HANGAR 9®

CAP 232G ARF

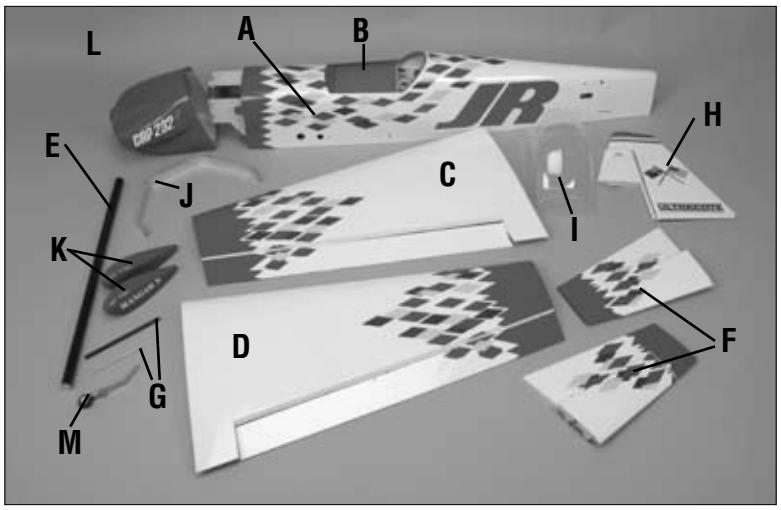
ASSEMBLY MANUAL

Specifications

Wingspan: ..... 80.5 in (2045mm)	Length: ..... 74.5 in (1892mm)
Wing Area: ..... 1260 sq in (81.2 sq dm)	Weight: ..... 15–16 lb (6.8kg–7.3kg)

Table of Contents

Contents of Kit



Replacement Parts

A.	HAN2901	Fuselage w/Hatch
B.	HAN2902	Fuselage Hatch
C.	HAN2903	Left Wing w/Aileron
D.	HAN2904	Right Wing w/Aileron
E.	HAN2905	Wing Tube
F.	HAN2906	Stabilizer w/Elevator
G.	HAN2907	Stabilizer Tube Set
H.	HAN2908	Fin w/Rudder
I.	HAN2909	Canopy
J.	HAN2910	Landing Gear w/Axles
K.	HAN2911	Wheel Pant Set
L.	HAN2912	Painted Cowl
M.	HAN2913	Aluminum Tail Wheel Assembly

Items not shown

HAN2914	Fuel Tank w/Stopper
HAN2915	Decal Set

UltraCote® Covering Colors

- True Red HANU866
- Pearl Purple HANU847
- White HANU870
- Cub Yellow HANU884

Radio and Power Systems Requirements

- 4-Channel radio system (minimum) w/receiver
- JRPS8411 Ultra Torque Digital Servo (5)
- JRPS537 Standard Servo (Throttle)
- 18" (458mm) Servo Extension (JRPA099) (2)
- 24" (610mm) Servo Extensions (JRPA102) (3)

Recommended JR® Systems

- 10X
- XP9303
- XP7202
- XP6102
- XP662

Recommended Power Systems

- Evolution 45GX

JR XP9303

JR XP6102

Evolution 454 GX
EVOE45GX2

JR XP7202

Required Tools and Adhesives

Tools

- Drill
- Adjustable wrench
- Hobby knife
- Phillips screwdriver
- Side cutters
- Crimping tool
- Drill bits: 1/16" (1.5mm), 5/64" (2mm), 5/32" (4mm), 7/32" (4.5mm)
- T-pins
- Hex wrench: 3/32", 5/32"
- Hobby scissors
- Pliers
- Nut driver: 5.5mm

Adhesives

- 6-minute epoxy (HAN8000)
- Thin CA
- Zap-A-Dap-A-Goo
- Medium CA
- 30-minute epoxy (HAN8002)
- Canopy glue
- Threadlock
- Pacer hinge glue (PT-55)

Other Required Items

- Epoxy brushes
- Measuring device (e.g. ruler, tape measure)
- Paper towels
- Masking tape
- Sandpaper
- Sealing Iron (HAN101)
- Sealing Iron Sock (HAN141)
- Cardstock
- Syringe
- Razor saw
- Clear covering (HANU964)
- Felt-tipped pen or pencil
- Mixing sticks for epoxy
- Rubbing alcohol
- Sanding bar
- Rotary tool w/sanding drum
- Covering Glove (HAN150)
- Soldering iron
- 1/4" (6mm) foam
- Toothpicks
- Petroleum jelly

Limited Warranty Period

Horizon Hobby, Inc. guarantees this product to be free from defects in both material and workmanship at the date of purchase.

Limited Warranty & Limits of Liability

Pursuant to this Limited Warranty, Horizon Hobby, Inc. will, at its option, (i) repair or (ii) replace, any product determined by Horizon Hobby, Inc. to be defective. In the event of a defect, these are your exclusive remedies.

This warranty does not cover cosmetic damage or damage due to acts of God, accident, misuse, abuse, negligence, commercial use, or modification of or to any part of the product. This warranty does not cover damage due to improper installation, operation, maintenance, or attempted repair by anyone other than an authorized Horizon Hobby, Inc. service center. This warranty is limited to the original purchaser and is not transferable. In no case shall Horizon Hobby's liability exceed the original cost of the purchased product and will not cover consequential, incidental or collateral damage. Horizon Hobby, Inc. reserves the right to inspect any and all equipment involved in a warranty claim. Repair or replacement decisions are at the sole discretion of Horizon Hobby, Inc. Further, Horizon Hobby reserves the right to change or modify this warranty without notice.

REPAIR OR REPLACEMENT AS PROVIDED UNDER THIS WARRANTY IS THE EXCLUSIVE REMEDY OF THE CONSUMER. HORIZON HOBBY, INC. SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

As Horizon Hobby, Inc. has no control over use, setup, final assembly, modification or misuse, no liability shall be assumed nor accepted for any resulting damage or injury. By the act of use, setup or assembly, the user accepts all resulting liability.

If you as the purchaser or user are not prepared to accept the liability associated with the use of this product, you are advised to return this product immediately in new and unused condition to the place of purchase.

Safety Precautions

This is a sophisticated hobby product and not a toy. It must be operated with caution and common sense and requires some basic mechanical ability. Failure to operate this product in a safe and responsible manner could result in injury or damage to the product or other property. This product is not intended for use by children without direct adult supervision.

The product manual contains instructions for safety, operation and maintenance. It is essential to read and follow all the instructions and warnings in the manual, prior to assembly, setup or use, in order to operate correctly and avoid damage or injury.

Questions, Assistance, and Repairs

Your local hobby store and/or place of purchase cannot provide warranty support or repair. Once assembly, setup or use of the product has been started, you must contact Horizon Hobby, Inc. directly. This will enable Horizon to better answer your questions and service you in the event that you may need any assistance.

Questions or Assistance

For questions or assistance, please direct your email to productsupport@horizonhobby.com, or call 877.504.0233 toll free to speak to a service technician.

Inspection or Repairs

If your product needs to be inspected or repaired, please call for a Return Merchandise Authorization (RMA). Pack the product securely using a shipping carton. Please note that original boxes may be included, but are not designed to withstand the rigors of shipping without additional protection. Ship via a carrier that provides tracking and insurance for lost or damaged parcels, as Horizon Hobby, Inc. is not responsible for merchandise until it arrives and is accepted at our facility. Include your complete name, address, phone number where you can be reached during business days, RMA number, and a brief summary of the problem. Be sure your name, address, and RMA number are clearly written on the shipping carton.

Warranty Inspection and Repairs

To receive warranty service, you must include your original sales receipt verifying the proof-of-purchase date. Providing warranty conditions have been met, your product will be repaired or replaced free of charge. Repair or replacement decisions are at the sole discretion of Horizon Hobby.

Non-Warranty Repairs

Should your repair not be covered by warranty and the expense exceeds 50% of the retail purchase cost, you will be provided with an estimate advising you of your options. You will be billed for any return freight for non-warranty repairs. Please advise us of your preferred method of payment. Horizon Hobby accepts money orders and cashiers checks, as well as Visa, MasterCard, American Express, and Discover cards. If you choose to pay by credit card, please include your credit card number and expiration date. Any repair left unpaid or unclaimed after 90 days will be considered abandoned and will be disposed of accordingly.

Electronics and engines requiring inspection or repair should be shipped to the following address (freight prepaid):

Horizon Service Center
4105 Fieldstone Road
Champaign, Illinois 61822

All other products requiring inspection or repair should be shipped to the following address (freight prepaid):

Horizon Product Support
4105 Fieldstone Road
Champaign, Illinois 61822

Safety, Precautions, and Warnings

This model is controlled by a radio signal that is subject to interference from many sources outside your control. This interference can cause momentary loss of control so it is advisable to always keep a safe distance in all directions around your model, as this margin will help to avoid collisions or injury.

- Always operate your model in an open area away from cars, traffic, or people.
- Never operate the model out into the street or populated areas for any reason as injury or damage can occur..
- Never operate your model with low transmitter batteries.
- Carefully follow the directions and warnings for this and any optional support equipment (chargers, rechargeable battery packs, etc.) that you use.
- Keep all chemicals, small parts and anything electrical out of the reach of children.
- Moisture causes damage to electronics. Avoid water exposure to all equipment not specifically designed and protected for this purpose.

Before Starting Assembly

Before beginning the assembly of the CAP 232G, remove each part from its bag for inspection. Closely inspect the fuselage, wing panels, rudder, and stabilizer for damage. If you find any damaged or missing parts, contact the place of purchase.

If you find any wrinkles in the covering, use a heat gun or sealing iron to remove them. Use caution while working around areas where the colors overlap to prevent separating the colors.

Using the Manual

HAN101 – Sealing Iron

HAN141 – Sealing Iron Sock

HAN100 – Heat Gun

HAN150 – Covering Glove

This manual is divided into sections to help make assembly easier to understand, and to provide breaks between each major section. In addition, check boxes have been placed next to each step to keep track of each step completed. Steps with a single box (☐) are performed once, while steps with two boxes (☐ ☐) indicate that the step will require repeating, such as for a right or left wing panel, two servos, etc. Remember to take your time and follow the directions.

Section 1 – Hinging the Control Surfaces

Required Parts

- Elevator (left and right)
- Rudder
- Wing panel (right and left)
- Aileron (left and right)
- Stabilizer (left and right)
- Fin
- Hinges (21)

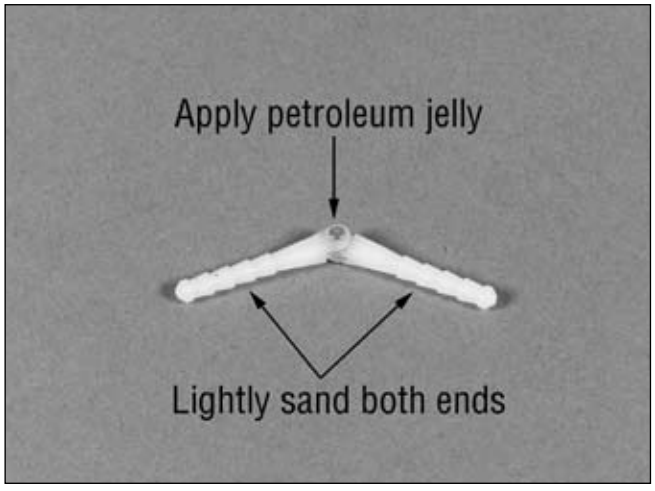
Required Tools and Adhesives

- Syringe
- Toothpicks
- Petroleum jelly
- Felt-tipped pen
- Hobby knife w/#11 blade
- Covering Iron (HAN101)
- Clear UltraCote® (HANU964)
- 30-minute epoxy or Pacer Hinge Glue (PT-55)
- Sandpaper (coarse)
- Razor saw
- Straight edge/ruler
- Scissors

Properly hinging the control surfaces on giant-scale models is vitally important. Poorly installed hinges affect the model's precision and control response and can also be dangerous. Each and every hinge needs to be securely bonded in place in both the flying surface and the control surface. The hinge pivot points need to be exactly parallel to each other and precisely located on the center of the hinge line.

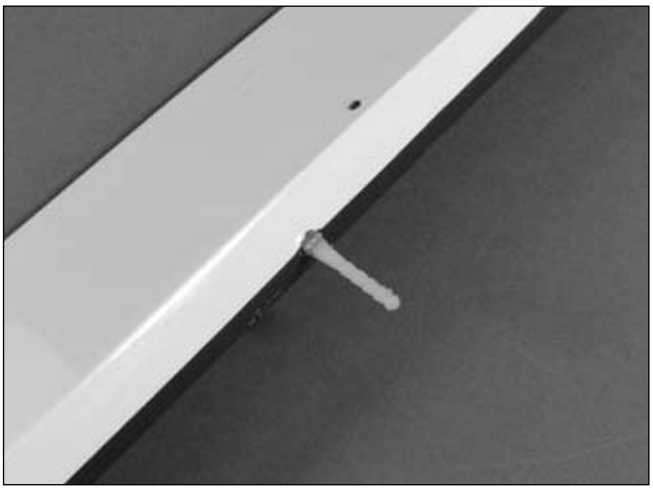
☐ ☐ Step 1

Sand each end of the hinge point using coarse sandpaper. This will improve the bond of the epoxy to the hinge. Apply a thin coat of Petroleum jelly to the hinge point to prevent the epoxy from gluing the hinge surface.



☐ ☐ Step 2

Mix one ounce of 30-minute epoxy. Using a glue syringe or toothpick, place a sufficient amount of 30-minute epoxy into one of the hinge pockets in the aileron leading edge only. Install one of the hinge points until the hinge pin center is flush with the leading edge of the aileron. Some epoxy should ooze out of the pocket as the hinge is installed. If not, remove the hinge and apply more epoxy. After gluing a few hinges, you'll get the hang of just how much epoxy is needed. Wipe away any excess epoxy with rubbing alcohol. Re-check that the center of the hinge pin is flush and parallel with the leading edge. Continue installing hinges in the leading edge of the aileron. The control surfaces (ailerons) will be installed after the epoxy is fully cured.

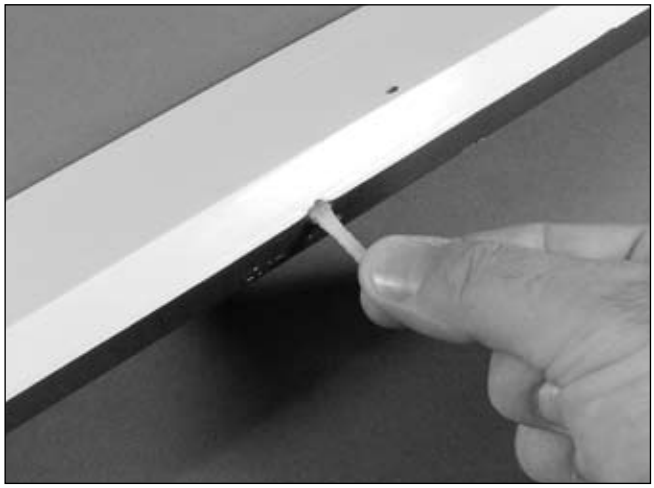


Note: Be sure that the hinge pivot pins are parallel and flush to the aileron leading edge. It's important to frequently mix a fresh batch of 30-minute epoxy in order to achieve good glue joint penetration. If you notice the epoxy becoming thicker, then mix a new batch.

Hint: You can also use Pacer PT-55 Hinge Glue to glue the hinges. Follow the instructions here as well as on the glue bottle to achieve the best results.

☐ ☐ **Step 3**

Allow the glue to fully cure for at least 6 hours. When cured, work each hinge throughout its full motion several times using your hands. This will break free any epoxy that may have found its way into the hinge joint. Move the hinge throughout its full travel until no resistance is felt. This may take as many as 40 or 50 times.



☐ ☐ **Step 4**

Mix one ounce of 30-minute epoxy or use Pacer PT-55 hinge glue. Place a sufficient amount of glue in each of the hinge pockets in one wing panel.

☐ ☐ **Step 5**

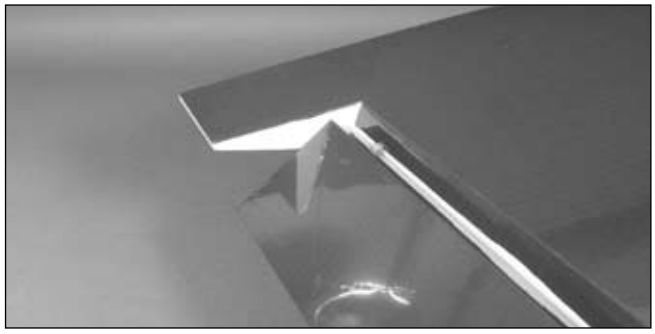
Carefully attach the aileron to the wing, making sure the hinges are inserted in their respective hinge pockets. Press the aileron and wing together such that less than a 1/64" (.5mm) hinge line gap exists between the aileron and wing. The bevels should virtually touch. Use a paper towel and rubbing alcohol to wipe away any visible epoxy around the hinges.

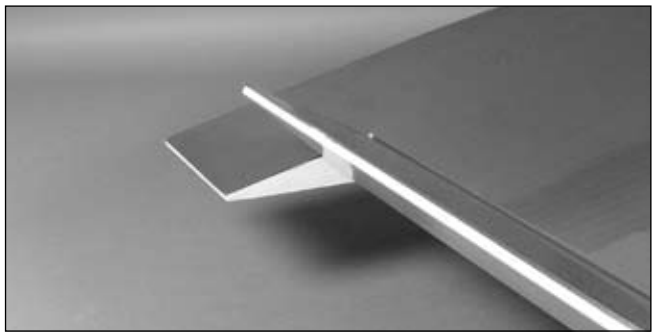
☐ ☐ **Step 6**

Double-check the hinge gap and allow the glue to fully cure for at least 6 hours.

☐ ☐ **Step 7**

When fully cured, move each control surface throughout its travel range several times to break away any epoxy in the hinge. Be sure to deflect the surface fully.

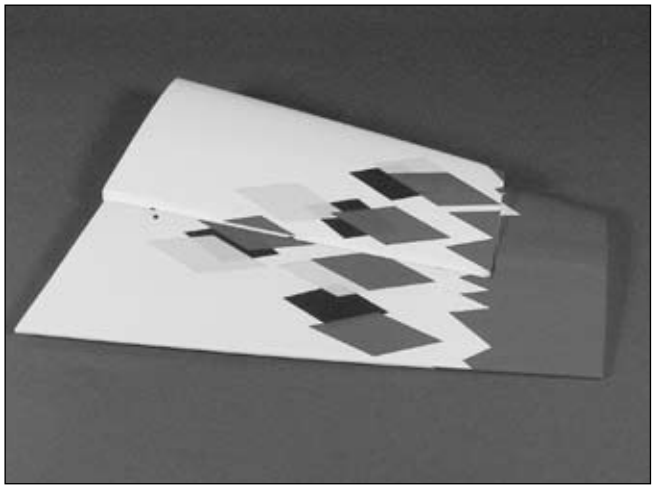




Section 1 – Hinging the Control Surfaces

☐ ☐ Step 8

Glue the elevator hinges in place using the same techniques used to hinge the ailerons.



☐ Step 9

Repeat Steps 1 through 8 for the remaining aileron and elevator.

> **Hint**: Combining the left and right wing/ aileron and/or left and right stabilizer/elevator while waiting for glue to cure will make this section move along much quicker.

☐ Step 10

Since all that's left is the rudder, this is a good time to glue it as well. Follow Steps 1 through 7 to complete hinging the control surfaces. Cut the bottom hinge flush with the forward edge of the fin post.

It is a good idea to be sure that the aileron and elevator hinge lines be sealed airtight. Sealing the hinge line has several advantages. A sealed hinge line gives a greater control response for a given control deflection. It also offers more precise, consistent control response and makes trimming easier. Sealing the aileron and elevator hinge line is highly recommended. Failure to do so may cause control surface flutter, resulting in a crash.

☐ ☐ ☐ ☐ Step 11

Cut a piece of Clear UltraCote® for sealing the ailerons to approximately 1" x 32" (25mm x 810mm). Fold the UltraCote down the center with the adhesive side to the outside making a sharp crease at the fold.

☐ ☐ ☐ ☐ Step 12

Remove the backing from the UltraCote. Place the folded crease side into the center of the hinge line on the bottom of the wing. Using a straight edge as shown, hold one side of the covering in place while ironing down the opposite side with a sealing iron. We recommend setting the iron temperature to 320° for this procedure.

> **Note**: White covering was used for clarity in the photos.

☐ ☐ ☐ ☐ Step 13

Fully deflect the aileron in the up position. Place the straight edge over the hinge line covering that you just ironed down in Step 2 with the edge of the straight edge placed firmly at the bottom of the hinge line as shown. Iron down this side of the covering, making sure the aileron is fully deflected.

☐ Step 14

Repeat Steps 11 through 13 for the remaining aileron hinge gap.

☐ Step 15

Repeat Steps 11 through 13 for both elevator halves using a 1" x 15" (13mm x 380mm) piece of clear covering.

Section 2 – Aileron Servo Installation

Required Parts

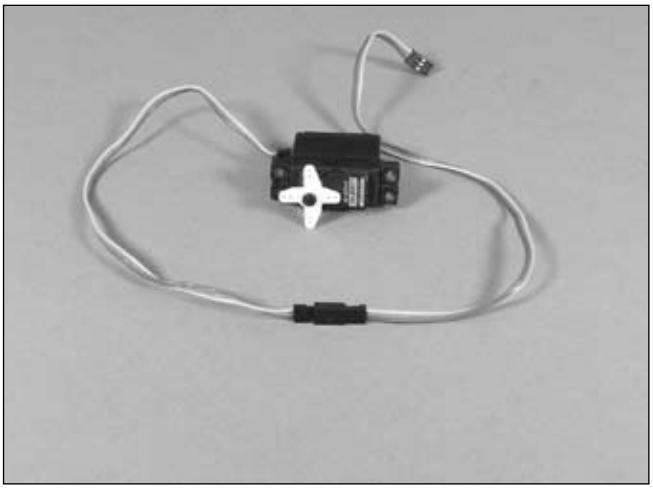
- 8-32 flange nut (2)
- 4-40 lock nut (2)
- Ball link for swivel link (2)
- Molded swivel link (2)
- Wing panel (right and left)
- 8-32 x 2 1/4" control horn screw (2)
- 4-40 x 1/2" socket head screw (2)
- Ball link for servo arm (2)
- 4 1/4" aileron linkage (2)

Required Tools and Adhesives

- Drill
- Ruler
- Drill bit: 1/16" (1.5mm)
- Phillips screwdriver (small)
- 18" Servo Extension (JRPA099) (2)
- 3D 1/2 Servo Arm 4-40: JR (HAN3578) (2)

☐ ☐ Step 1

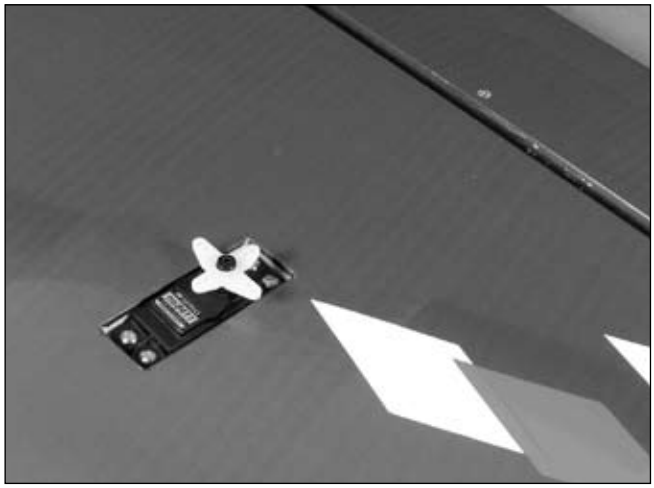
Install the servo hardware (grommets and eyelets) included with the servo. Plug a 18" servo extension onto the servo. Tie the servo leads together, using a commercially available connector, or use unwaxed dental floss to secure the extensions to prevent them from coming loose during flight.

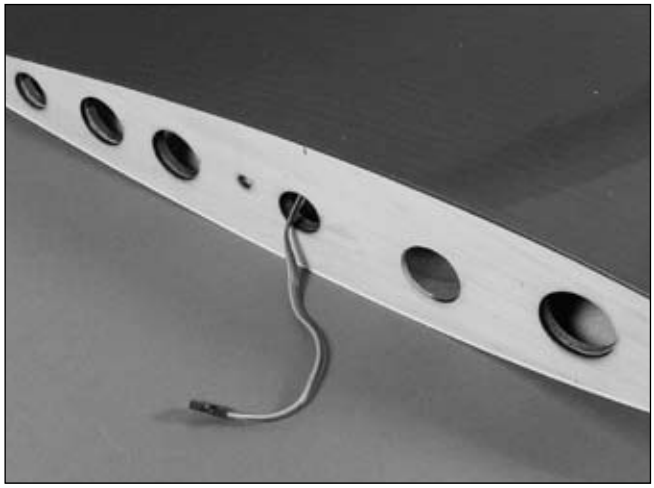


Section 2 – Aileron Servo Installation

☐ ☐ Step 2

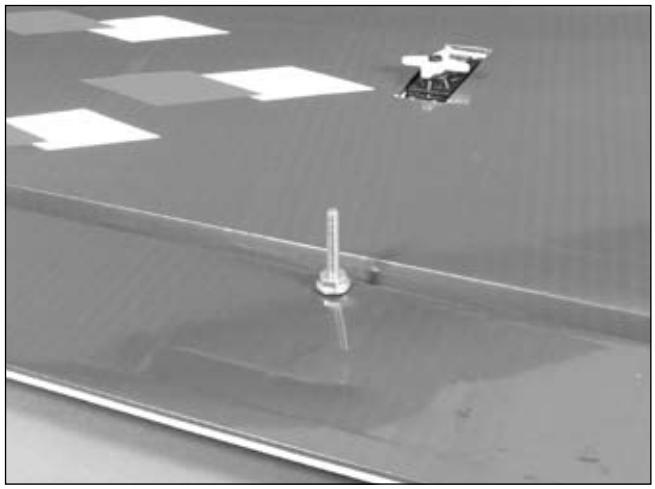
Tie the string to the servo extension and insert the servo into the wing. Use the string to pull the servo lead through the wing. Position the servo so the output shaft is toward the trailing edge of the wing. Use a 1/16" (1.5mm) drill bit to drill the locations for the servo screws. Mount the servos using the hardware provided with the servos.





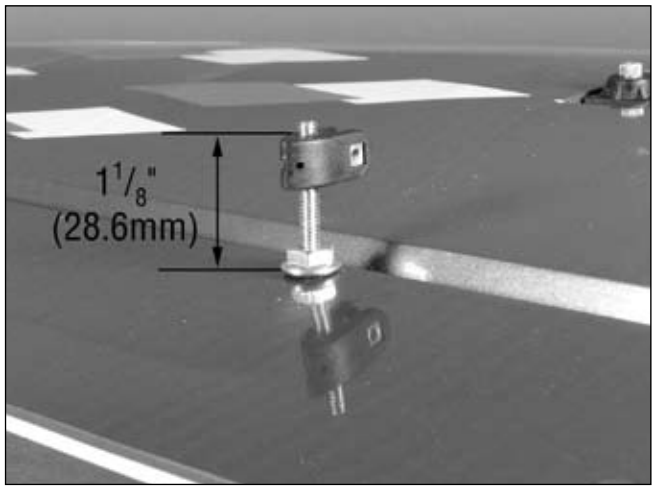
☐ ☐ Step 3

Mix a small amount of 30-minute epoxy and lightly coat the inside of the hole in the aileron and the 8-32 x $2\frac{1}{4}$" control horn screw. Thread the screw into the hole from the top of the surface. Wipe away any excess epoxy on the wing and screw with rubbing alcohol and a paper towel. Screw the 8-32 flanged nut in place as shown. Allow the epoxy to fully cure.



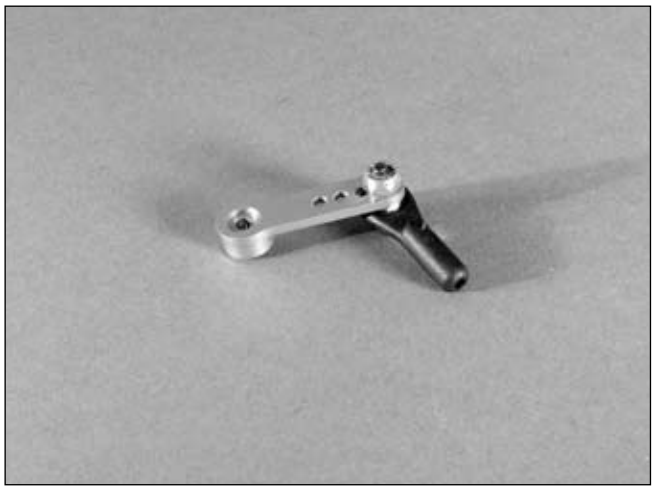
☐ ☐ Step 4

Screw the molded swivel link onto the 8-32 screw until the distance from the aileron surface to the top of the link is $1\frac{1}{8}$" (28.6mm).



☐ ☐ Step 5

Using the 4-40 screws (don't substitute a standard screw) and nuts included, attach the ball link to the outer hole in the servo arm from the bottom side as shown. The sequence is screw, ball link, servo arm and nut. Don't forget to use threadlock.



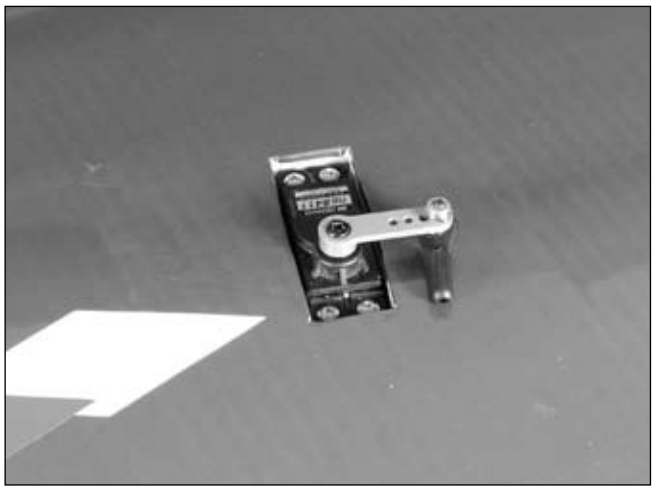
Note: Hangar 9® aluminum servo arms are suggested for ease of installation and durability. Use 3D 1/2 Servo Arm 4-40: JR (HAN3578) for the aileron servos.

☐ ☐ Step 6

Screw a 4-40 ball link 5 to 6 turns onto each end of a $4\,^1/_4$" long aileron linkage.

☐ ☐ Step 7

Center the servo using the radio system. Attach the servo horn to the servo using the screw provided with the servo. The arm faces towards the root of the wing.



☐ ☐ Step 8

Attach the linkage to the servo horn on the aileron. Adjust the link so the aileron is centered at the same time as the servo.

☐ Step 9

Repeat Steps 1 through 8 for the remaining wing panel.

Section 3 – Wing and Tail Installation

Required Parts

- Wing panels
- Wing tube
- 1/4-20 x 2" nylon bolt (2)
- 3mm x 15mm machine screw (4)
- Fuselage
- Stabilizer tube
- 3mm washer (4)

Required Tools and Adhesives

- 30-minute epoxy
- Hobby knife
- Phillips screwdriver
- Threadlock

☐ Step 1

Remove the two 4-40 x1/2" screws securing the hatch to the fuselage. Remove the hatch and store it in a safe place until later.

☐ Step 2

Locate the wing tube and carefully slide it into one wing panel. Slide the wing (with tube) into the wing tube opening in the fuselage. Make sure the wing panel alignment pins slide into the holes provided in the fuselage. Be sure the alignment pins are secure in the wing halves before installing the wings. If they are not, remove the pin and apply a small amount of thin CA into the tube socket and reinstall the alignment pin.

☐ Step 3

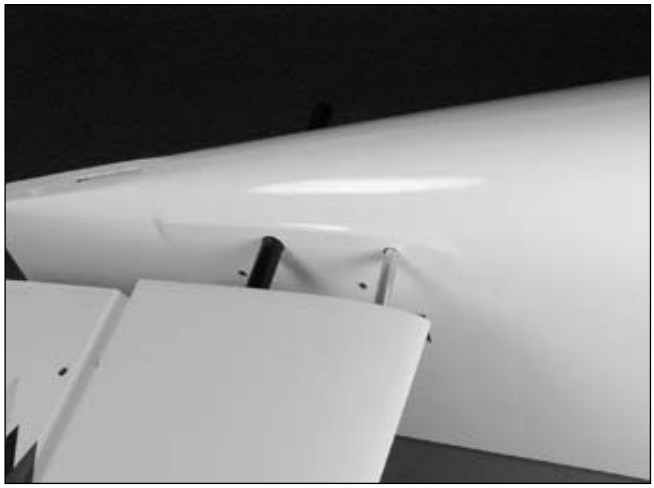
Carefully slide the remaining wing panel onto the wing tube that projects from the fuselage. The fit may be tight; use caution when inserting the wing panels onto the wing tube and fuselage.

☐ Step 4

Secure the wing panels using the 1/4-20 x 2" wing bolts.

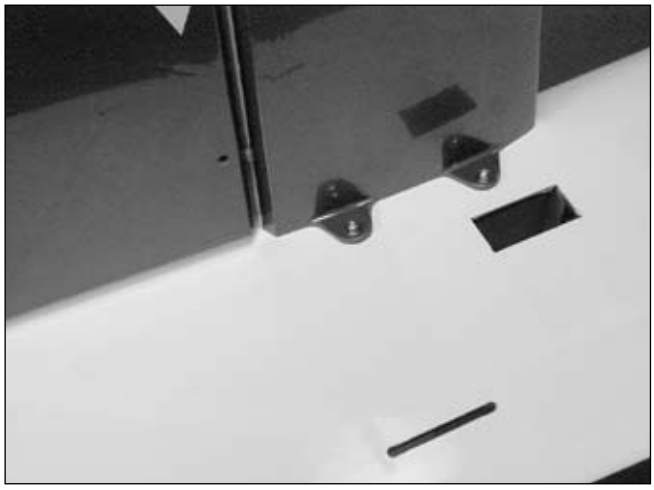
☐ Step 5

Slide the aluminum rod and tube into the holes in the fuselage for the stabilizer. Slide one stabilizer onto the rod and tube.



☐ ☐ Step 6

Secure the stabilizer using two 3mm washers and two 3mm x 15mm machine screws. Use threadlock on the screws to prevent them from loosening during flight.



☐ Step 7

Repeat Step 6 to secure the remaining stabilizer to the fuselage.

☐ Step 8

Test fit the rudder assembly to the fuselage. Remove any covering from the fin post that comes in contact with the fuselage. Use 30-minute epoxy to glue the fin to the fuselage.

Section 4 – Landing Gear Installation

Required Parts

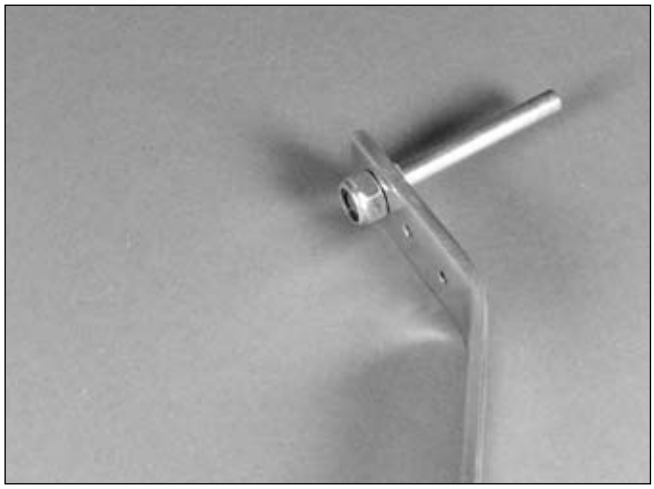
- Fuselage
- Wheel pant (left and right)
- 8-32 nylon lock nut (4)
- 3/16" wheel collar (4)
- 8-32 x 3/4" socket head bolt (4)
- 4-40 x 1/2" socket head screw (4)
- #8 lock washer (4)
- #8 washer (4)
- $3\frac{1}{2}$" wheel (2)
- #4 washer (2)

Required Tools and Adhesives

- Hex wrench: 5/32"
- Felt-tipped pen
- Adjustable wrench (small)
- Ruler
- Square

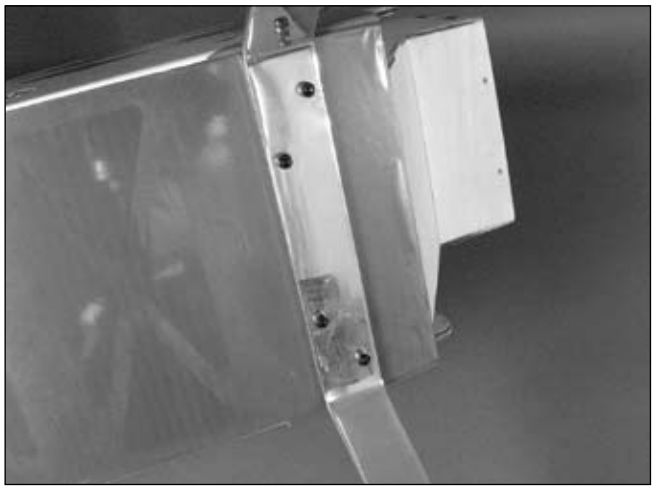
☐ Step 1

Install the axles in the landing gear. Secure the axles using an adjustable wrench and the nuts provided with the axles.



☐ Step 2

Install the landing gear using four 8-32 x 3/4" socket head bolts and four #8 lock washers



☐ ☐ Step 3

Install the following items onto the axle: wheel pant, 3/16" wheel collar, wheel then another 3/16" wheel collar.

☐ ☐ Step 4

Secure the pant in place using a 4-40 x 1/2" socket head screw and #4 washer. Use threadlock on the screw to prevent it from coming loose in flight.

☐ ☐ **Step 5**

Center the wheel in the wheel pant and tighten the collars to prevent the wheel from moving side to side. Use threadlock on both setscrews.

☐ ☐ **Step 6**

Repeat Steps 3 through 5 for the remaining wheel pant.

Section 5 – Elevator Servo Installation

Required Parts

- 8-32 flange nut (2)
- 4-40 lock nut (2)
- Fuselage w/stabilizer
- $2\,^1/_2$" elevator linkage (2)
- 8-32 x $2\,^1/_4$" control horn screw (2)
- Molded swivel link (2)
- Ball link for swivel link (2)
- 4-40 x 1/2" socket head screw (2)
- Ball link for servo arm (2)

Required Tools and Adhesives

- Drill
- Drill bit: 1/16" (1.5mm)
- Dental floss or string
- Aluminum servo arms (2)
- Control horn ball ends (2)
- 24" (610mm) Servo Extensions (JRPA102) (2)

Note: Using two standard rotation servos and a standard "Y" harness for the elevators will result in them moving in opposite directions instead of the same direction. As such, the elevator installation will either require the use of one reversed rotation servo and one standard rotation servo or a reversing "Y" harness. It is highly recommended to use a computer radio or a JR® MatchBox™ to link the two elevator servos to operate properly.

The elevators require a minimum of 80 ounce inch of servo torque. In the prototype CAP 232, we used JR8231 and JR9411 servos with excellent results. Using servos with less torque could cause a crash.

Section 5 – Elevator Servo Installation

☐ ☐ Step 1

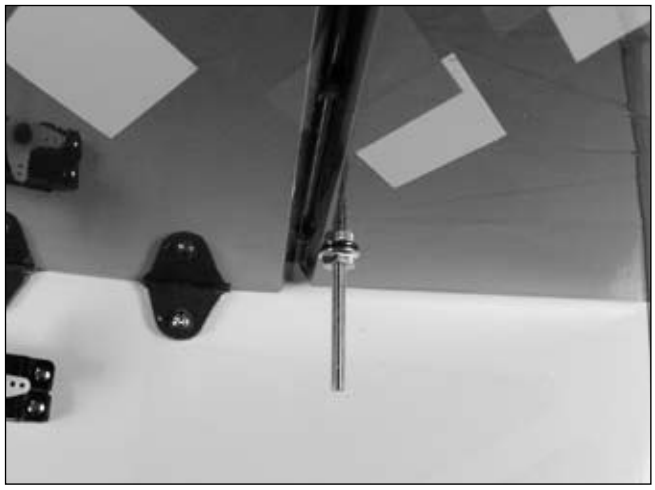
Install an 24" (610mm) servo extension onto an elevator servo. Tie the servo leads together, using a commercially available connector, or use unwaxed dental floss to secure the extensions to prevent them from coming loose during flight. If using a Y-harness, install one side only of the Y-harness to one of the servos, also tying knots to prevent disconnection. The other servo will be hooked up to the Y-harness when installed in the airplane. One elevator servo will need to be a reversed-direction servo.

☐ ☐ Step 2

Install the servo in the fuselage tail section with the output shaft to the rear of the fuselage. Drill 1/16" pilot holes before installing the screws. Using the screws included with the servos, fasten the servos in place.

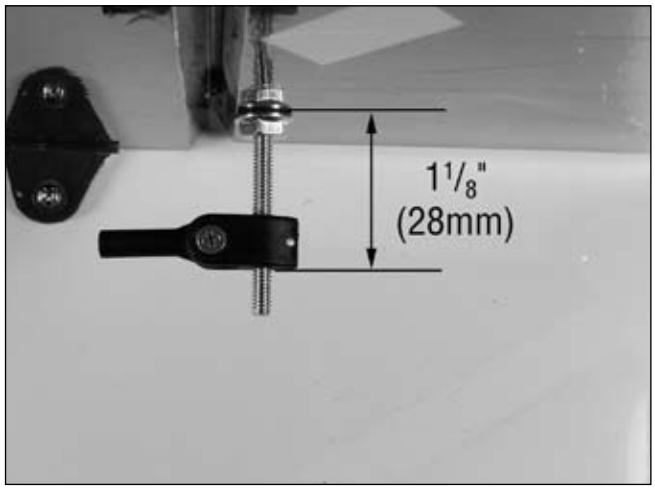
☐ ☐ Step 3

Mix a small amount of 30-minute epoxy and lightly coat the inside of the hole in the elevator and the 8-32 x $2\frac{1}{4}$" control horn screw. Thread the screw into the hole from the top of the elevator. Wipe away any excess epoxy on the wing and screw with rubbing alcohol and a paper towel. Screw the 8-32 flange nut in place as shown. Allow the epoxy to fully cure.



☐ ☐ Step 4

Screw the molded swivel link onto the 8-32 screw until the distance from the elevator surface to the top of the link is $1\frac{1}{8}$" (28mm).



☐ ☐ Step 5

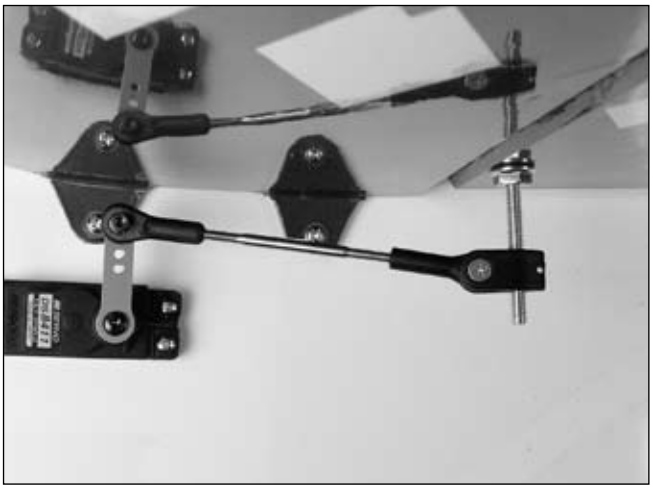
Remove the stock servo arms from the elevator servos and replace them with 3D XL 1/2 servo arms. The arms need to face down as shown. Be sure to use a drop of threadlock on the servo arm screw if using metal-geared servos.

☐ ☐ Step 6

Screw a 4-40 ball link 5 to 6 turns onto a $2\frac{1}{2}$" elevator linkage. Screw the opposite end of the linkage into the swivel control horn on the elevator. Adjust the linkage length until the hole in the ball link lines up with the outer hole in the servo arm when the elevator is neutral and the servo arm is centered.

☐ ☐ Step 7

Use the included 4-40 screws and nuts to attach the ball link to the outer hole in the arm. From the topside, the correct sequence is 4-40 screw, ball link, servo arm and 4-40 locknut. Be sure to use threadlock.



☐ Step 8

Repeat Steps 1 through 7 for the remaining elevator servo and linkage.

Section 6A – Rudder Servo Installation: Pull-Pull

Required Parts

- Fuselage assembly
- 4-40 linkage
- 8-32 flange nut (2)
- 4-40 locknut (2)
- 8-32 x 4" control horn screw
- 4-40 x 1/2" socket head screw (2)

Required Tools and Adhesives

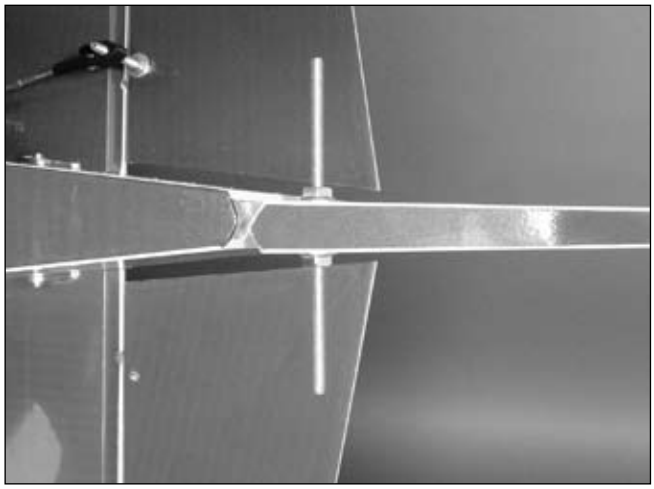
- Threadlock
- Ruler

The CAP 232G has two options for mounting the rudder servo. For lighter engines, a pull-pull system is used. For heavier engines a tail-mounted servo is used.

The rudder requires a minimum of 100 ounce inch of servo torque. In the prototype CAP 232G we used a JRPS8411 servo with excellent results. Using servos with less torque could result in blow back.

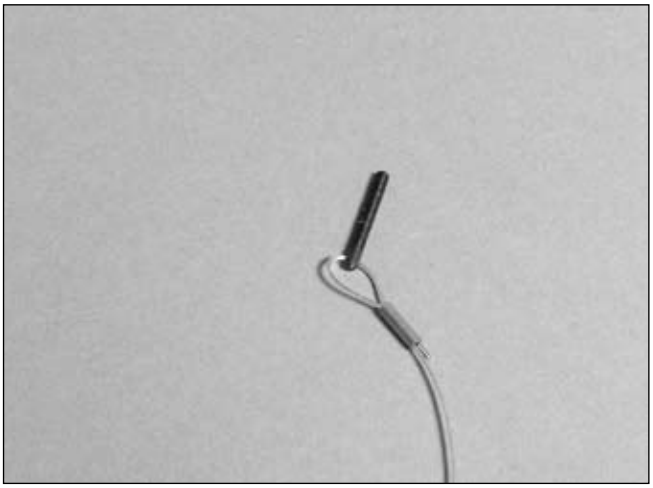
☐ Step 1

Thread the 8-32 x 4" control horn screw into the hole in the rudder and epoxy in place. Thread the 8-32 flange nuts onto the screw from both sides of the rudder. Position the screw so it is centered in the rudder. Use threadlock on the nuts to prevent them from loosening during flight.



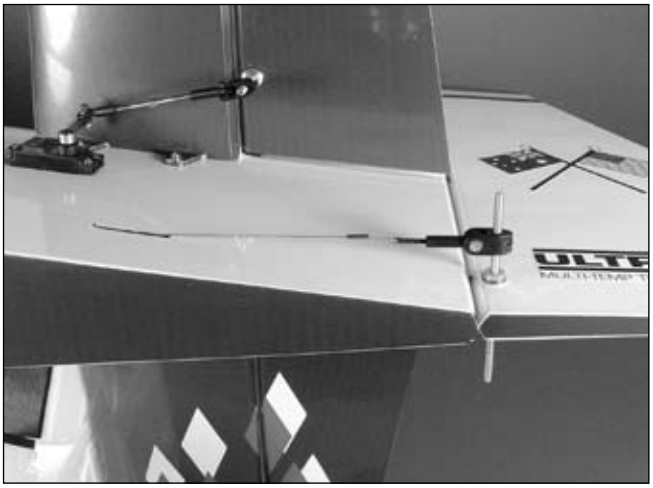
☐ Step 2

Cut the cable into two equal pieces. Prepare one end of the pull-pull cable using the cable, threaded cable end and crimp. The cable passes through the crimp, through the threaded end, then back through the crimp. Pull the excess cable tight and use a crimping tool to complete the job.



☐ ☐ Step 3

Screw the molded swivel link onto the 8-32 screw until the distance from the rudder surface to the top of the link is 11/16" (17mm). Thread the cable end halfway into the ball link. Pass the cable into the fuselage through the opening.



☐ Step 4

Repeat Step 3 for the second cable. Tape the cables to the rudder servo tray to keep them from moving around inside the fuselage.

☐ Step 5

Prepare the rudder servo arm by attaching two 4-40 ball links using the standoffs and 4-40 lock nuts.

Using the screws included with the servos, fasten the servos in place. You may find it helpful to drill 1/16" (1.5mm) pilot holes before installing the screws. Center the rudder servo and place the servo arm onto the servo.

☐ Step 6

Adjust the position of the threaded end on the cable so it will thread into the ball end and have slight tension on the cable to the rudder. It will take some time to get the position right. Once the position of the end is correct, pass the cable back through the crimp and secure the cable. Thread the end into the ball end. Repeat this for both cables.

Note: The cables will cross inside the fuselage to get the correct geometry.

☐ Step 7

With the radio on, check the operation of the rudder. Adjust the cables so when the rudder servo is centered, the rudder is centered as well. There will be tension on the cables. Adjustments can be made at the rudder control horn and at the servo arm. Once adjustments are made, secure the servo arm to the rudder servo using the screw that came with the servo.

Note: Check the tension of the rudder cables before every flying session, as they may stretch over time.

Section 6B – Rudder Servo Installation: Direct Linkage

Required Parts

- Fuselage w/ stabilizer
- 8-32 flange nut
- 4-40 locknut
- Ball link for swivel link
- 4-40 x 1/2" socket head screw
- 8-32 x $2\frac{1}{4}$" control horn screw
- 8" rudder linkage
- Molded swivel link
- Ball link for servo arm

Required Tools and Adhesives

- Drill
- Drill bit: 1/16" (1.5mm)
- Aluminum servo arms
- Control horn ball ends
- 24" (610mm) Servo Extension (JRPA102)
- Dental floss or string

The rudder requires a minimum of 100 ounce inch of servo torque. In the prototype CAP 232Gwe used JRPS8411 servos with excellent results. Using servos with less torque could result in blow back.

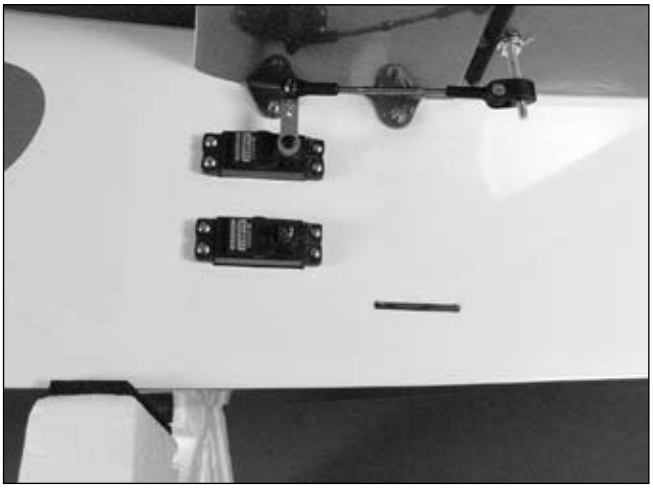
The rudder servo installation is very similar to that of the elevator and aileron servos. You can either follow the steps as described, or just use the last photo to illustrate the direction of the servo and layout of the completed linkage.

☐ Step 1

Install an 24" (610mm) servo extension onto the rudder servo. Tie the servo leads together, using a commercially available connector, or use unwaxed dental floss to secure the extensions to prevent them from coming loose during flight.

☐ Step 2

Remove the covering from the rudder servo opening on the left side of the fuselage using a hobby knife. Install the servo in the fuselage tail section with the output shaft to the rear of the fuselage. Drill 1/16" pilot holes before installing the screws. Using the screws included with the servos, fasten the servo in place.

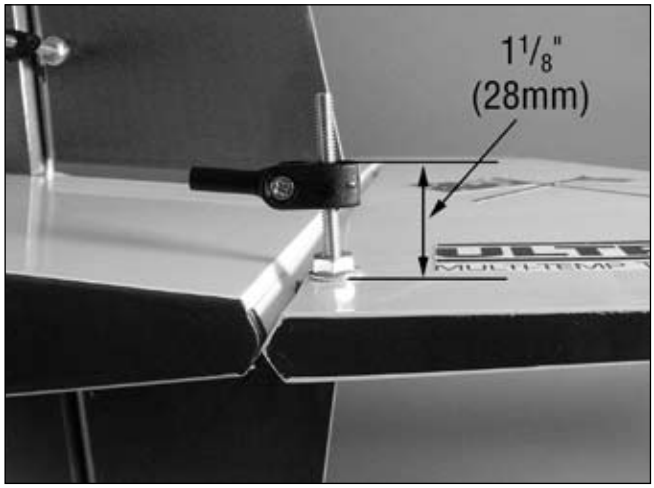


☐ Step 3

Mix a small amount of 30-minute epoxy and lightly coat the inside of the hole in the rudder and the 8-32 x $2\frac{1}{4}$" control horn screw. Thread the screw into the hole from the right side of the rudder. Wipe away any excess epoxy on the rudder and screw with rubbing alcohol and a paper towel. Screw the 8-32 flange nut in place as shown. Allow the epoxy to fully cure.

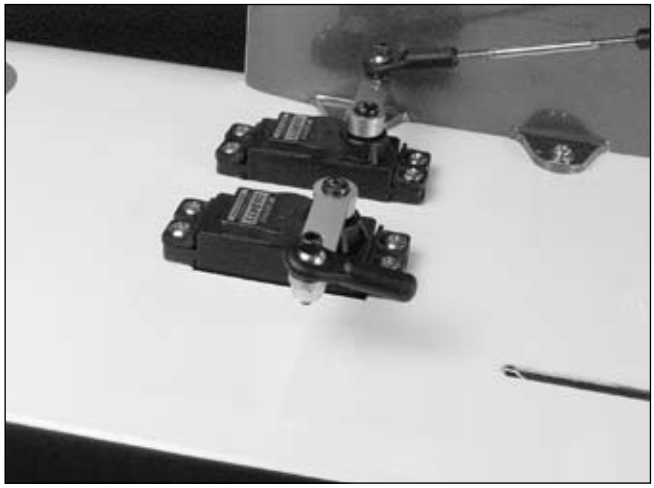
☐ Step 4

Screw the molded swivel link onto the 8-32 screw until the distance from the rudder surface to the top of the link is $1\frac{1}{8}$" (28mm).



☐ Step 5

Remove the stock servo arms from the rudder servo and replace them with 3D XL 1/2 servo arms. The arms need to face down as shown. Be sure to use a drop of threadlock on the servo arm screw if using metal-geared servos.



☐ Step 6

Use the included 4-40 screws and nuts to attach the ball link to the outer hole in the arm. From the topside, the correct sequence is 4-40 screw, ball link, servo arm and 4-40 locknut. Be sure to use threadlock.

☐ Step 7

Screw a 4-40 ball link 5 to 6 turns onto the 8" rudder linkage. Screw the opposite end of the linkage into the swivel control horn on the rudder. Adjust the linkage length until the hole in the ball link lines up with the outer hole in the servo arm when the rudder is neutral and the servo arm is centered.

Section 7 – Tail Wheel Installation

Required Parts

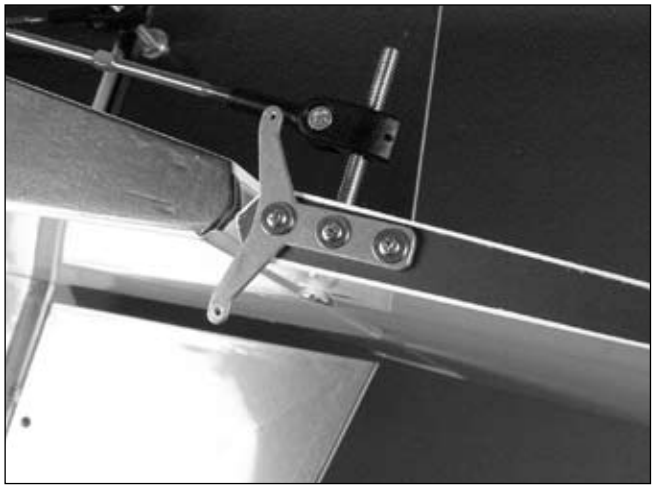
- Fuselage
- Tail wheel assembly
- Tail wheel spring (2)
- Tiller arm
- #4 x 5/8" socket head wood screw (3)

Required Tools and Adhesives

- Drill
- Felt-tipped pen
- Drill bit: 5/64" (2mm)

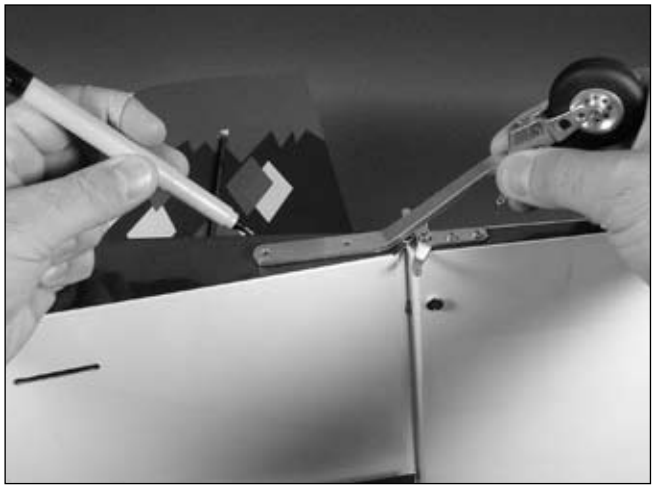
☐ Step 1

Secure the tiller arm to the bottom of the rudder using three wood screws. Remove the screws and apply 2-3 drops of thin CA into the holes to harden the balsa, and then reinstall the screws.



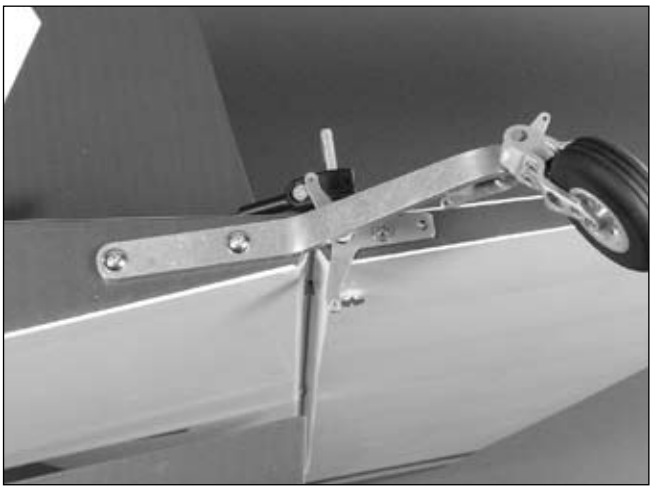
☐ Step 2

Position the tail wheel assembly in place as shown, centered on the rear of the fuselage. Using a felt-tipped pen, mark the positions for the mounting screws through the tail wheel bracket.



☐ Step 3

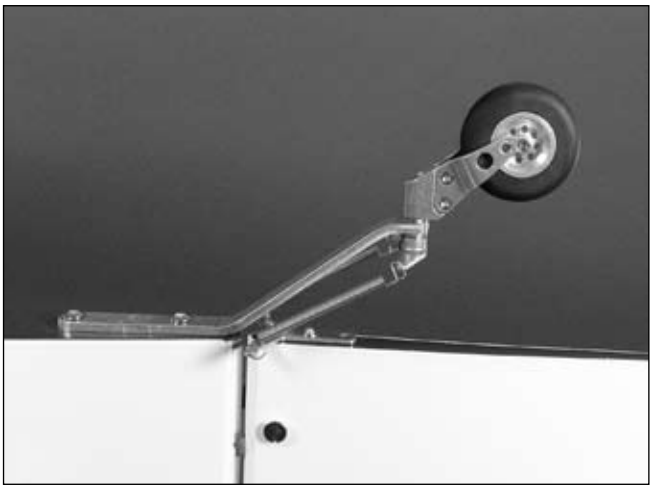
Remove the bracket and drill 5/64" (2mm) pilot holes at the previously marked positions. Use two #4 x 5/8" sheet metal screws to secure the tail wheel bracket in place. A hardwood plate is positioned in the rear of the fuselage, allowing these screws to be firmly tightened.



Hint: Remove the screws and wick thin CA into the holes to strengthen the threads. When dry, reinstall the screws.

☐ Step 4

Use the tail wheel springs to make the connection between the tiller arm and the steering arm. Bend the springs so they won't come loose during flight.



Section 8 – Engine Installation

Required Parts

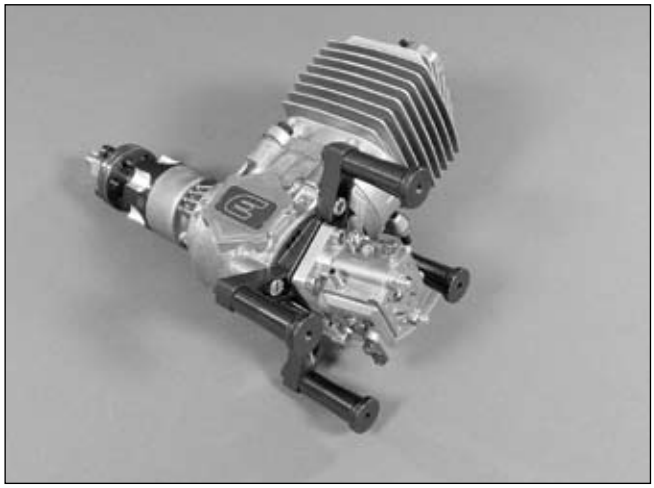
- Fuselage
- 17" throttle pushrod tube
- Nylon clevis
- 13 3/4" throttle pushrod
- #4 washer (4)
- Clunk (fuel pickup)
- Fuel tubing
- Rubber stopper
- 15" (380mm) tie wrap
- 4-40 x 1" socket head screw (4)
- Metal tubes (short and long)
- 1/4-20 x 1" bolts (4)
- 1/4" fuel tubing
- 1/4" split washers (4)
- Cowling
- 1/4" fuel tube (4)
- Metal caps (2)
- Fuel tank
- M3 x 20 screw

Required Tools and Adhesives

- Medium CA
- Ruler
- Hobby knife
- Foam: 1/4" (6mm)
- Rotary tool with sanding drum
- Drill bit: 5/32" (4mm), 7/32" (5.5mm)
- 3 1/4" (83mm) spinner and adapters
- Phillips screwdriver
- Drill
- Square
- Razor saw

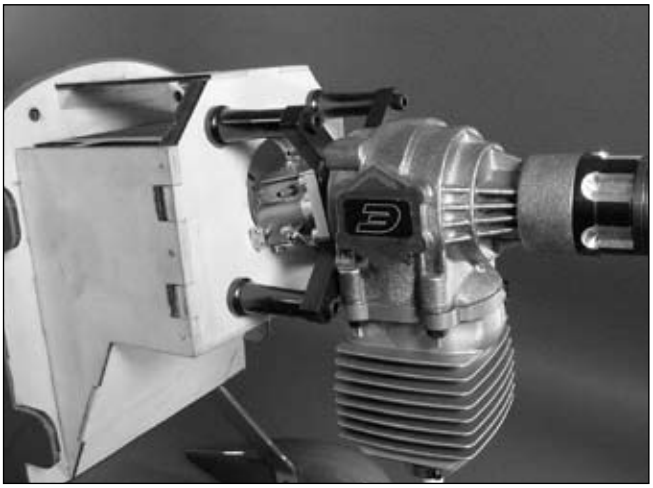
☐ Step 1

Attach the engine standoff onto the engine using the instructions provided with the engine. Also collect all the items required for the exhaust system at this time.



☐ Step 2

Attach the engine to the firewall using the hardware provided with your engine from the inside of the firewall. Mount the muffler to the engine.



☐ Step 3

Determine the proper location for the throttle pushrod. Mark the location with a felt-tipped pen. Remove the engine and drill the firewall for the pushrod tube using a drill and 5/32" (4mm) drill bit. Roughen the tube using medium sandpaper. Slide the tube into position and use medium CA to glue it to the firewall.

☐ Step 4

Trim the tube 1/2" (13mm) in front of the throttle servo tray. Place a 1/4" (6mm) piece of fuel tubing onto a clevis, then thread the clevis onto the 13 3/4" (350mm) throttle pushrod. Attach the clevis to the carburetor arm. Use a brass connector to connect the throttle pushrod to the servo arm as shown.

Section 8 – Engine Installation

☐ Step 5

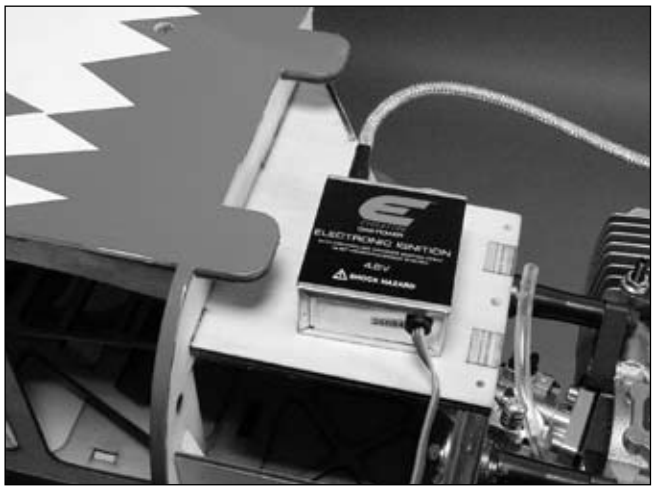
Move the servo to the throttle open position using the radio system. Manually move the throttle arm on the carburetor to the open position. Mark the pushrod where it crosses the servo arm. Make a 90-degree bend in the wire and install it into the servo arm.

☐ Step 6

Check the movement of the throttle to verify there is no binding at either low or high throttle. If there is, make the necessary adjustment to eliminate any binding. Secure the pushrod using a pushrod keeper when all adjustments are complete.

☐ Step 7

Install the ignition onto the engine box. Make any connections from the ignition to the engine using the instructions provided with your engine. Mounting the ignition to the engine box keeps it away from the radio. Being too near could cause radio interference.

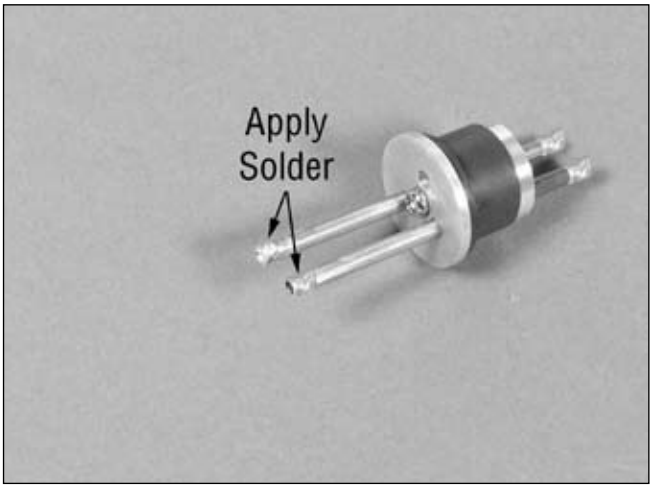


Note: The stopper provided with the CAP 232G has three holes in the stopper. The holes are for the fuel pickup, fill and vent lines. Only two holes will be used: one for the fuel pickup and one for the fuel vent. Only open the third hole if you want to use a separate fill line.

Note for Glow Engines: The stopper and tubing supplied is for gas engines. If you are using a glow engine you will need to purchase a separate stopper and tubing for your engine.

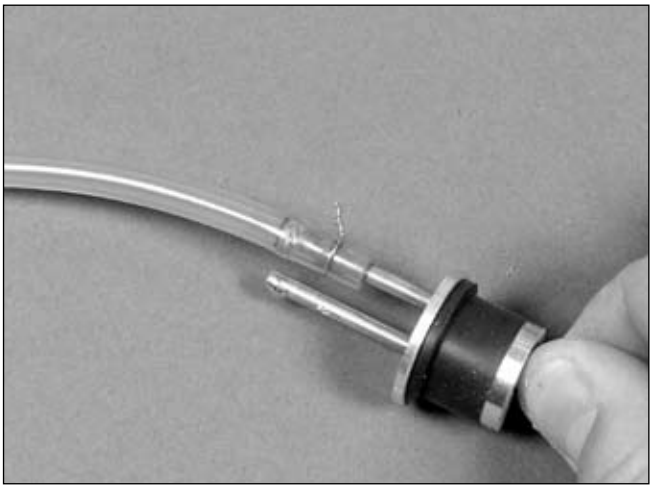
☐ Step 8

Prepare the tubing by placing a drop of solder on the ends of the brass tubing as shown. This will keep the fuel line from slipping off the tube when combined with Step 7.



☐ Step 9

Slide the tubes onto the brass tubes. Use fine wire to secure the tubes. The wire is placed behind the solder applied in the previous step to keep the tubes in place.



☐ Step 10

Bend the longer fuel tube carefully to a 45-degree angle using your fingers. This will be the fuel tank vent tube. Use care not to kink the tube while bending.

☐ Step 11

Connect two 12" (305mm) pieces of fuel tubing for pickup and vent tubes. Attach the tubing to the pick-up and the vent.

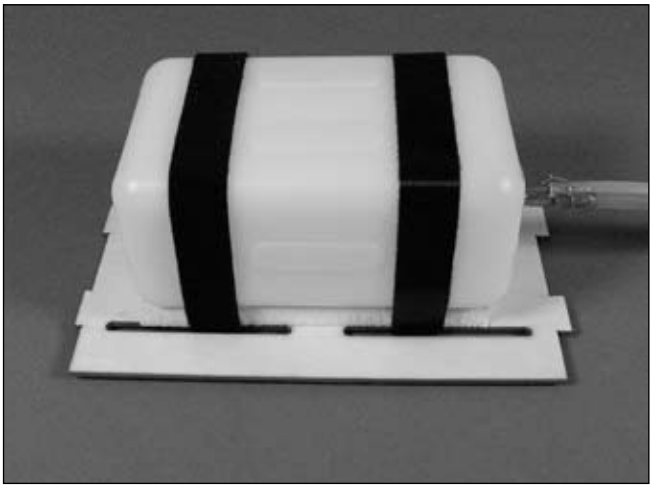
☐ Step 12

Carefully insert the stopper assembly into the fuel tank. Note the position of the vent tube; it must be up at the top portion of the fuel tank to function properly. Also, it may be necessary to shorten the length of the fuel pickup tubing to make sure the clunk does not rub against the back of the fuel tank. You should be able to turn the tank to any attitude, and the clunk will fall to the lowest point (all directions except for having the stopper facing down). Tighten the M3 x 20 screw carefully—do not over-tighten. This allows the rubber stopper to form a seal by being slightly compressed, thus sealing the fuel tank opening.

Note: When installing the fuel tank, make sure to have a piece of foam at any point that contacts any structure inside the fuselage. Without the foam, vibrations will be transmitted to the fuel tank, which could cause the fuel to foam. In turn, you will not get the optimum performance from your engine.

☐ Step 13

Cut a piece of 1/4" foam the size of the bottom of the fuel tank. Secure the fuel tank to the fusel tank floor, placing the foam between the tank and floor.



Note: The longer tabs on the floor face toward the front of the fuselage.

☐ Step 14

Secure the fuel tank floor into the fuselage using 30-minute epoxy.

Note: Once the epoxy has cured it may be necessary to move the fuel tank forward or aft depending on your servo location to prevent binding of the servo.

Section 8 – Engine Installation

☐ Step 15

Attach the cowling onto the fuselage using four 4-40 x 1" socket head screws, four #4 washers and four pieces of 1/4" (6mm) long fuel tubing. Make any necessary cut-outs to clear items such as needle valves, glow plugs, cut-off switches, mufflers, etc.

Note: Start by removing only a little material at a time. You can always make the holes bigger as you work. Work until the cowl fits nicely over the engine.

☐ Step 16

Remove the bottom rear edge of the cowl for an air exhaust. This is important for engine cooling.

☐ Step 17

Install the propeller and spinner to complete the cowling installation.

Section 9 – Final Assembly

Required Parts

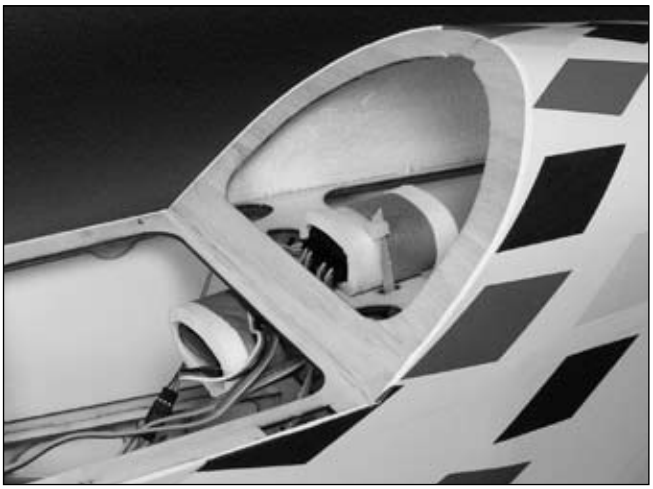
- Fuselage
- Hatch
- 4-40 x 1/2" screw (4)
- Decals
- Pushrod keeper
- Canopy
- #4 washer (4)
- 25–30% pilot

Required Tools and Adhesives

- Velcro straps
- Hex wrench: 3/32"
- Formula 560-canopy glue
- 1/4" (6mm) foam
- Masking tape
- Shoo Goo

☐ Step 1

Wrap the receiver battery and receiver in 1/4" (6mm) foam. Use Velcro straps or tie wraps to secure the receiver and battery to the battery tray.



☐ **Step 2**

Mount the receiver switch in a convenient location in the side of the fuselage.

☐ **Step 3**

Plug the servos into the receiver. Check the operation of the servos using the transmitter. Make any necessary programming changes to the radio for the operation of the aileron and elevator servos.

☐ **Step 4**

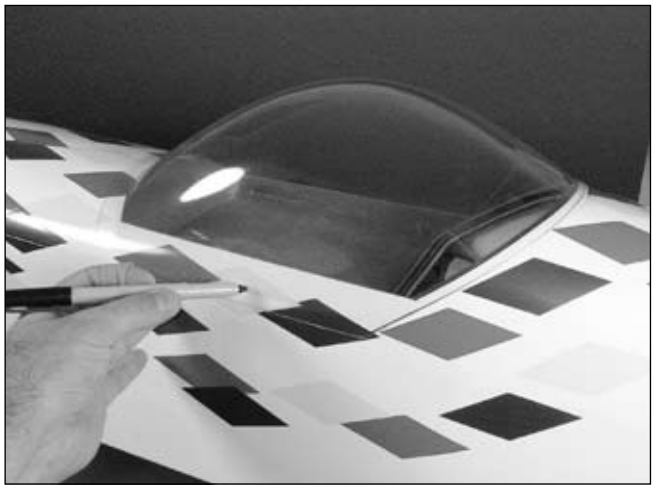
Cut out the instrument panel decal from the decal sheet. Attach it into position.

☐ **Step 5**

Install a 25% or 30% pilot figure to the hatch using Shoo Goo or similar adhesive that will remain flexible. Let the glue dry before securing the canopy in place.

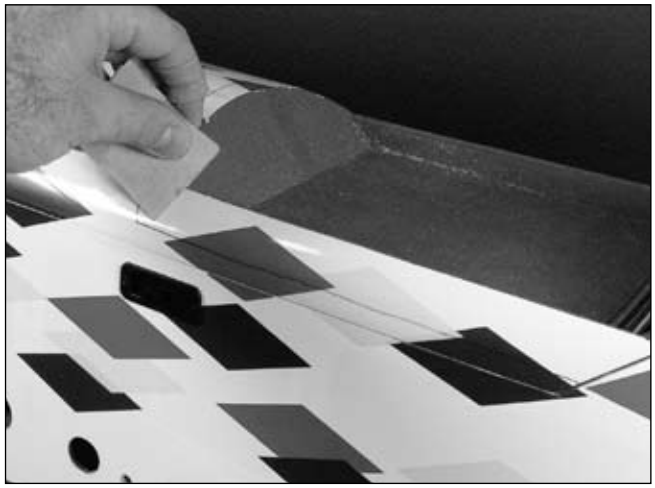
☐ **Step 6**

Use hobby scissors to trim the canopy. Position the canopy onto the canopy hatch. Trace around the canopy and onto the hatch using a felt-tipped pen.



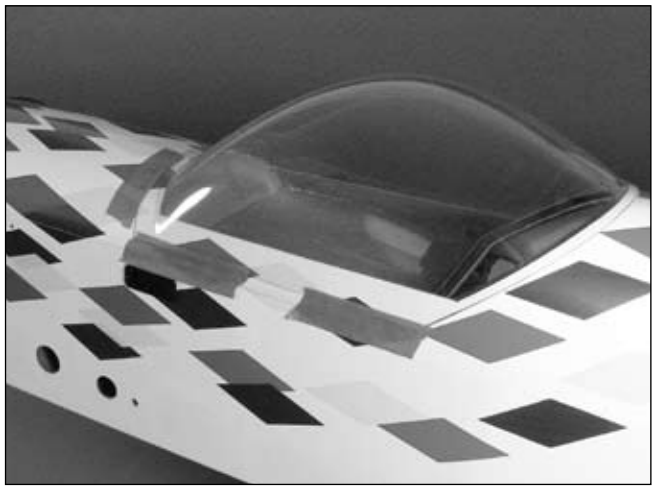
☐ **Step 7**

Lightly sand the inside edge of the canopy and slightly inside the line drawn on the hatch using medium sandpaper.



☐ **Step 8**

Apply a bead of RCZ56 Canopy Glue (ZINJ5007) around the inside edge of the canopy. Position the canopy onto the hatch. Use tape to hold the canopy secure until the glue fully cures.



☐ **Step 9**

Apply the decals using the photos on the box as a guide.

Seal the Aileron and Elevator Hinge Gaps

This should be considered part of finishing the model, and is as important as installing the fuel tank or battery pack. Although this is mentioned back in Section 1, it is important enough to emphasize it a second time in the manual.

On large aerobatic models, this is absolutely necessary. Failure to do this can cause control surface flutter, and on a large model, this will most likely cause a crash.

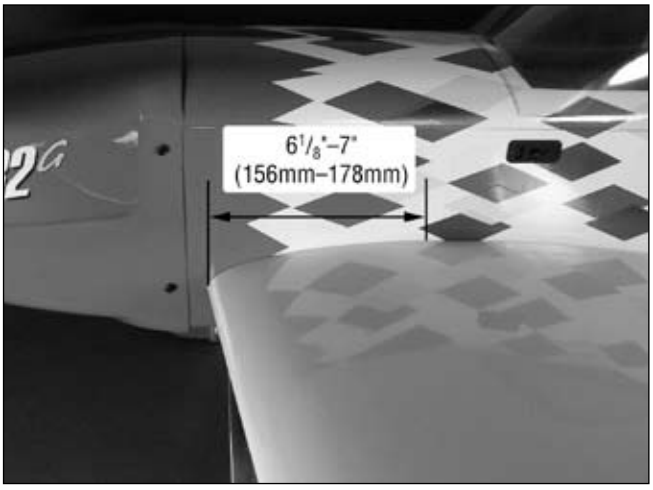
Putting safety and model preservation to the side, there are several other reasons to do this on an aerobatic model. It will increase the effectiveness of the control surfaces, and the model will track more true and precise.

Center of Gravity

An important part of preparing the aircraft for flight is properly balancing the model. This is especially important when various engines can be mounted.

Caution: Do not inadvertently skip this step!

The recommended Center of Gravity (CG) location for the CAP 232G is $6\,1/8$"–7" (156mm–178mm) behind the leading edge of the wing against the fuselage. If necessary, move the battery pack or add weight to either the nose or the tail until the correct balance is achieved. Stick-on weights are available at your local hobby shop and work well for this purpose.



Control Throws

Setting the control throws for your CAP 232G does require some attention to detail. To correctly set the throws, it is highly suggested to use the following procedure to achieve the greatest mechanical advantage from your servos. This will help in preventing stripped servo gears and reduce the potential for in-flight flutter.

☐ Step 1

Determine the maximum amount of control surface throw from the throws listed. Use the 3D throws to set the maximum amount of throw, then use your computer radio for the lower rate listed.

☐ Step 2

Set the Travel Adjust (ATV on Futaba TX) to about 15% under the max. (On a JR transmitter that is 135%). Make sure to set both directions during this process.

☐ Step 3

Adjust the position of the clevis on the control horn and position of the ball link on the servo arm to achieve the throw decided in Step 1. It is highly recommended not to change the position on the servo arm unless absolutely necessary. Use Travel Adjust (ATV) to finalize the throws. That is why we left a little margin in the percentages back in Step 2.

☐ Step 4

If setting a dual elevator or aileron, match the linkage locations used back in Step 3. Increase or decrease the Travel Adjust (ATV) a few points as necessary to fine-tune the throws to match up left and right sides and up and down throws so all is symmetrical.

This is all necessary to tune the mechanical advantage as good as possible. When setting up a model for 3D, the mechanical advantage will be less because of the large throws, and thus the servo will work harder and wear faster. Using an insufficient servo for the job, or trying to get too much throw, will cause something to give, probably the servo.

There isn't an exact geometry to the linkage, as it depends on how much throw each individual modeler requires. The linkage geometry should always be maximized so the servo isn't working any harder than it has to.

	Low rate	**3D rate**
Aileron		
	20° up	35° up
	19° down	34° down
Elevator		
	12° up	40° up
	13° down	40° down
Rudder		
	25° right	50° right
	25° left	50° left

Computer Radio Enhancements

A computer radio will allow you to do quite a bit of fine-tuning to the feel of the CAP 232G, which will make aerobatics even easier.

Rates and Expos

Use an Expo to soften the feel of the model. On high 3D rates use quite a bit of expo. The goal on 3D rates is to get the model to feel the same around neutral as it does on low rates around neutral.

Use low rate settings for all flying except for 3D aerobatics. For precision flying or general sport hot-dogging, the low rate throws are perfect, even for snap rolls. The only exception is rudder rates. Use 3D rudder rate when doing stall turns and rolling circles, since the more rudder the better for these. When doing 3D aerobatics, flip to 3D rates just before the maneuver. As soon as the maneuver is done, flip back down to low rate to avoid over-controlling the model.

Radio Setup

A 7-Channel or greater computer radio is highly recommended. This allows the following features:

- Mixing the right aileron to the left aileron (flaperon mix)
- Electronically adjustable aileron differential
- Mixing the right elevator to the left elevator (dual elevator mixing)
- Independent travel and trim adjustments for each elevator half

When using a 7-Channel or greater computer radio, each servo is plugged into its own separate channel. Consult your radio manual for specific details on hookup and programming.

If using a 6-Channel radio with flaperon mix, the aileron servos are each plugged into their own channels. The right aileron plugs into the aileron socket in the receiver, while the left aileron plugs into channel 6. With flaperon activated in the programming, this allows for independent travel adjustment of each aileron in each direction and electronic aileron differential. Consult your manual for more programming details.

With a 6-Channel computer radio, it will be necessary to Y-harness the two elevator servos; a reversed elevator servo is needed to achieve the correct control direction. A servo reverser can be used here.

Using a non-computer radio will require that the aileron, elevator and rudder be Y-harnessed. Be sure to use a reversed servo (or a reverser) for one of the elevator servos. If you've ever thought about purchasing a computer radio, now is a good time to do it!

Preflight

For those of you who are veterans of large models, this is old news. But to you newcomers to the world of large models, this is very important information.

While many smaller models are very tolerant of improper control linkage setups and flying techniques, large models are not. Don't let that scare you away from large models; they are truly one of the best flying experiences in RC that money can buy. However, please pay particular attention to the following areas.

Just as with unsealed hinge gaps, mechanical advantage is often another cause of flutter. Please follow the control horn and servo arm lengths recommended in this manual. Shorter arms on the servo or longer control horns on the elevator and ailerons are fine, but do not try to go the other way to increase throw. It can cause flutter on the CAP 232G. The recommended linkage setups are more than adequate to achieve full 3D throws.

Never attempt to make full throttle dives!

Large models perform much more like full-size aircraft than small models. If the airframe goes too fast, such as in a high throttle dive, it may fail. The CAP 232G should be flown like a full-scale CAP 232. Throttle management is absolutely necessary.

Range Test Your Radio

☐ **Step 1**

Before each flying session, be sure to range check your radio. This is accomplished by turning on your transmitter with the antenna collapsed. Turn on the receiver in your airplane. With your airplane on the ground and the engine running, you should be able to walk 30 paces (approximately 100 feet) away from your airplane and still have complete control of all functions. If not, don't attempt to fly! Have your radio equipment checked out by the manufacturer.

☐ **Step 2**

Double-check that all controls (aileron, elevator, rudder and throttle) move in the correct direction.

☐ **Step 3**

Be sure that your batteries are fully charged, per the instructions included with your radio.

2006 Official AMA National Model Aircraft Safety Code

GENERAL

1) I will not fly my model aircraft in sanctioned events, air shows or model flying demonstrations until it has been proven to be airworthy by having been previously, successfully flight tested.

2) I will not fly my model higher than approximately 400 feet within 3 miles of an airport without notifying the airport operator. I will give right-of-way and avoid flying in the proximity of full-scale aircraft. Where necessary, an observer shall be utilized to supervise flying to avoid having models fly in the proximity of full-scale aircraft.

3) Where established, I will abide by the safety rules for the flying site I use, and I will not willfully and deliberately fly my models in a careless, reckless and/or dangerous manner.

4) The maximum takeoff weight of a model is 55 pounds, except models flown under Experimental Aircraft rules.

5) I will not fly my model unless it is identified with my name and address or AMA number, on or in the model. (This does not apply to models while being flown indoors.)

6) I will not operate models with metal-bladed propellers or with gaseous boosts, in which gases other than air enter their internal combustion engine(s); nor will I operate models with extremely hazardous fuels such as those containing tetranitromethane or hydrazine.

7) I will not operate models with pyrotechnics (any device that explodes, burns, or propels a projectile of any kind) including, but not limited to, rockets, explosive bombs dropped from models, smoke bombs, all explosive gases (such as hydrogen-filled balloons), or ground mounted devices launching a projectile. The only exceptions permitted are rockets flown in accordance with the National Model Rocketry Safety Code or those permanently attached (as per JATO use); also those items authorized for Air Show Team use as defined by AST Advisory Committee (document available from AMA HQ). In any case, models using rocket motors as a primary means of propulsion are limited to a maximum weight of 3.3 pounds and a G series motor. (A model aircraft is defined as an aircraft with or without engine, not able to carry a human being.)

8) I will not consume alcoholic beverages prior to, nor during, participation in any model operations.

9) Children under 6 years old are only allowed on the flight line as a pilot or while receiving flight instruction.

RADIO CONTROL

1) I will have completed a successful radio equipment ground range check before the first flight of a new or repaired model.

2) I will not fly my model aircraft in the presence of spectators until I become a qualified flier, unless assisted by an experienced helper.

3) At all flying sites a straight or curved line(s) must be established in front of which all flying takes place with the other side for spectators. Only personnel involved with flying the aircraft are allowed at or in the front of the flight line. Intentional flying behind the flight line is prohibited.

4) I will operate my model using only radio-control frequencies currently allowed by the Federal Communications Commission. (Only properly licensed Amateurs are authorized to operate equipment on Amateur Band frequencies.)

2006 Official AMA National Model Aircraft Safety Code

5) Flying sites separated by three miles or more are considered safe from site-to site interference, even when both sites use the same frequencies. Any circumstances under three miles separation require a frequency management arrangement, which may be either an allocation of specific frequencies for each site or testing to determine that freedom from interference exists. Allocation plans or interference test reports shall be signed by the parties involved and provided to AMA Headquarters. Documents of agreement and reports may exist between (1) two or more AMA Chartered Clubs, (2) AMA clubs and individual AMA members not associated with AMA Clubs, or (3) two or more individual AMA members.

6) For Combat, distance between combat engagement line and spectator line will be 500 feet per cubic inch of engine displacement. (Example: .40 engine = 200 feet.); electric motors will be based on equivalent combustion engine size. Additional safety requirements will be per the RC Combat section of the current Competition Regulations.

7) At air shows or model flying demonstrations, a single straight line must be established, one side of which is for flying, with the other side for spectators.

8) With the exception of events flown under AMA Competition rules, after launch, except for pilots or helpers being used, no powered model may be flown closer than 25 feet to any person.

9) Under no circumstances may a pilot or other person touch a powered model in flight.

Organized RC Racing Event

10) An RC racing event, whether or not an AMA Rule Book event, is one in which model aircraft compete in flight over a prescribed course with the objective of finishing the course faster to determine the winner.

A. In every organized racing event in which contestants, callers and officials are on the course:

1. All officials, callers and contestants must properly wear helmets, which are OSHA, DOT, ANSI, SNELL or NOCSAE approved or comparable standard while on the racecourse.

2. All officials will be off the course except for the starter and their assistant.

3."On the course" is defined to mean any area beyond the pilot/staging area where actual flying takes place.

B. I will not fly my model aircraft in any organized racing event which does not comply with paragraph A above or which allows models over 20 pounds unless that competition event is AMA sanctioned.

C. Distance from the pylon to the nearest spectator (line) will be in accordance with the current Competition Regulations under the RC Pylon Racing section for the specific event pending two or three pylon course layout.

11) RC night flying is limited to low-performance models (less than 100 mph). The models must be equipped with a lighting system that clearly defines the aircraft's position in the air at all times.

HANGAR 9®

HORIZON HOBBY

4105 Fieldstone Road
Champaign, Illinois 61822
(877) 504-0233
horizonhobby.com

8793