

THE "G2 SYSTEM" INSTALLATION INSTRUCTIONS (September 10, 2011)

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Hello from Harley at Walla Walla, WA with a scratch-built, G2-equipped Smooth Genie Pro.

LOOK! NOTHING HANGS OUT OF THE WING, TOP or BOTTOM!

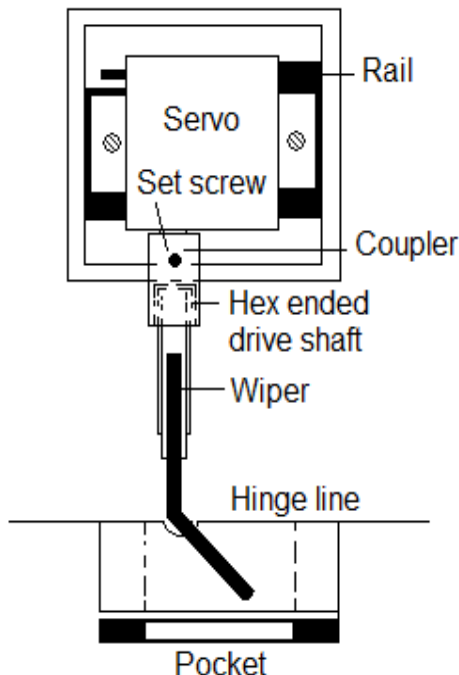
Over 20 years ago, the basic, all-internal mechanics popped into mind. Now, thanks to RC friends who financed it, refined, unique, new hardware is available so all kinds of RC aircraft can have totally clean wings for best possible performance!

G2 SYSTEM MISSION: "To make wings of RC aircraft clean, stealthy, more beautiful and without the parasitic drag of external hardware, able to perform at their maximum aerodynamic potential".

The drawing below illustrates an installation in a typical ARF wing. Access to the setscrew is needed. To connect/disconnect the coupler from the output gear or the hex ended shaft from the coupler requires space to separate them up to 5/16". Sliding the servo toward the LE, sliding the wiper some behind the pocket or some combination of both will do it.

Sliding calls for a servo with side mounting lugs or removing lugs to secure it with a "hat" bracket as done with "HEMS". . . Harley's Easy Mounting System. For details see page 4 of this document and HARLEY'S EASY MOUNTING SYSTEM (HEMS) documents on this web site.

<http://augiemckibben.tripod.com/sitebuildercontent/sitebuilderfiles/HEMS.pdf>

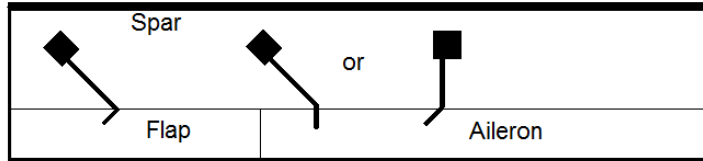


DEVELOPED IN COLLABORATION WITH KIMBROUGH RACING PRODUCTS, INC. & IRF MACHINE WORKS, INC. THE NEW "G2 SYSTEM" HAS UNIQUE FEATURES INCLUDING:

- Superbly engineered new coupler with tree of double-splined adapters to fit popular servos. Features a simple way to be firmly attached, detached & rotationally adjusted on the output gear. See drawing at bottom of page 2.
- Sliding hex coupler/shaft link to simplify installation & automatically resolve shaft "fore-aft" & "float" issues related to dissimilar servo, hinging and pocket planes.
- Length-sizable shafts to select servo location with ample headroom and to facilitate balancing.
- Wide array of parts available "a la carte" to custom fit most any airframe size and kind.
- E-mail & web-based support.

It would be more convenient to install the G2 System in ARF wings if the openings were angled and made longer, something to anticipate in ARFs designed to utilize the "G2-System".

See drawings and pictures that follow and the RELATED PICTURES AND DRAWINGS pages. www.irfmachineworks.com (modeler-machinist Walt Dimick) offers all G2 parts. See the Pre-Ordering Pricing and Work Sheet in the Genie pages for parts description and pricing.



Flap servos must be angled and wipers bent enough to get liberal down flap. Aileron servos may be angled or squared-up. Shaft lengths vary with servo location and wing chord.

SHAFT ANGLES: Studies have established that shafts angled at 50 degrees to the hinge line give best mechanical trade-offs. In RELATED PICTURES AND DRAWINGS, refer to Drawing #1 to see how modeler Tuan Le fitted flap servos at 50 degrees into an ARF wing with small, squared-up openings.

At the 50 degree angle, the table below illustrates relationships between wiper bend angle and deflection for a 90 degree rotation of a flap servo and 50 of an aileron servo. It's assumed hinging, gap seals, other structure or radio limitations don't prevent the indicated deflections.

FLAPS, WIPER BEND ANGLE:	60	65	70	75	80	85	90
APPROX. MAX DEFLECTION:	66	70	74	78	82	86	90
AILERONS, WIPER BEND ANGLE:	25	30	35	40	45		
APPROX. MAX DEFLECTION:	20	24	27	30	33		
AILERON, shaft at 90 to hinge line:	20	24	28	33	38		

Using a smaller bend angle equates to using a closer-in hole in an output arm. Power and resolution are improved. Where practical, use a smaller bend and more servo rotation/stick travel.

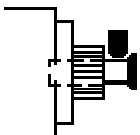
DOUBLE-SPLINED ADAPTERS: From trees, locate ones specified. If not specified, check for a fit. No fit? See Genie pages document "Custom Splining the Coupler" or use servos known to have a fit.



LEFT TOP: Std. Hitec, Volz Alu-Star. LEFT CENTER: Std. Airtronics, JR, Multiplex, Sanwa. LEFT BOTTOM: Std. Futaba, FMA series 300, Std. Dymond. RIGHT TOP: Std. Volz. MKS 6125 (tight fit). RIGHT BOTTOM: FMA 88/90/95/100, etc. Cirrus CS 20/21, MPI MX 30.



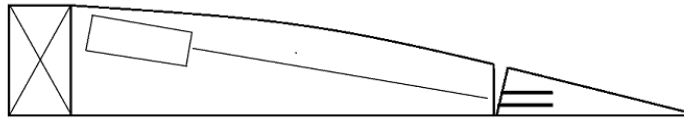
The 3/8" x 5/8" coupler with its single set screw is shown with a partially inserted adapter, set screw, brass reinforcing sleeve for heavy duty applications and the 3/16" x 3/8" hex end of a drive shaft. Nicely squared up, tap the set screw hole with a 4-40 tap or any longer 4-40 screw.



COUPLER SECURING: The coupler set screw is captured behind an Auxiliary Servo Screw 1, 2 or 3. See the PROGRAMMING and FINISHING THE INSTALLATION paragraphs on page 4 about dealing with these screws and with servos using a sheet metal type screw in a plastic gear.

BENT WIPERS: IRF makes these from precision-ground tool steel drill stock, bent at needed low radius, then hardened and tempered. The surface gets oxidized in the process. To mark on it, wet sand the long end to bright steel. Wipers are made "STANDARD", specified as .104" and "HEAVY DUTY" specified as .1285" with stock bends of 85, 62, 45 and 30 degrees. Custom bends are available.

Exaggerated, the drawing below depicts a common situation of the servo/mount being attached to the top skin and the pocket lower in the hinged surface. Since coupler and shaft are rigid, the servo/mount has to be tilted to direct the shaft into the pocket. Tilting is easily done with a wedge, glob of epoxy putty, silicone sealer, etc. under the servo/mount. Have everything in place as the adhesive cures.

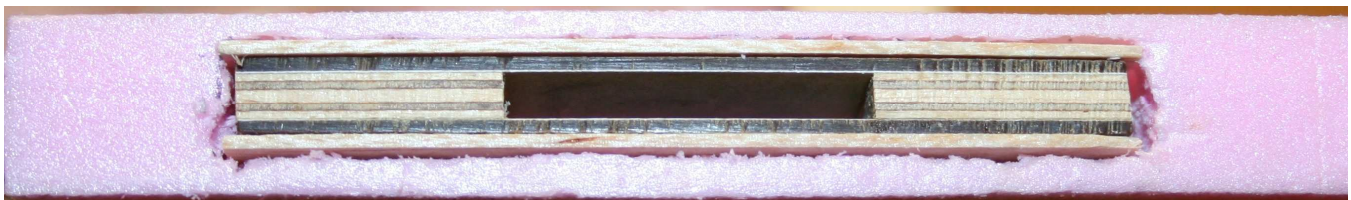


To make installation more convenient, perhaps some servo frame maker will make a sliding mount for G2 System installations and ARF makers will make wings with better oriented and configured servo openings. ARF wings could be made with a tilted area where the servo goes. Then pockets could be placed between the skins to best align to the shaft in profile view.

SERVO LOCATION/OPENING CONFIGURATION: If the wing is hollow with openings pre-made, there's leeway in locating servos between the skins. Given that clear, thin, flush mounted plastic servo covers (Page 5) can be used, it may be practical to reconfigure an opening to make installation more convenient. If the wing allows cutting openings or if the modeler is making it, openings can be cut for most convenience. See Genie pages Const. File 3, Part 2. Decide where a servo is to be located with ample headroom and so it can be slid toward the LE.

SHAFT PATH: On which to mark the path, whether angled or squared up, apply low tack masking tape on the wing bottom and in the general area where the pocket is to go. Mark the path on the tape. Align the wiper long end to the marked path. Position the pocket so the wiper short end clears it's inside edges.

IRF POCKETS: Spacers between tops and bottoms are precisely machined for a uniform "slightly snug" fit on the order of .001" less than wiper diameter. This avoids surface buzz at higher speeds. A given length of the steel drill stock used will vary as much as .002" in diameter. If some IRF wipers seem too tight compared to others, there's an easy custom fix. Using #320-400 wet or dry paper wetted, wrap it around a block. To the wiper sides that lay flat, make 10 passes on each side and recheck the fit. Repeat until it feels "slightly snug". See the document "Making Your Own Pockets" to cut cost. Use epoxy as the adhesive when installing pockets, but keep it out of the wiper opening!



Mark where the pocket recess should be made. If there's space, use balsa shims over and under the pocket. Assembled pockets can be thinned to get them fully recessed.

If the hinged surface face is beveled for deflection, similarly bevel the pocket. Wrap pocket ends with one layer of fine thread, preferably Kevlar. If the pocket top and bottom are not in perfect parallel planes or are a non-rigid material, it's essential to use a waxed insert between them to keep them parallel until the adhesive and fill around the pocket are cured. It's essential for the adhesive to make a secure bond between pocket and the opening it recesses into. Keep all flat as the adhesive cures. See installation in Const. File 3, Part 2 page 5-6.

HONING THE HEX FIT: Slight manufacturing variations in the brass hex diameter impact the sliding fit with the coupler. If tight, touch up faces with a flat whetstone. The 3" triangular Bear Paw Tackle Co. Fish Hook Sharpener used wet and flat, works well. Mark shaft where you start. Count strokes to do faces uniformly. A proper fit will allow sliding without unwanted rotation inside the coupler. Bevel the hex brass front edges to get it going into the coupler.

SIZING A SHAFT TO LENGTH: Seat an adapter on the servo and a coupler on the adapter. Invert the wing. Place a servo in its intended location. Along the shaft path superimpose the shaft hex end 1/4" over the coupler. Mark the tube 1/4" ahead of where it intersects the hinge line. Cut it there. Put ID on the shaft. Repeat for all wing servos.

HINGE LINE HOLE: Through hinge line structure along the shaft path, progressively make an opening opposite the pocket plane large enough to insert the shaft hex end. If pre-hinged, deflect surface for access. If gap seal is in the way, remove a little of it. The hole allows "float". Its edges control lateral play.

"SWEET SPOT": This is the wiper elbow location relative to the hinge line that allows smooth, easy deflection. For flaps, it's typically wiper diameter behind the hinge line and for ailerons, that ahead of it.

ATTACHING THE WIPER: Options are silver soldering (see website document) or the black, rubber-toughened CA glue such as the Bob Smith Industries IC-2000. One servo at a time, do this: Place the servo/coupler in its intended location. Superimpose the shaft hex end 1/4" over the coupler. Slip a wiper into the shaft to put the elbow at the mentioned typical sweet spot. Mark the wiper where it exits the shaft. Attach the wiper. Repeat for all shafts. Shafts will be installed after programming is done.

INITIAL PROGRAMMING: Pick a setup. Program out all throws for the wing servos. If the wing has ailerons, proceed with one of those. Put the related trim tab in neutral. Program the servo to its neutral. Turn radio off. Holding the servo in the hand, oriented as it will be mounted with wing inverted, fully seat an adapter on the output gear. Run the Auxiliary Servo Screw in leaving 1/8" of the threads exposed. Slip on a coupler so its set screw is essentially pointing straight up. Fully seat coupler on the adapter and thread in the set screw to just touch the Aux SS. Then back off a hair. From the coupler hex end, screw in the Aux SS to take up any slack with the set screw. This firmly secures the coupler to the output gear with no set screws bearing on it. As needed with radio on, program the Tx to get the wiper perfectly horizontal. Repeat this sequence with all wing servos, noting that for flaps, neutral means no up or down flap.

GETTING THE SHAFTS IN: If the moving surface is not pre-hinged its pocket can be slid over the protruding wiper, when later hinged. If pre-hinged, if the wing is hollow and if the wiper bend angle is small it may be possible to manipulate the wiper into the pocket working through the servo opening. If not, make the hinge line hole into a horizontal groove or depression deep enough to get the shaft/wiper forward enough to close the pocket over the wiper.

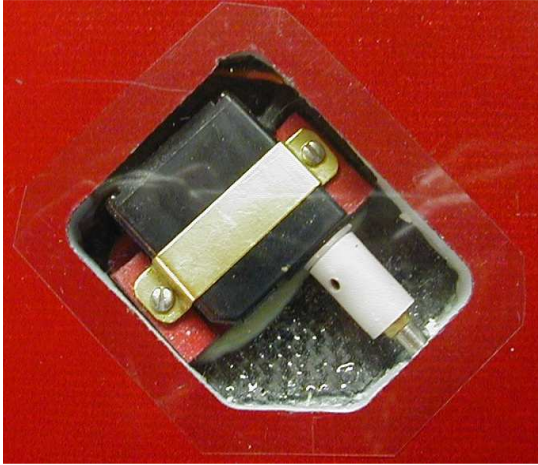


This servo is "HEMS" mounted with a bracket. Taller rails could be used and a plate cinched down on the case with screws. Note space for sliding, the accessible set screw and that about 3/32" of the hex brass is exposed to allow "fore-aft" sliding on deflection. Foam behind the pocket was also cleared out so it was easy to separate the coupler from the servo or the shaft from the coupler. Using long drill bits and round files, a path for the shaft was tunneled through the foam from the hinge line to the coupler. It's much easier in a hollow wing.

FINALIZING THE SWEET SPOT: Run the shaft hex end ¼” into the coupler. Slide the servo/coupler/shaft assembly to put the elbow where the surface can be manually most easily deflected. That’s the spot! Position the servo to retain it. If necessary, redo the joint to adjust shaft/wiper length. The elbow automatically stays put at the sweet spot although it can meander a bit through the deflection range.

FINAL PROGRAMMING: Observe which direction the servo/wiper is to move to deflect the surface in the intended direction. Program in some throw. Check that rotation is correct with the related stick or lever. Finish setting end points. Repeat the sequence for all servos.

FINISHING THE INSTALLATION: If a sheet metal type servo screw is used, find a Phillips head flat headed longer one the same diameter. Grind down the head to narrow it to slip into the coupler.



FLUSH SERVO COVERS: Barely visible here, for easy inspection and to demonstrate the installation, use clear, thin plastic sheeting attached under its corners with double sticky clear tape. Pull about 1” of the tape beyond the dispenser serrated edge, scissor off smudged part, overlap a corner of the cover on it, press lightly with Popsicle stick, etc. scissor off & trim. Repeat on all corners. Press in place.

REMOVING A SERVO &/OR SHAFT FOR SERVICE: Separate servo and shaft enough to get the servo out. To get the shaft/wiper out, the wiper must be slipped out of the pocket in the hinged surface. If a groove was made ahead of the hinge line to get the wiper in the pocket in a pre-hinged surface, recess the wiper in the groove to deflect the surface to get it out of the pocket. Then pull the shaft/wiper out of the wing. If there’s no groove for recessing, make one.

If surface play is present or develops, one or more reasons may be as follows:

1. There’s slop in the servo gear train
2. The surface itself is flimsy or flexible
3. The servo, its mount or a bracket is loose
4. Hinging allows play between wing and surface
5. An adapter may seem to fit an unspecified servo, but the two may be differently splined and allow slippage
6. The pocket is loose.
7. The pocket has split
8. The coupler has split in a hard dork or from flaps dragging
9. The hex brass was over-honed
10. The “slightly snug” fit between wiper and pocket is not snug enough.

Puff a little dry keyhole lubricant into the pocket. A compressed air canister will clear out dust and debris.