SETUP FOR FLIGHT and LANDING

by Harley Michaelis (June 12, 2009)

Note: Much content of these pages is specific to the Genie line of airframes, but parts about balance, trim, decalage, throws, mixing, towhook location, initial hand glides & towing, etc. can apply to most any TD ship.

Tape foam around the front of the battery to keep it jammed forward. Tape cord around it so it can be pulled out. Wrap foam around the Rx so it will stay put. Fuselages are 2.4 GHz friendly. Attach regular long antennas to a 1/8" sq. stick of balsa to run down the fuselage.

Initially set ailerons to deflect 1/2" to 5/8" up and 1/8" down in high rate. With too much down adverse yaw is particularly noted on higher aspect ratio wings such as these. Cut throws about 1/3 for low rate. If your radio will do it, for greater roll command, you can program in a little down flap opposite the side of up aileron, such as some right down flap with up left aileron. Just bear in mind that too much will to tend to turn (adverse yaw) the ship the other way.

Pushrod detached, program your stab servo to be in its neutral. Turn on the radio. Put the trim tab in neutral. Mechanically position the output arm on the gear to point as closely as possible toward the fuse side. Then program to point it straight toward the fuse side. Adjust the pushrod linkages so the stab looks neutral relative to a line centered on the fuselage side under the stab. Stick a little piece of masking tape on the fin by the LE on which to mark this "apparent neutral".

Ships in the Genie line are quite sensitive in the pitch axis unless balanced too far forward. In high rate, for the larger versions, initially set the stab to move 5/16" each way at the LE. For the smaller versions set the stab to move about ¼" each way. Duplicate throws in low rate for starters. As you get some flying experience you can change the throws to get the pitch responses you like in both high and low rates. Be sure things move in the right direction for either position. To me, it's logical to get most deflection when a DR switch is flipped up. . .in its "high" position.

Down elevator compensation with full 90 degrees down flap will be about 3/16". However, full 90 degrees down may be overkill and cause drift to one side at lower speeds. For starters, go for 75 to 80 degrees. If you like rudder mixed in with ailerons, go for about 20 degrees each way. If too much, the tail end will swing out beyond the intended flight path and the wing tips will "walk". Get plenty on independent rudder throw in case an aileron servo quits while airborne. You may also like maximum independent rudder throw when towing.

Tips must always be snugly secured to the center or blades will be subject to extreme bending forces on launch. If you know the characteristics of a particular tape and trust it to secure the tip section, that's fine. Friend Doug Coleman finds **3M brand Scotch #35 Vinyl Electrical Tape (made in the USA) to work well. I am impressed how well it holds. Doug says "It comes in a wide variety of colors and comes off cleanly. Electricians might call it phase tape because they use the various colors to mark motor phase wiring. Before I put tape on a wing I put a 1/2" strip of clear packing tape on the wing to protect it. I do this on both molded and painted wings.

Place some pieces of thin (1/32") foam tape on the saddle. If it is double sticky, apply talc on the exposed surface. Some residual sticking power will tend to keep the wing from shifting, but still allow it to lift off when you are packing up.

The cables, the two way output arm and the rudder "T" are to form a parallelogram. The operating radius at the output arm should not be greater than at the "T" or the cable will be under increased and unwanted tension during deflection. With a true parallelogram the operation should be very smooth and easy.
In some landings where the tail whips around, the wire nail part of the "T" may get bent. To straighten it, hold the brass part in one hand and pinch the rudder bottom in the other.

The softer nail is used so less stress is put on the solder joint and the slot in the rudder. If the solder joint separates, disconnect the output arm from the servo for slack. Pop the rudder loose. Remove the nail to resolder it. A small butane torch is good to keep in the field box.

New cables tend to stretch. When slack develops, the rudder is subject to buzzing at higher speeds. Take up slack at the clevises. In time, cables may stretch so much that no threads are left to take up slack. Detach the output arm to pull the cable rear ends out of the rudder "T". Make new knots adjacent to the old ones and re-adjust the clevises on the rigging couplers. If necessary, put in new cables.

Oh, <u>that</u> little thingy! Why isn't it on the plans? It's because "best" balance point is subjective, depending on what kind of flight characteristics are wanted. Also, each scratch built ship is different in some way, so displaying a CG emblem at some fixed point on the plans that worked for some other ship is not likely to be right for yours. You'll need to sort it out.

IMHO, the "best" balance point is that which, along with the stab setting, makes the ship handle nicely in the pitch axis, but "nicely" is subjective. You may not like what I like and vice versa.

I place the spar near where the wing is thickest. The main bolt is located a little ahead of the spar and puts it about ¼ chord behind the LE. For a starting point with my ships, <u>with the wing off</u>, I like them to statically balance about at the main wing bolt. If needed, in spite of any built-in nose lead and battery weight, I'll tape sheet lead outside on the nose to get that. With the wing off and suspended by the fingers at the bolt, the fuse boom area will be about level. Ignore the droop snoot. This "wing-off balance point" is conservative and something ahead of the "<u>best</u> wing-<u>on</u> balance point". This latter point is found by flying.

The lurking enemy in that initial hand toss is an abrupt stall and ensuing hard smack into the ground. My premise is that a diving tendency and a poke into the turf is a lesser evil. Nylon bolts may be a good idea for initial hand tosses and initial tows, but I find them to break easily.

Eyeball the stab and with the trim tab, adjust it so its LE is a tad higher than at the "apparent neutral" mark on the tape. Again, the objective is to avoid a stall on the initial hand toss. Be prepared, though, to quickly get on the stick to correct bad pitch tendencies.

Be sure the wing is seated well with no harness between it and the saddle to mess up incidence. Throw it straight, level and hard enough to fly at cruising speed.

<u>Ignore the droop snoot!</u> Just look at the attitude of the wing and tail boom area. If there is an unwanted diving or stalling tendency, you need to fuss with (1) balance and (2) stab neutral.

Let's assume the nose consistently tends to rise and the ship stalls. Rather than adding more lead up front, adjust the stab trim tab for more down trim. This reduces the positive angular difference (decalage) between the wing and the stab that may be causing the rise and stall tendency.

Do more hand tosses to observe the effect. If the ship flounders and fails to maintain a steady airspeed, it may be balanced too far back. Leave the stab as it is and tape a bit more lead on the nose. Continue fussing with balance and stab setting until you are comfortable with the results. Mark the position of the LE of the stab on the masking tape, put the trim tab in its neutral position and then adjust the pushrod length to duplicate the position of the stab.

If the tendency during initial hand tosses is to dive, remove some of the nose lead and/or lengthen the pushrod until you are comfortable with the results.

Expect 150-200 feet on a typical hand glide. Do several to be sure the ship is behaving predictably. Most likely, normal cruising speed will be different than that from hand tosses. You won't know until you do some launches and get into steady level flight.

Opinions and objectives differ here, but my initial goals in balancing at normal cruising speed would include the following: With stab set at the selected neutral position, to get a cruising speed that gives effective control (no floundering around on the point of stall) and flight path predictability. . . moving and grooving in a straight path without pitching oscillations.

Initially tow using a hook position that is ahead of the balance point found to be acceptable during the hand tosses. Initially tow without down flap since it may cause weaving side to side. Controls are ineffective with insufficient airspeed. Throw aggressively with the droop snoot pointing up only enough to avoid being caught in the chute lines. Tow angle may be rather shallow. The hook position for a steep ascent will be optimized later after a final balance point is determined that gives the desired handling during flight.

Some flyers like a "neutral" ship in the pitch axis. That is, in flight it tends to neither to tuck or nose up. If you are comfortable with that. . .fine, but check out the overall handling on launch, in cruise, in thermals, in tight maneuvering and on landing. Response of a "neutral" ship is quick in the pitch axis and to avoid over control, low rate with less deflection may be preferred.

If you don't like a neutral ship or if it tends to pitch down, increase the decalage by adjusting (longer for Genie line ships) the pushrod length. Balance it a bit further forward. Check out the overall handling to see if it is to your liking.

If it abruptly pulls up on its own, a ship will be sluggish in the pitch axis. Balance further rearward and shorten the pushrod for less positive decalage or you will have to be constantly inputting pitch corrections to stay level, especially as the air speed increases.

When initially satisfied, remove the wing and find the temporary "wing off" balance point. Remove any outside lead and add lead inside behind the nose block to retain that balance point. When the balance point you prefer is finalized, lead shot and resin can be poured into the nose to make it permanent to use with a battery size and configuration you like. Minor balance adjustments can be made by shifting the battery and receiver.

Opinions to the contrary, my own experience with these ships indicates overall handling is best if they are balanced and trimmed for a slight tendency to pull out on their own. In situations where airspeed is increasing, slight down stick pressure will momentarily be needed to stay level. The way the saddle is angled, the wing will be moving at a 2 to 2-1/2 degree Angle Of Attack for a low sink rate as well as good penetration. The tail will appear to be slightly up. This AOA helps give crisp response to control input for thermal soaring.

The down stick correction is analogous to what we do with the steering wheel when driving a well-aligned vehicle, but are affected by road irregularities and side winds. If a tendency to veer off the intended path starts, we briefly hold the correction until "neutral" again.

It is the nature of non-symmetrical, cambered "thermal" airfoils to lift more as speed increases in level flight. The stabs we use are commonly symmetrical in airfoil and do not automatically compensate at all airspeeds to prevent the nose from rising. Therefore, we commonly use stick input to make pitch adjustments.

When in a strong lift and wanting to stay at a particular altitude, use the stab trim tab to reduce the decalage. Speed will noticeably increase and in fact get so high at times that you will think an explosion followed by descent of hundreds of little pieces is imminent. I've never had it happen, but it surely gets the adrenalin going! You may want to switch to low rate for ailerons and elevator to avoid over control at higher speeds.

Again, learn to ignore the droop snoot. Watch the wing and the aft portion of the fuselage. The tail may appear to be slightly up in best cruise attitude. Let it bore in and fly at higher cruising speeds, rather than hanging on the point of stall, floundering around. Let it move and groove, "high-tailing" it around the field.

Sensitivity to stab movement increases as the balance point is moved rearward. The right amount of stab throw for me is about what will just hold a finely-balanced ship inverted from a half loop, with the stick held not quite fully forward. If we were using symmetrical airfoils at zero decalage, this would not apply. Upright and at a safe altitude and in high rate for stab, you may find it interesting to give full down and wait for the ship to tuck under. If you then back off a little on down stab when it levels out, you can cover a lot of ground and do very fast inverted 360 turns, etc. You can then easily get out either by rolling upright with ailerons or pushing full down to stall inverted to pull out at low speed.

With compensated flaps fully down, this amount of stab throw described usually allows safe, near vertical descent from altitude. If the ship tends to then want to tuck under in down flap, just back off a bit on the down stick, rather than programming for less throw. You may need the stab throw to level out at the top of a zoom launch.

Best tow hook location is next. Without flaps, let winch tension build or fully stretch the hi-start. Throw aggressively to get all possible airspeed. To steepen the ascent angle and have the ship promptly rotate, incrementally move the tow hook rearward until the ship is on the fringe of getting squirrelly. Too much steepness may just cause excess drag and impair the speed for zoom after release. Opinions and personal preferences abound in this area, too. Note that lowering a towhook has the same effect as moving it more rearward, etc.

Properly balanced with the tow hook properly placed, no up elevator should be needed to get a fast and steep launch. It should almost instantly rotate with a burst from the winch and go up steeply by tapping the pedal, rather than lead footing all the way up.

By trial, establish the amount of down flap that seems to generate best tow. 5/16" droop is about it. Too much adds excess drag, slows the ship down and it may wander from a straight path of ascent. If it wanders, back off on the flaps. If you want to use full TE droop on launch, you will have to sort out the amount, the elevator compensation, the tow hook location, etc.

For landing, check out down elevator compensation with down flap at safe altitude. Some flyers like a ship to go into a steep descent angle and require up elevator to level it out. Others like it to stay level and apply down elevator to get the desired descent angle. Too much down flap may result in drifting to one side as you flare out at lower airspeeds. Fine-tune all this to your liking.

If you can switch out of compensation for launch you will find tow ascent angle much steeper, need less, if any, down flap, go faster and exit faster for higher zoom. Switched out, you may find the ship squirrelly and want to move the tow hook a bit forward again.

Generally speaking, on a good winch, full allowable line under high tension, the big GENIE should be into the zoom after 10 seconds of "pedal to the metal" tow. Being a big ship, it takes a bit longer to get to release altitude. Figure half that for an optimally trimmed LT/S. 5 second, full bore launches, followed by a dip and a leap into a vertical zoom at high speed is a lot of fun.

Having found the best balance, tow hook and down flap positions for tow, continue with the tow until it is apparent that altitude is not being gained. At this point transition to neutral flap and then into reflex of an amount that gives max airspeed for the zoom. Servo gear slop can leave a little play in flaps, which may then buzz. A bit of reflex pressure during the zoom, etc. helps avoid buzz.

Some like steep zooms and some shallow. The LT/S, if built as instructed, will handle the more spectacular abrupt dip and vertical zoom. The bigger birds do not do that as well on the typical

thermal contest winch. Note that on a hard launch, the tips will appear to flex, but the flex is largely in the spring steel blades with overall carbon and dense foam used on the tips..

After zoom, trim the TE for cruising and thermal search. Full TE camber of flaps and ailerons will reduce the airspeed and sink rate to make the ship a fine "floater". Camber of ailerons and flaps should match and at the flap roots 3/16" droop appears to be about right. Mess with reflex, camber and "crow" to your heart's content.

LANDING: The least effective landing technique is to thrash the sticks around the last few feet or few seconds in an attempt to lose altitude, straighten up the ship or reduce airspeed. Best one is to come in straight and level from some distance out, gradually slowing down with some flap or TE camber and let the ship touch down on its own. The nose will touch and the tail will drop. Just do a few such landings that way without the tape or circle to observe that the ship will land very nicely on its own without your "help". Then work on a timing approach from an appropriate altitude.

Again, ignore the droop snoot. Watch the wing. Head on, if you see the top, it is diving, speed is increasing and you may land short. If you see the bottom, it may slow too much and drift to one side if you flare out. It's better to gently drive the ship to the ground and let the skid dig in. Another useful technique is to come in with flaps down to slow the ship, come in low and at the last moment before touchdown, put the flaps into neutral to pancake the ship to the turf for lack of flying speed.

When satisfied with overall handling and if you've settled on a particular battery pack and know what it takes to balance out to your liking with it, mix an appropriate amount of lead shot with resin, pour it down into the nose, stand it tail up and let it cure.

Make a pinhole in the fin at your final stab neutral point and remove the masking tape.

If your depth perception is gone along with motor skills and your ability to concentrate has deteriorated, as in my case, a precise landing is more blind luck than skill. Ah yes, I remember when I could frequently land within 1" of the line and within 1 second of the time with my droop snoot ships. I recall one 2-day contest in which 8 perfect rounds were flown among 30 pilots. I did 5 of them with a big GENIE. At one contest where two other NWSS seasonal champs participated, in 12 rounds over 2 days, all for 10 minute max, I could do no wrong and ended up 333 points ahead of the pack with a big GENIE. Those were the days. Way back when, I might have a couple of days like that about every 10 years.

ABOUT BALLASTING: Lead weighs about 6.6 oz. a cubic inch. Best bet with the glassed-over fuselages is to cut pieces from 1/16" sheet lead to fit inside on the fuselage bottom. Run a bolt or stud through a spare hole in the towhook block from the outside. Make a hole in the sheets to fit over the towhook block to retain the desired "wing-off balance point". Secure with a wing nut.
1-1/4" x 4" pieces stacked to ¾" add about 24 ounces.

If using a composite fuse, pieces of lead cast in ¼" x 1" cross section can be used.

Engineer friend Jay Decker, offers the following suggestions for fine tuning a Genie line ship.

I generally start with Harley's cg and throws and modify them to suit.

A few specifics:

CG Setup: I move the cg back a 1/4 oz at a time, while flying on a calm day without much thermal activity. I measure my flight time just letting the plane fly without much control input.

Keep removing weight until the flight time start decreasing or the plane starts to get unmanageable and then search around this optimum in 1/8 oz. increments. I always add another 1/8 oz. after I find the optimum.

Tow Hook: set after finding optimal cg.

Camber: 3/16" maximum at the flap root. Use up to 1/8" of camber for thermaling. I never found reflex noticeably effective.

Launch: Camber the entire wing and add in up elevator until it goes straight up.

Separate rudder: at least 35 degrees.

Landing: 80 to 90 on the flaps and 15 degrees down aileron, the down aileron should be reached by half the control stick movement -- make sure that there is enough down elevator compensation to keep the plane flying.

Get used to getting the plane belly button to chest high coming toward you aways on final - the plane is big and it takes some time to bleed the energy on approach. This is one plane that is really no fun to land down wind, but you can learn to land it well in no wind conditions - learning to keep it low on final helps.

Thermal Turns: I fly the Genie uncoupled, because with rearward cg you need to cross control the plane, e.g., use rudder to hold the tail up in the turn and use opposite aileron to keep the turn from tightening.

Have fun with it, it is incredibly capable...

Jay

If play develops in the blade boxes, tilt a section about 30 degrees. Run a little thin CA glue into the bottom or top of a slot, wherever play is evident. Don't overdo it and block the slot! Do it a little at a time and allow applications plenty of time to cure, like overnight, in what is a non-porous environment with parts having been joined originally with thin CA glue.

<<<< >>>>