Precision Paper Space Models

. . . Space-Age History in Card and Paper

MERCURY ATLAS LAUNCH VEHICLE

Model Description

This 1/96 scale Precision Paper Space Model represents the Atlas 109-D/Mercury Capsule No. 13 combination that carried U.S. astronaut John Glenn into orbit during the Mercury-Atlas 6 (MA-6) mission on 20 February 1962. Glenn and his capsule "Friendship 7" were orbited from Cape Canaveral Launch Complex 14. Glenn was the first U.S. astronaut to orbit the earth (see Mercury-Atlas program overview)

The model's Mercury capsule, with escape tower attached, is detachable. Forward and aft cardstock bulkheads and a double-wrapped tube create a study Atlas body. The model includes Mercury capsule details and a lattice escape tower support structure. A display stand and base is provided for assembly. When assembled, the model stands 11.92 inches tall and is 1.25 inches in diameter.

Mercury Atlas 6 launches John Glenn into orbit from Cape Canaveral Pad 14. Atlas liquid oxygen tanks were shrouded in ice at lift off time.*NASA Photo*

The model fills six pages of 20 pound or heavier paper. The sixth page includes all of the color parts, which include the red Mercury escape tower. To assemble, you will need a pair of scissors and/or a hobby knife, rubber cement, white paper glue, a toothpick or narrow strip of paper, a dowel rod or a round pen or pencil, and some cardstock (ie, several 3 x 5 cards). If desired, a few square inches of poster board may be used for constructing the display stand base.

MODEL ASSEMBLY INSTRUCTIONS

This model can be assembled with rubber cement, white paper glue, or a combination of the two. White paper glue sets faster than rubber cement, but can wrinkle paper. Rubber cement takes longer to set, but the result is usually stain and wrinkle-free. In the following instructions, the term "cement" is used whenever rubber cement is thought to be the preferred method. The term "glue" means that white paper glue should be used.

1. Cut out Atlas body and Atlas forward bulkhead mount. Cement adapter mount to inside of body underfold section on opposite of gray area denoted as "Location A".

2. Roll Atlas body into a double-layered tube. Apply rubber cement sparingly with toothpick or small strip of paper to small sections of body at seam. Use pen or dowel rod inside tube to assist. Clean excess glue with tissue paper. Finish by gluing loose underfold sections at each end of the body tube using toothpick or small strip of paper to insert glue.

3. Cut out Atlas forward and aft bulkheads (Page 2) and cement to a single layer of cardstock. When dry, cut out bulkheads again. Insert forward bulkhead into top of Atlas body tube until it rests on the Atlas forward bulkhead mount. You may need to trim or sand the bulkhead slightly to get a good fit. With the bulkhead in place, apply a seam of glue around the top edge.

4. Cut out main tank cylinder/tapered section adapter (page 2). Cut top adapter section into strips as indicated. Roll and cement to inside of Atlas main tank body tube at top, allowing strips to extend outside body. Press into place with pen or dowel.

5. Cut out Atlas main tank tapered section (page 2). Roll and cement into a double-layered tapered cylinder by

aligning lines "B" and "A". Apply cement with toothpick or small strip of paper to loose underfold (inner layer) ends.

6. Cut out Atlas tapered section upper adapter (page 2). Cut upper portion into strips. Roll into a tapered cylinder and cement to inside top of tapered section cylinder. Allow strips to extend from tapered section.

7. Cement Atlas main tank tapered section to top of Atlas main tank, being sure to align seams and helium feed line. Carefully align so that tapered section is centered. Use a pen or dowel to press adapter strips into place from inside.

8. Cut out long and short instrumentation pods (page 3). Fold and cement/glue into long rectangular channels topped by tapered triangulalar transition sections. Cement into place on opposite sides of Atlas main tank at positions shown. Center the long pod on the Atlas body seam. The bottom of each pod should be at the top of the "ribbed" booster skirt (second line from the missile base). Press the pods firmly against the side of the tank, then press the tapered triangular transition section of each pod into place.

9. Cut out two booster skirt fairings (page 3). Fold in tabs on each side of fairing. Roll fairing slightly until it assumes a tapered cylindrical shape. Test fit fairing by inserting its top, up to the top line on the fairing, into open base of instrumentation pod and by aligning its base to bottom corners of the silver rectangle on the booster skirt. Carefully cement/glue both fairings into place, being sure to center the fairing top and bottom.

10. Fold in triangular tabs on Atlas body base. Glue aft bulkhead to the Atlas base using the tabs. Align bulkhead with booster fairings. Press firmly into place.

11. Cut out LOX pipe and LOX pipe top and bottom caps (page 4). Roll pipe into tight cylinder and glue. Cut out and glue top and bottom caps. Trim top and bottom caps after glue sets. Cement LOX pipe to side of Atlas main tank on red line, seam side inward. LOX pipe carried liquid oxygen around fuel tank from the upper LOX tank. On the launch pad, the LOX fill pipes attached at the LOX pipe base.

12. Cut out two vernier fairings (page 4). Fold and glue into tapered triangular shape. Attach to opposite sides of Atlas main tank just above booster fairing (second line up from base of missile) below missile number "109 D". The small 1000 pound thrust vernier motors, which were angled out 45 degrees from the missile, were mounted on these fairings.

13. Cut out Rocketdyne LR105-5 sustainer engine (page 4). Roll into truncated cone, underfolding inner layer so "B" lines up with "A". Cement underfold end at bottom of thrust chamber. Cut upper adapter strips and fold inward. Glue engine to center of aft bulkhead. The sustainer engine stayed attached to the Atlas body during the flight.

14. Cut out two Rocketdyne LR89-5 booster engines (page 4). Assemble using sustainer engine procedure. Attach engines to outer positions of aft bulkhead. The booster engines and booster skirt fell away from Atlas after a little more than two minutes of flight.

15. Cut out the Mercury/Atlas adapter and the Mercury/Atlas adapter bulkhead (Page 5). Cement bulkhead to a layer of cardstock. Roll and cement adapter into a double-layered slightly tapered truncated cone. When dry, cement to top of Atlas, with wider (red striped) end at top.

16. Carefully cut out the center, black portion of the adapter bulkhead with a hobby knife, then cut the remainder of the bulkhead from the cardstock layer. Fit check the bulkhead by inserting it into the top of the Mercury/Atlas adapter. The adapter should fit snugly just below the top of the adapter. Trim or sand if necessary to get correct fit, then glue into place.

17. Cut out Mercury capsule heat shield, retro base, and capsule recovery compartment top (Page 5). Cement each part to cardstock and set aside to dry.

18. Cut out Mercury capsule and capsule/recovery compartment adapter (Page 5). Cement adapter to "inside" top portion of Mercury capsule underfold section (white) so that triangular tabs will allow attachment of cylindrical Mercury capsule recovery compartment.

19. Roll and cement Mercury capsule into a truncated cone shape.

20. Cut out Mercury capsule heat shield. Heat shield can be assembled by either underfolding so that "B" meets "A" or by cutting out "A-B-Center" triangle and using a piece of paper backing to join the shield into a mildly tapered cone. The latter method is preferred. Use glue and set aside to dry.

21. Cut out Mercury capsule recovery compartment, retrograde package, and antenna section (Page 5). Roll and cement each part, using a pen or dowel for assistance. Set aside to dry.

22. Glue Mercury capsule heat shield to base of Mercury capsule. Carefully center and adjust to fit. Press attach tabs into place from top with a pen or dowel.

23. Glue recovery compartment to top of Mercury capsule. Triangular tabs should point up. Allow to dry.

24. Glue retrograde package to center of heat shield so that triangular tabs point downward. Carefully center.

25. Bend recovery compartment tabs inward. Cut out and glue recovery compartment top/cardstock assembly to top of recovery compartment.

26. Bend retrograde compartment tabs inward. Cut out and glue retro base/cardstock assembly to base of retrograde package.

27. Bend antenna section tabs inward. Glue antenna section to top of recovery compartment. Press and hold until glue begins to set.

28. Cut out capsule antenna section top (Page 5). Cut and glue into a small, slightly-tapered cone. Glue to top of antenna section.

29. After allowing both Atlas and Mercury to dry, test fit Mercury to top of Atlas. Retro pack should just fit into center hole of adapter bulkhead. You may need to twist Mercury capsule to fit. Carefully trim forward bulkhead with a hobby knife if needed. This is meant to be a friction fit. Do not glue if you would like to be able to remove the Mercury capsule later.

30. Cut out escape tower mast rectangle (Page 6). Fold in half so that the solid red portion is provided as backing. Cement the two halves together and set aside to dry.

31. Cut out the escape tower body, body top, and body bottom (Page 6). Roll body into cylinder, keeping red portion on outside. Glue or cement body, then glue the top and bottom parts into place. Set aside to dry.

32. (Optional) Cut out the escape tower tip (the "transonic spike") (Page 6) and "roll" into a small mast. Glue or cement and set aside to dry.

33. Using a sharp hobby knife, carefully trim the 21 white paper sections from the lattice framework of the escape tower mast. Patience is necessary!

34. Cut out the escape tower mast, fold into a triangular shape, and glue using the two red attachment tabs as aids. After the glue sets, cut off the attachment tabs to create the delicate framework of the escape tower mast.

35. Glue the escape tower mast to the top of the Mercury capsule. The mast should be widest at its bottom, should encapsulate the antenna section, and should rest on the top of the recovery section. Carefully check and recheck the mast for centering.

36. Glue the escape tower body to the top of the escape tower mast. The body should fit within the top "rung" of the mast. Carefully center. If you decide to include it, glue escape tower tip (transonic spike) to top of escape tower body.

37. Cut out display stand template (Page 6). Cement to one layer of cardstock for rigidity. When dry, cut out display stand-cardstock sandwich, then fold and assemble base.

38. Cut out display stand base (Page 6). Cement to rigid poster board or to several layers of cardstock. Cut out again, then cement or glue completed display stand to center of display stand base.

39. After display base has thoroughly dried, mount Atlas into base. The Atlas engines should fit between the two display base vertical supports. You may need to adjust or trim the base slightly.

40. Your Mercury-Atlas is ready to launch!

HISTORY

In December 1958, NASA's Langley, Virginia-based Space Task Group (STG) ordered nine Atlas boosters from Convair Astronautics for use in suborbital and orbital Project Mercury flights. The Atlas boosters would eventually be delivered as operational "D" models. At the time, the unproven Atlas was the only booster capable of orbiting a Mercury capsule.

MA-1, launched like Big Joe without an escape tower, is seen 60 seconds before its demise.*NASA Photo*

Atlas D was 120 inches in diameter and 67.3 feet long. With the Mercury spacecraft and escape rocket, the vehicle was 95.4 feet tall. Atlas D used the 360,000 pound thrust Rocketdyne MA-2 propulsion package, consisting of two 150,000 pound thrust XLR-89NA5 booster engines and one 60,000 pound thrust XLR-105NA5 sustainer engine. All engines ignited on the pad. The boosters burned for 145 seconds before falling away. The sustainer burned for 250 seconds.

At launch, the Atlas D first stage weighed 265,000 pounds. All but 12,000 pounds of this was RP-1 kerosene fuel and liquid oxygen. The Mercury capsule and escape system weighed 4,200 pounds at launch. Mercury Atlas was controlled in flight by the same ground radio command guidance system used for the operational Atlas D ICBM.

MA-2, begins its successful 21 February 1961 suborbital flight from Cape Canaveral Pad 14.*NASA Photo*

The first Mercury Atlas mission was designated "Big Joe" because its heat-shield test mission was similar to the "Little Joe" tests. Atlas 10-D launched the Big Joe boilerplate Mercury capsule on a suborbital flight from Cape Canaveral Launch Complex 14 on 9 September 1959. Atlas 10-D's booster engines failed to separate, however, causing a shorter than intended flight. Nonetheless, the capsule survived reentry and was recovered, proving Mercury's ablative heat shield design.

The next flight, MA-1, carried a real Mercury capsule (No. 4) on 29 July 1960. Unfortunately, structural failure near the Atlas/Mercury adapter destroyed the vehicle about 60 seconds after launch. The failure occurred in heavy cloud cover, frustrating post-flight analysis. Because MA-1 did not include an escape tower, the capsule was destroyed.

Mercury Capsule No. 8A, refurbished after the MA-3 failure, is prepared for mission MA-4. This was the first successful orbital Mercury flight.*NASA Photo*

A stiffener was added to the top of the Mercury Atlas LOX tank, making for a successful MA-2 suborbital flight on 21 February 1961. Two months later, however, the first unmanned orbital try, on MA-3, had to be destroyed by Range Safety when the Atlas autopilot programmer failed to initiate roll and pitch programs just after launch. This time, an active escape system pulled Capsule No. 8 safely away from the exploding Atlas.

Capsule No. 8 was refurbished and orbited successfully on the 13 September 1961 MA-4 mission. On 29 November 1961, chimpanzee Enos rode Capsule No. 9 on MA-5, completing two of three planned orbits before a malfunctioning RCS thruster cut the flight short. An astronaut could have switched to a backup system and completed the flight.

Finally, astronaut John Glenn rode Atlas 109-D and Mercury capsule No. 13 into orbit on the 20 February 1962 MA-6 mission. Glenn named his capsule "Friendship 7". America's first orbiting astronaut safely completed his planned 3-orbit mission, although a false heat shield deploy signal added drama to his reentry. Three more Mercury-Atlas missions were flown during 1962-63. These carried Scott Carpenter, Walter Schirra, and Gordon Cooper into the history books.

The last Mercury Atlas stands on Pad 14 prior to Gordon Cooper's one-day MA-9 mission. The Complex 14 launch tower, now in solid red paint, had been rebuilt after the early unmanned Mercury Atlas flights.*NASA Photo*

After six consecutive Mercury Atlas successes, NASA decided to play it safe and end the program, cancelling a planned MA-10 mission. Today, an Atlas D (number unknown) on display with a dummy Mercury capsule at the Kennedy Space Center Visitors Center serves as the only physical reminder of America's first manned orbital launch vehicle. Cape Canaveral Launch Complex 14 served as an Atlas-Agena pad for several years before being deactivated and dismantled in 1967. Several Mercury capsules can be found in museums. Glenn's Friendship 7 is at the National Air and Space Musuem.

Mercury Atlas Firing History

Mission/Vehicle	Date	Site	Comments
Big Joe 10-D	9/9/59	CC14	Partial failure 95x1496 mi. suborbital mission; Atlas boosters failed to separate; Boilerplate reentered and recovered, proving ablative heatshield method
MA-1 50-D	7/29/60	CC14	Failed; Structural failure at max-Q, T+~60sec, near Atlas/Mercury adapter; Mercury Capsule No. 4 destroyed since escape system was not installed; Planned suborbital flight
MA-2 67-D	2/21/61	CC14	Success; 114x1432 mi suborbital mission with Capsule No. 6; first escape tower flight; Atlas had 8 in. wide stiffener at top of LOX tank
MA-3 100-D	4/25/61	CC14	Failure; Atlas autopilot programmer failed, RSO destroyed at T+40sec; Capsule No. 8 saved by escape system; Planned orbital flight
MA-4 88-D	9/13/61	CC14	Success; Capsule No. 8A completed one 142x99 mi orbit
MA-5 93-D	11/29/61	CC14	Success; Chimp Enos in Capsule No. 9 finished 2 of 3 planned 147x100 mi orbits; Malf RCS thruster caused early return
MA-6 109-D	2/20/62	CC14	Success; John Glenn in Capsule 13 (Friendship 7) completed 3 162x100 mi orbits; no RCS fuel on landing
MA-7 117-D	5/24/62	CC14	Success; Scott Carpenter in Capsule 18 (Aurora 7) completed 3 167x100 mi orbits; long reentry; no RCS fuel on landing
MA-8 113-D	10/3/62	CC14	Success; Walter Schirra in Capsule 16 (Sigma 7) completed 6 176x100 mi orbits
MA-9 130-D	5/15/63	CC14	Success; Gordon Cooper in Capsule 20 (Faith 7) completed 22.5 157x100 mi orbits

CC = Cape Canaveral, RCS = Reaction Control System

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