihedral angle, size of stabilizer and vertical fin. You, too, must decide certain stability factors, such as angles of incidence of wing and stabilizer, amount of rudder tab offset, engine thrust offset, etc. You have a vital role in the eventual stability of the model.

We're about ready to go flying, and we'll do just that in Part Two. Meanwhile, in your spare moments, become familiar with checking the decalage on one of your models using a bubble protractor and spirit level. Use the spirit level to establish a reference line that for convenience is zero degrees.

Then with a bubble protractor, measure the angle of incidence of the wing and stabilizer. The angular difference between them is the decalage.

Do the same to measure the down thrust Also experiment with different thicknesses of wood to see how much it takes to change the angle of incidence one degree in the wing and stabilizer. If you don't have a bubble protractor, Sears has several inexpensive types, available at retail or catalogue order. For example, Angle Finder #9 3987 retails here in Los Angeles for $3.99. Add Protractor Level #9 3990 retails for $2.89. Either style is excellent for model use. Also check the hardware stores for a precision style bubble protractor, and don't overlook the Army Surplus stores for an obsolete propeller blade angle protractor.

Lastly, experiment with shifting the Center of Gravity on one of your models. Use lead fish weights. Any sporting store has fish weights in all sizes, and increments of an ounce, or ounces. Don't forget to check the wing and stabilizer for wash-in or wash-out. Armed with this new knowledge, we can honestly say we're ready to go flying.

Note 1: Center of Gravity is a thing physicists call a "resultant." For example, if four different weights were placed on a long board, each one would push down a different amount at a different place. But the total forces downward could be considered as a single force pushing down from whatever point along the board would be necessary to give exactly the same effect as the four different weights. That "resultant" point is called the Center of Gravity. Therefore any change of weight or location on the board will shift the balance point from the original CG location. A model is nose heavy when the balance point is further forward in relation to the designed Center of Gravity.

Note 2: Baughman's Aviation Dictionary defines Decalage as a difference in angles of incidence of the wings of a biplane or multiplane. It is measured by the acute angle between the chords in a plane parallel to the plane of symmetry. Rightly or wrongly, many modelers, including the author, have expanded the term to include monoplanes when referring to the difference in angles of incidence of the wing and stabilizer.

PART TWO

There are three elements leading to a consistent max in dead air, namely, a fast steep climb, a smooth transition, and a low sink rate glide. The key to success is selecting trim adjustments that are in harmony with each other from launch to the end -- a max. How do you go about making a selection? Answer. ***Fly it, try it, and fly it again.***

The main ingredients of our new generation free flight models are: high speed climb, super engine power, and a quick response to adjustments. It makes sense then to concentrate on the adjusting techniques affecting the climb pattern. Once the climb is adjusted to our liking, the glide can then be ironed out. And if the glide adjustment also affects the climb, we'll have to re adjust the climb again before proceeding with the glide. This seesaw procedure is needed because adjusting techniques, such as shifting the Center of Gravity (CG), and decalage, are often used to adjust both climb and glide.

To begin with, hand test gliding a high powered, high performance model is useful only to verify CG location and decalage. The test glide shows us the CG is sufficiently forward and that there is enough decalage to keep the nose up during the initial climb on the first flight. If not the CG is shifted farther forward and decalage increased to assure a nose up attitude. Very little time is spent hand test gliding to adjust the glide sink rate or glide circle, the reason being that it is very difficult to duplicate the actual flying speed by hand test glides.

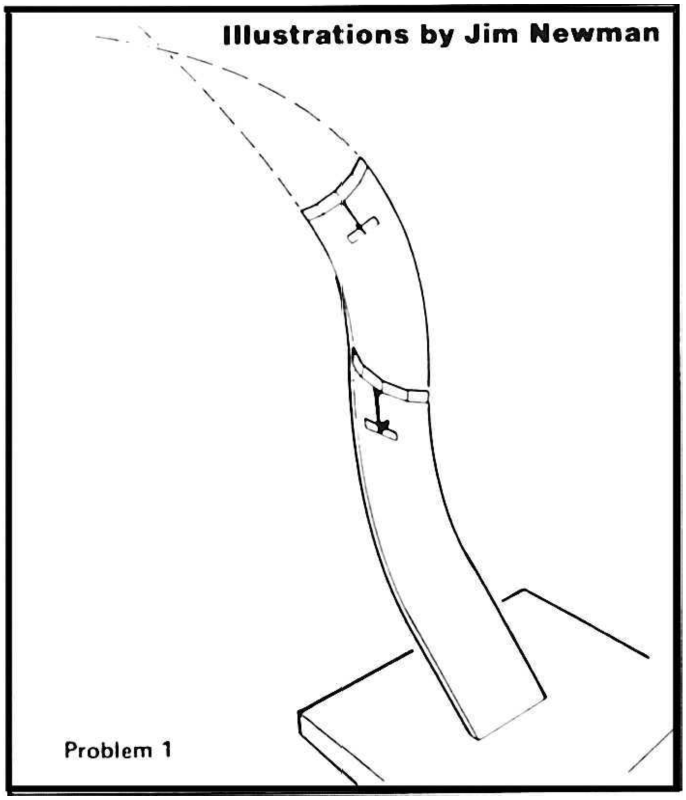
Significant, too, in the adjusting procedure is the use of short engine runs (3 seconds) at or very near full power, followed with quick DT. Engine runs are successively increased 1 or 2 seconds, provided the climb pattern on the previous flight was safe. Conversely, engine runs are reduced 1 or 2 seconds depending upon the trim adjustments made following the last test flight. The logic of using short engine runs at. or very near, full power is sound. Fewer adjustments need be made using this high power. For example, test flights using longer runs at low power will have to be re» adjusted each time the power and speed increase. The use of quick DT 2 to 3 seconds after engine shut off is a must. It is a safety factor as well as a time saver in chasing. The interval before quick DT varies as the test flights progress from climb, to transition, and to eventual glide adjustment.

Let's consider some typical flight test problems and select trim adjustments from the options available for the particular design. The design of the model must be taken into consideration because each design has flight characteristics peculiar to itself. To make matters more complicated, no two models of the same design will fly exactly alike with the same flight trim adjustments. That’s why the name of the game is *fly it, try it, and fly it again*. Fortunately, there are adjustments that can be used safely with many models comparable to the design planforms described. The following problems are ones you’ll likely to encounter and careful application of adjustment techniques explained should help you adjust a comparable model.

Problem 1: Model grooves in a steep right climb for 6 to 8 seconds, after which the right wing starts to raise up, and the turn begins to straighten towards the left. The climb attitude remains steep. Any further engine run would result in a climbing left roll. The problem involves the Longitudinal and Vertical axes.

For pylon designs with wash-in on the right main wing panel, which use right or left thrust, the raising of the right wing after 6 to 8 seconds is due to wash-in becoming more effective with speed and eventual left roll. Thrust effectiveness decreases with speed and is not the cause. To reduce the left roll, decrease the wash-in slightly. Make no other adjustments.

For pylon designs with wash-out on the left main wing panel and which use right thrust, the wash-out of the left wing panel becomes more effective with speed, raising the right wing as speed builds up in 6 to 8 seconds, rolling the model to the left. Some designs also use left fin or rudder offset with wash -out to control the right bank. Fin and rudder tab effectiveness increase with speed In this case. you have the option to reduce the left rudder tab, or washout to reduce the left roll. Increasing right thrust is the “last chance" option.



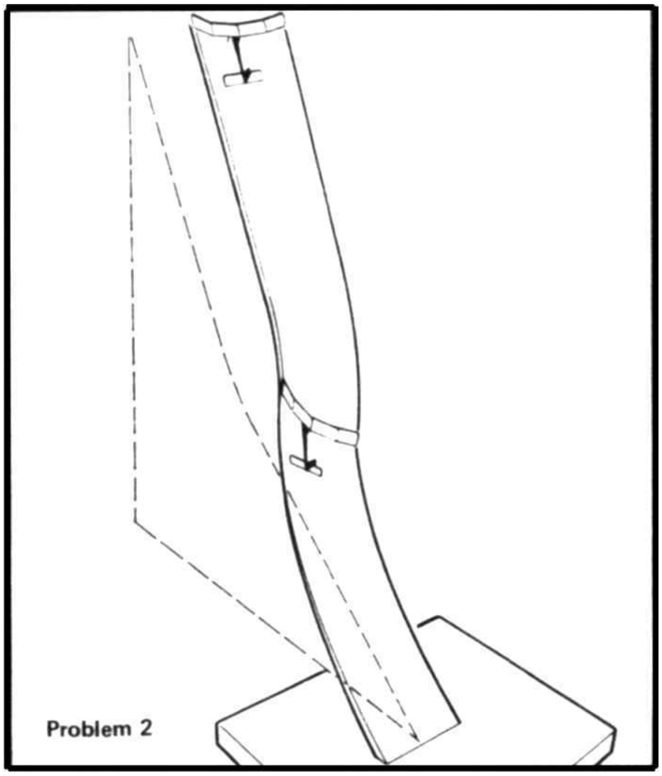
Problem 1

For pylon designs with no wing wash-in or wash-out, that use left vertical fin or rudder offset, with or without thrust offset. The raising of the right wing after 6 to 8 seconds is due to increased effectiveness of the left fin or rudder offset as speed increased. Thrust looses effectiveness with speed and is not the cause. Decrease the left fin or rudder offset, and make no other adjustments.

For high thrust line designs, the model is climbing in the wrong direction Check carefully for wing warps. There should be no wash-in in the left main panel, or wash-out in the right main panel. Also check the thrust offset. There should be no right thrust. Use rudder tab offset to the left to control the model into a climbing left turn.

Problem 2: Model grooves in a steep right climb for 9 to 10 seconds, after which the climb angle increased slightly, and the turn started to straighten towards the left, with the right wing starting to raise. Another few seconds (full 12 seconds) engine run, the wing would be almost level with the horizon at a steep climb angle. The problem involves the Longitudinal and Vertical axes.

For pylon designs with wash-in on the right main wing panel, which use right or left thrust, the wash-in is still the reason for the changes the last few seconds. Don't change the wash-in. Instead. add



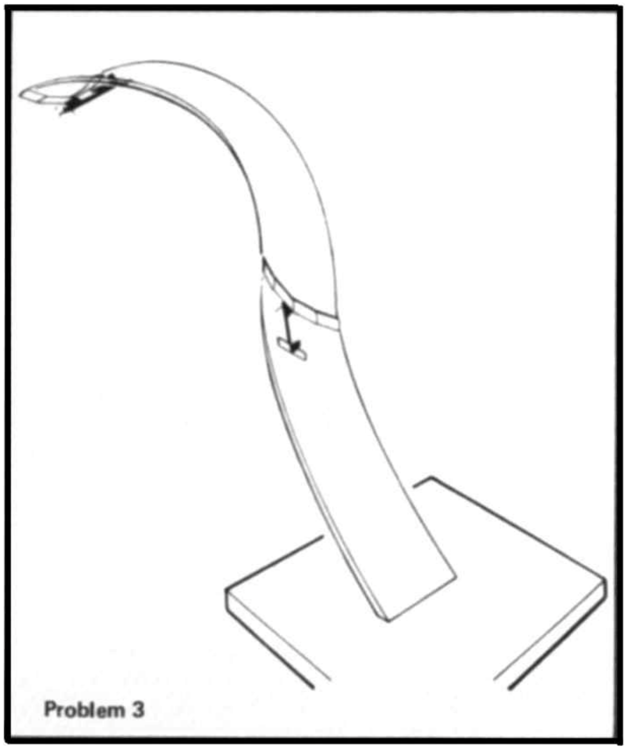
Problem 2

a very small amount of right rudder tab offset. The right tab will start to become effective as speed builds up (6 to 8 seconds), and will keep the model grooving by overpowering the wash-in the full run. Moreover, if the model is set to glide right which is the preferred and safest direction, the right tab will help the transition by holding the model in a right turn. As speed decreases, the right tab looses effectiveness, and the stabilizer tilt then takes over for the glide turn. Make no other adjustments. If the model is set to glide left, the small amount of right»rudder tab should not adversely affect the transition or the glide. If it does, then don‘t use the right tab offset. but reduce the wash-in. The traditional right climb, left glide pattern when using stabilizer tilt and wash-in on the right wing or wash-out on the left wing, could result in the model diving in the glide. Particularly if the glide speed increases, due to upset by a gust of wind, the increased speed increases the effectiveness of the wash-in and washout, resulting in a left rolling dive.

For pylon designs with wash-out on the left main wing panel and which use right thrust, and designs also using left rudder, the wash-out and or left rudder are still the reason for the changes the last few seconds of the climb. For designs with left rudder, wash-out, and left glide, I would fly again, only this time run the full 12 seconds with quick DT set for 6 to 8 seconds after the engine cuts. There may be sufficient speed at the end of the run for a smooth transition to the glide. If the glide is set to the right, the climb angle may be too steep at the end of the run, causing a slight stall before transition to the right glide. For designs only using wash-out, reduce wash-out.

For pylon designs with no wing wash-in or wash-out, that use left vertical fin or rudder offset, with or without thrust offset, the left rudder offset is still too much the last few seconds of climb. Decrease the left rudder offset very slightly, make no other adjustments.

Problem 3: Model grooves in a steep right climb for 8 to 10 seconds, after which the nose starts to drop, flattening the climb angle. The right wing raises slightly and the turn starts to straighten, while the speed increases very rapidly. Any further engine run would result in further flattening out and nosing over into a dive. The problem involves the Lateral axis.

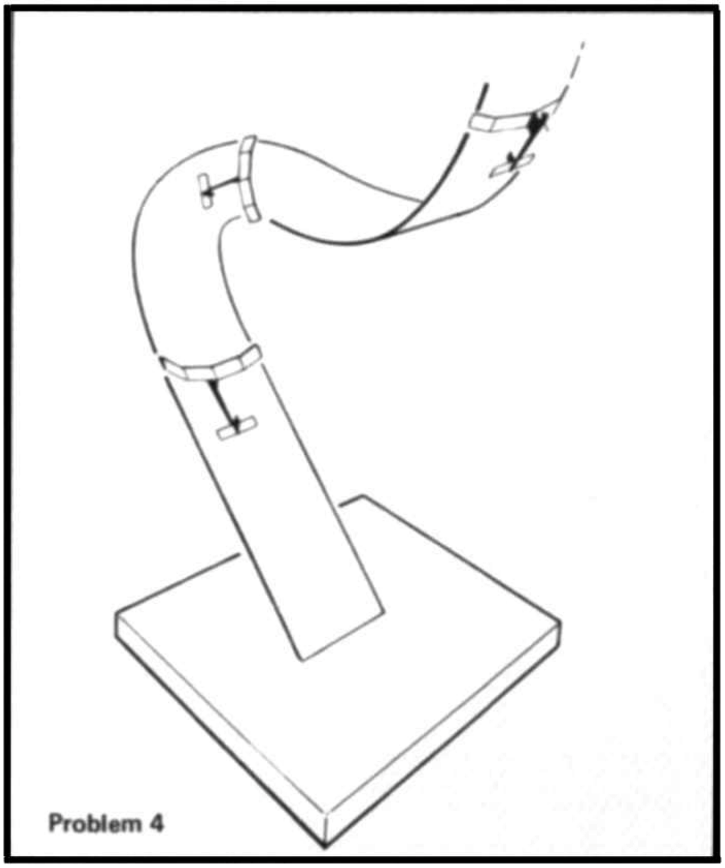

Problem 3

Most pylon designs could encounter this problem. It is likely due to a rearward location of the CG and/or insufficient decalage. Check the location of CG to plans. If the CG is farther back than plans show, shifting the CG forward 1/8 inch at a time will bring the nose up. If the CG is correct as per plans, the other option is to increase the decalage. The wing should have 1/2 to 1 degree positive incidence. If not, increase the wing incidence before changing the stabilizer incidence. If the wing incidence is 1/2 to 1 degree positive, then change the stabilizer incidence so the net result is an increase in decalage. Use a bubble protractor to accurately measure the angles with reference to a base line arbitrarily set at zero degrees.

High thrust line designs could also encounter this problem. The climb pattern would be a steep left climb, rather than a right climb, but it too, would flatten out would also go into a dive. The causes would be the same as for a pylon model the correction would be the same as for a pylon model.

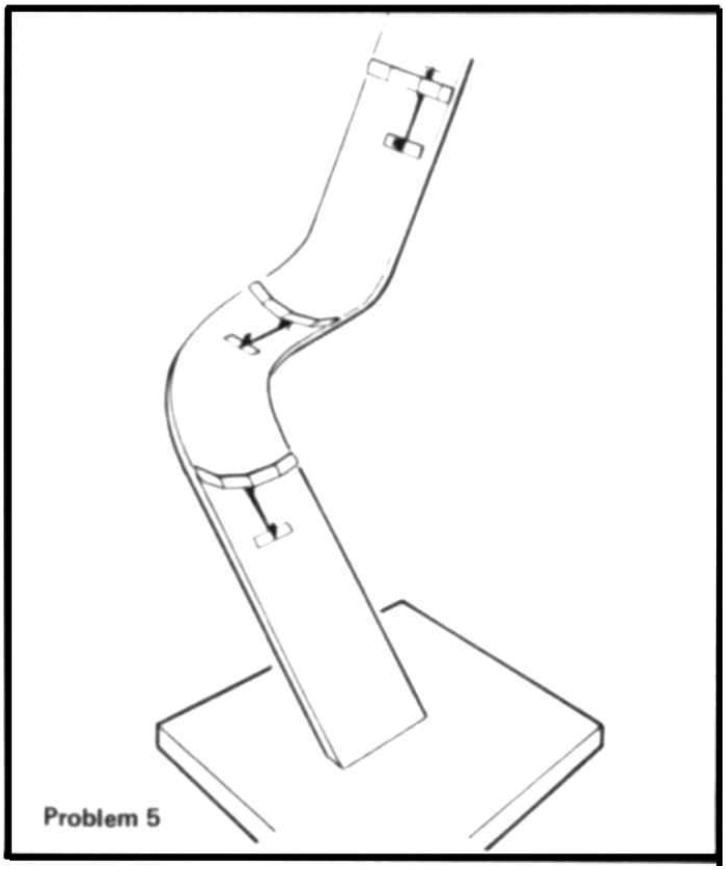
Problem 4: Model grooves in a steep right climb for 4 to 5 seconds, and then the nose drops, right wing drops, and speed builds up. It makes a scary one quarter to one half circle to the right before raising the nose and right wing to resume the right climbing turn. The problem primarily involves the Lateral axis.

Many pylon designs encounter this problem. Actually, the model is making a side ways loop, caused by either a forward CG location or too much decalage, or both. Check out the CG. If the CG is farther forward than the plans specify, shift the CG rearward 1/8 inch at a time towards the correct location. Also check the decalage against the plan. If decalage is more than plans specify, you also have the option to reduce decalage. However, proceed very cautiously by making only one adjustment at a time. Don't exceed the specified CG location without trying the other options also. In some cases the plans may call for thrust offset and or wash-in, or wash-out on a main wing panel. Check these adjustments too, and if neither is correct, you have more options to consider.


Problem 4

Problem 5: Model starts a steep right climb, and after 1 to 2 seconds dips to the right building up speed, and then resumes a steep right climb. The problem involves the Vertical axis.

There is one other aspect to the problem. The dip can be due to the angle and direction the model was launched. If it was launched near vertical, or steeper than the normal climb angle, it will dip right after launch. Also, if it was launched crosswind so that the wind strikes the left half of the wing greater than the right, which would occur when the nose is banked and pointed to the right of the wind. The launch is very important. The model should be pointed up at about an 80 degree angle and almost dead center into the wind with a slight right bank. Never launch a pylon model to the left of the wind, or more than a few degrees to the right of the wind. And never bank the model more than a few degrees to the right while launching. If the launch was correct, the dip right after launch is due to the thrust offset.


Problem 5

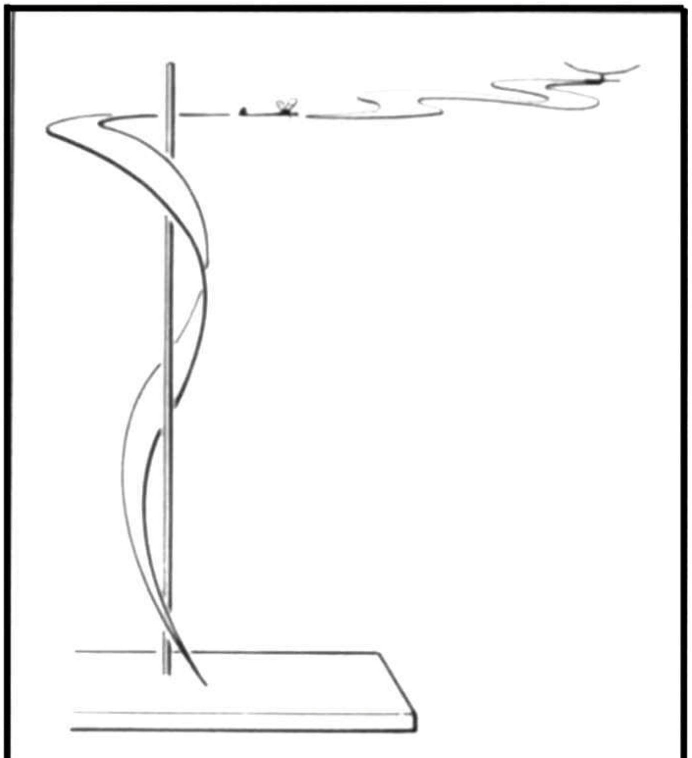
For pylon designs with wash-in on the right main wing panel, which use right or left thrust, check the thrust offset. If right thrust is used, reduce the right thrust If left thrust is used, increase the left thrust.

For pylon designs with wash»out on the left main wing panel and which use right thrust, reduce the right thrust.

For pylon designs with no wash-in or wash-out, that use left vertical fin or rudder offset, with or without thrust offset, crank in left thrust.

For high-thrust-line designs, better watch that launch, or else put in more left rudder tab offset. You never want to climb right.

Problem 6: Model grooves the full engine run, and the transition is satisfactory. The glide starts out turning to the desired glide direction. but slows down upwind, and starts turning the opposite direction. It now speeds up downwind, and again starts to change turn direction, slowing down up wind, repeating the wandering. The problem involves the Longitudinal axis.


Problem 6

For pylon designs with wash-in on the right main wing panel, with stabilizer tilted for a left turn, the wash-in is too much, causing drag. The drag increases upwind as the model slows down, and turns the model to the right As speed builds up downwind, the drag decreases, and lift increases, turning the model to the left. The process keeps repeating.

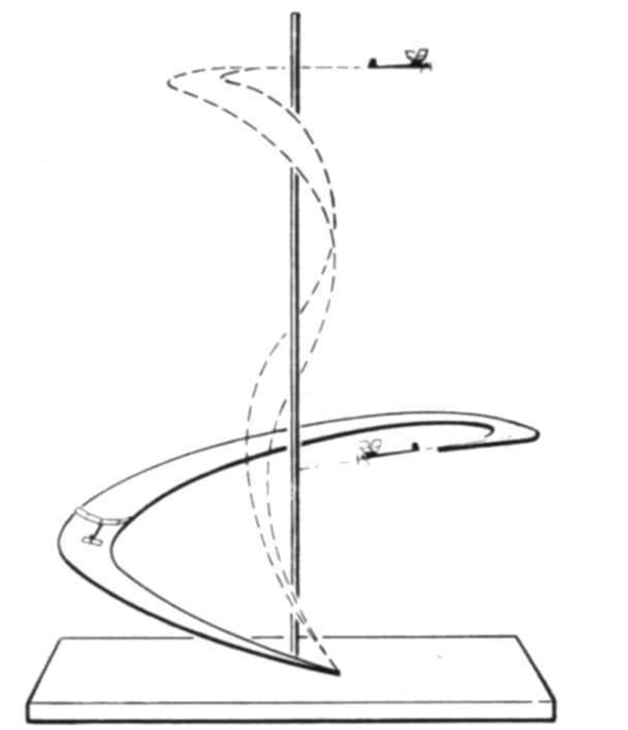
You have several options. The first is to change the glide circle from left to right. Depending upon the size of the stabilizer, and the amount of tilt, the model may glide to the right without changing the wash-in. If you want to stay with the left glide, the other option would be to reduce the wash-in, and readjust the climb. (Increasing the left tilt will cause the model to be unstable, and dive to the left if speed increases in the glide.) With reduced wash-in, the model will bank and turn tighter to the right during climb. Use left vertical fin or rudder tab offset will help the transition by initiating a left turn as soon as the engine cuts, and will assist the tilt for left glide. If the glide circle was originally set for a right glide, then increase the stabilizer tilt. However, it may also be necessary to decrease the wash-in if stab tilt does not make the model turn right. If wash-in is reduced, readjust the climb using right rudder as required, to bank right in the climb.

For pylon designs with wash-out on the left main wing panel, and stabilizer tilt for left glide turn, the wash-out becomes effective upwind due to the decreased speed The stabilizer tilt is trying to overpower the wing forces, but can’t quite make it. Therefore, increase the stabilizer tilt for more left glide turn. Be careful not to use too much tilt which could cause the model to be unstable in the glide turn. Too much tilt would increase the turn into the washed out wing which, when upset by a gust of wind, could cause it to dive in to the left.

For pylon designs with no wash-in or wash-out, that use left vertical fin or rudder offset, and high thrust line designs, the stabilizer tilt is not enough to keep the model turning left or right, as the case may be. Also, the left rudder tab offset may be affecting the turn as the speed increases downwind, causing some of the wandering. Increase the tilt for either more left or right turn, as the case may be.

Problem 7: Model grooves the full engine run at a shallower angle than you like. It also makes about 1/2 to 3/4 right turn during the full 12 seconds, and you want at least 1 to 1 1/4 turns. The transition is good, but the glide is too fast, nose down. The problem involves the Lateral axis.

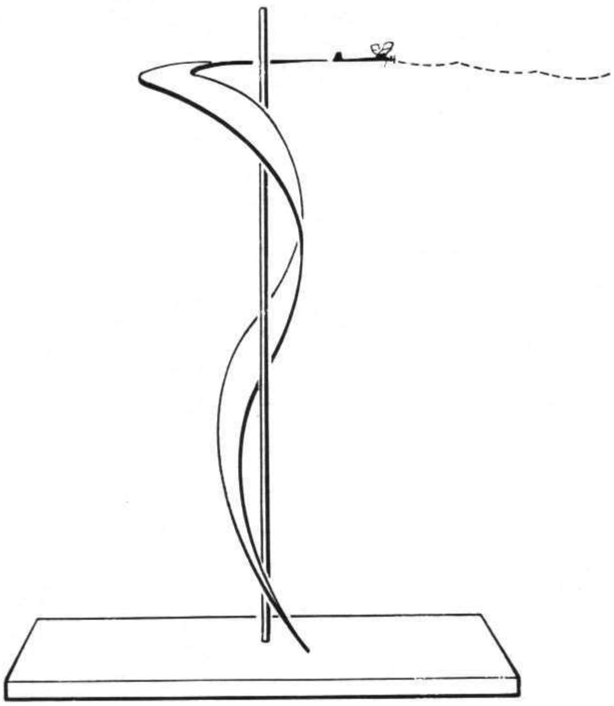
For pylon models, this is an overall nose down tendency caused by insufficient decalage. Increasing the decalage by decreasing the positive angle of incidence of the stabilizer will raise the nose up in the climb, and in the glide. When decalage is increased, it also increases the tendency of the model to turn right in the climb, and conversely, decrease the turn (right or left) in the glide. Therefore, increasing the decalage will result in increasing the right turn in the climb to the desired 1 to 1 1/4 turns, and slow up the sink rate in the glide. Adjust glide turn with stabilizer tilt.



Problem 7

Problem 8. Model grooves in a steep right climb, transition is perfect. The glide turn is perfect, but there is an occasional slight stall. The problem involves the Lateral axis.

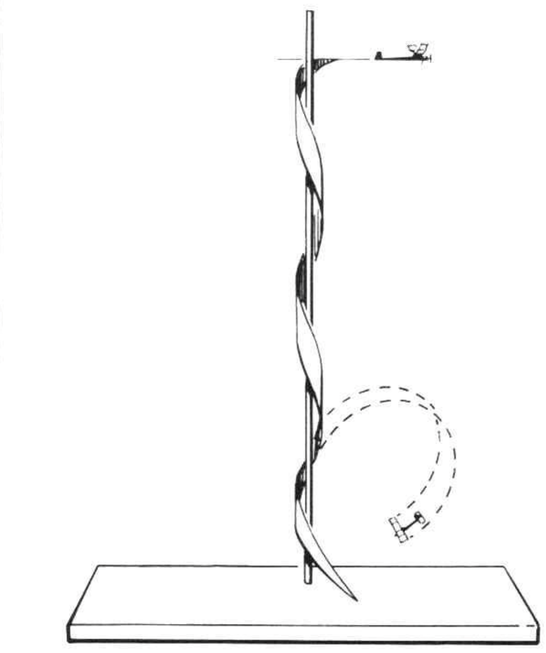
For most pylon designs, and high thrust models, this is an easy problem to cure; however, many fliers fight the cure. Simply add a little weight to the nose to reduce the stall. You'd be surprised the alibis used to keep from adding weight. The weight will actually help the model penetrate upwind and improve the glide sink rate.



Problem 8

Problem 9: Model grooves in a steeper climb than you want, but the transition is good, and the glide is perfect On a calm day, the climb pattern would be alright. However, the least bit of increase in wind could make the model loop in the climb. This problem involves the Lateral axis.

For most pylon designs and high thrust models, this, too, can be an easy problem to cure. And here again, adding weight as a cure seems to be offensive. Reduce the decalage to flatten the climb, and add weight to the tail to adjust the glide. The decalage can be reduced by shims under the leading edge of the stabilizer which will bring the nose down in the climb. The reduced decalage will speed up the glide; however, the added weight to the tail will restore perfect glide. The few grams added to the tail to get the glide adjusted perfectly won't add to the wing loading enough to change the glide.



Problem 9

I hope the above problems will give you a better insight into adjusting that new generation of gas free flight models. While making the adjustments mentioned above, there are a few do's and don'ts that also merit consideration. When adding incidence to the wing or stabilizer, don't use balsa wood shims. Balsa wood compresses and will change the adjustment. Use 1/64, 1/32, or 1/16 plywood shims. If shims less than 1/64 are needed, use brass shims. Any auto parts store has brass shim stock in various sizes. If the vertical fin is to be used for offset instead of a rudder tab, be sure to rekey the stabilizer when the fin is on the stabilizer. Again, use hard woods.

If a metal engine mount is used, be sure that side thrust can be added without also adding down thrust. For example, when adding side thrust to a mount with only three mounting holes, down thrust is also added, which is not needed. Re drill the mount so that there are four mounting holes, and don't use the original center bottom hole for mounting. The four holes can be spaced so that when side thrust is needed, you don't get down thrust. Use metal shims for all engine thrust adjustments when using metal mounts. To keep the shim from pressing into the plywood firewall, use an .020" aluminum spacer against the firewall and the metal mount. Insert the metal shim between the aluminum spacer and the mount. Check the DT line for tension. Too much tension can bow the fuselage, changing either the decalage or the vertical fin or rudder offset.

One final thought. Stand on your own decisions as to what adjustments to make. It's your model, and your decision; don't let some bystander try to con you into other adjustments against your judgment. You've built into your design, or model, things he doesn't know about. Even if you do make a mistake, let it be your decision. You'll learn more by making your own decisions. I sincerely hope the information in this article will help you make the right decision . . . . . to continuously max in dead air.

None other than "The Master," Carl Goldberg, making one last check of the engine timer before launching his latest high-thrust Skyrocket design. Note forthcoming steep launch angle. See text for details.

Junior Joey Foster gets off a perfect launch—feet In air of his dad's National Record Holder Class A-B called Buck, powered by Schnuerle K&B 3.25 and 3.5 nitro-breathing engine. Again, note steep angle and barely perceptible right bank. Sophisticated "gimmickry." Dad, once the world champ in Wakefield, a leading Pylon flier, is struggling to find time to compete. Article on Buck in 9/83 MA.

Making a prefect hand-launch of his Mach Zu, Glen Schneider releases the ship at a steep angle in a slight right bank— note angle of trailing edge of stab with the horizon. The 735 sq. in. ship is powered by a K&B Schnuerle Class C engine. See text for launching techniques.

Problems increase with speed, as badly damaged wing attests. Wing flutter at high speed caused this havoc to 1175 sq. in. wing of author's OS Max 65 RR Schnuerle powered Excelerator D Gas design. Too little incidence did it in-see Problem 3 in the text.. And the wing was a toughie-full geodetic ribs, spruce turbulating spars, silk covering.