MERCURY REDSTONE LAUNCH VEHICLE

This 1/96 scale Precision Paper Space Model represents Mercury-Redstone booster MR-7 and Mercury Capsule No. 7 ("Freedom 7"); the combination that launched U.S. astronaut Alan Shepard on a May 5, 1961 suborbital flight from Cape Canaveral Pad 5. NASA called the mission "MR-3" (See Mercury Redstone History).

The model's Mercury capsule, with escape tower attached, is detachable. Forward and aft cardstock bulkheads and a double-wrapped tube create a study Redstone body. The model shows how carbon steering vanes were mounted in the Rocketdyne A-7 engine exhaust. Additional details include fuel and LOX fill/drain/vent valves, accurate roll bar patterns, Mercury capsule portholes, and a lattice escape tower support structure. A display stand and base is provided for assembly. When assembled, the model stands 10.42 inches tall and is 0.73 inches in diameter.

The model fills four pages of 20 pound or heavier paper. The first page has all of the color parts, including the red-lettered booster and 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 Redstone body and Mercury adapter mount (Page 1). Cement adapter mount to inside of body underfold section on opposite of gray area denoted as "Location A".

2. Roll Redstone 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 Mercury/Redstone adapter (top of Page 1). Roll and cement to outside of Redstone body tube at top, with red line at the very top. This adapter was needed because the Mercury capsule was 4.5 inches wider than the Redstone.

4. Cut out forward and aft bulkheads (Page 2) and cement to a layer of 3 x 5 card type cardstock. Be certain to write "aft" and "forward" next to the bulkheads, as they differ slightly. Set aside to dry.

5. Cut out Rocketdyne A-7 engine cone (Page 2). Roll into conical shape and glue or cement. Set aside to dry.

6. Cut out four tail-fin assemblies (Page 2). Bend and fold the attachment tabs up, then cement each fin assembly to a layer of cardstock. Make sure that the attach tabs are folded up so that they do not stick to the cardstock. Set aside to dry.

7. Carefully, cut out the center, black portion of the aft bulkhead with a hobby knife, then cut the remainder of the bulkhead from the cardstock layer. Attach the Rocketdyne A-7 engine to the inside of the bulkhead with glue or cement, centering the engine on the bulkhead hole.

8. Bend the triangular tabs at the base of the Redstone body inward, then glue the aft bulkhead assembly to the base of the Redstone. As the glue begins to set, adjust the body to fit the circular bulkhead, then press the bulkhead flat against the base of the Redstone. Set the Redstone upright on a flat surface to dry, periodically checking the fit of the bulkhead.

9. Carefully, cut out the center, black portion of the forward 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 Redstone body. The adapter should fit snugly, stopping at the top of the Mercury adapter mount. Trim or sand if necessary to get correct fit, then glue into place.

10. Cut out tail fin cardstock assemblies. Either fold the two fin halves of each fin together, or cut the two halves out separately. Cement the two fin halves of each fin together. When dry, fit test each fin assembly on Redstone base, trimming if needed, by pressing the attach tabs to the Redstone body. Determine fin position by matching the unique roll patterns. Attach fins with glue or cement. Set Redstone aside to dry in an inverted position.

11. Cut out Mercury capsule heat shield, retro base, and capsule recovery compartment top (Page 3). Cement each part to cardstock and set aside to dry.

12. Cut out Mercury capsule and capsule/recovery compartment adapter (Page 3). 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.

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

14. 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.

15. Cut out Mercury capsule recovery compartment, retrograde package, and antenna section (Page 3). Roll and cement each part, using a pen or dowel for assistance. Set aside to dry.

16. 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.

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

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

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

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

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

22. Cut out capsule antenna section top (Page 3). Cut and glue into a small, slightly-tapered cone. Glue to top of antenna section.

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

24. Cut out escape tower mast rectangle (Page 1). Fold in half so that the solid red portion is provided as backing. Cement the two halves together and set aside to dry.

25. Cut out the escape tower body, body top, and body bottom (Page 1). 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.

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

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

28. 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. Your friends and family will be impressed!

29. 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.

30. 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.

31. Cut out display base and display stand parts (Page 4). Cement display stand onto cardstock. Cement display base to either cardstock or heavy poster board. Cut out display stand and assemble into a rectangular box shape. Cut out fin slot on each stand face. Bend tabs inward and glue to center of display base. Set aside to dry.

32. Test fit of Redstone into display base, trimming base as needed. Now, your Mercury-Redstone is ready for launch!

HISTORY

Mercury-Redstone booster MR-7 launches Alan Shepard in Freedom 7 on mission MR-3. This May 5, 1961 launch was from Cape Canaveral Pad 5. ***NASA Photo***

The launch of Sputnik in October 1957 provided the impetus for researchers at the U.S. National Advisory Committee for Aeronautics (NACA) to begin serious study of methods to put men into space. NACA's resulting blunt body reentry capsule design became the basis for project Mercury when NASA was created in October 1958.

NASA's Space Task Group (STG), based at Langley, Virginia, managed project Mercury. McDonnell Aircraft Corporation built the Mercury spacecraft. In January 1959, STG it ordered eight Redstone and two Jupiter boosters from the U.S. Army Ordnance Missile Command for use in suborbital Mercury flights. The unproven Jupiters were later deleted in favor of the more trustworthy Redstone.

Mercury Redstone weighed 66,000 pounds fully fueled, with the Mercury capsule and escape system accounting for about 4,200 pounds. The Redstone booster was 70 inches in diameter and 59.5 feet long. It's four clipped delta fins were 9.4 feet tall and spanned 12.7 feet at the base. With the Mercury spacecraft and escape rocket, the vehicle was 83 feet long.

Redstone's single Rocketdyne 78,000 pound thrust A-7 engine burned for 142 seconds, propelling the Mercury spacecraft to a speed of roughly 5,100 mph. The A-7 had a fixed, regeneratively-cooled steel thrust chamber. Carbon jet-vanes extending into the motor exhaust and air vanes on the vehicle's four fins provided pitch, yaw, and roll control. These were controlled by servo-motors as directed by the vehicle's autopilot.

On November 21, 1960 the Mercury Control Center at Cape Canaveral was manned for the first time for unmanned Mercury-Redstone 1's (MR-1's) scheduled 9 A.M. launch. All seven prospective Mercury astronauts were in attendance. The booster ignited, but then abruptly shut down. MR-1 rose about four inches off its pad, then settled back down onto its fins. The escape pylon suddenly ignited and flew away, leaving the capsule sitting on top of the tetering rocket. A few seconds later, the drouge parachute deployed, followed by the main and reserve parachutes.

MR-1 performs a nasty hang-fire on November 21, 1960. ***NASA Photo***

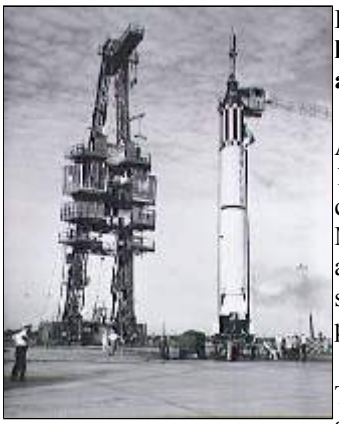
The MR-1 failure disclosed a subtle design flaw in the reliable Redstone. A tail plug, designed to disconnect when the missile had risen about one-inch off the pad, had two prongs of different lengths. Because Mercury-Redstone was heavier, and rose slower, than the Redstone missile, the time interval between the disconnect of the two prongs was longer. This caused a relay to drop out and give a normal engine cutoff signal. The emergency escape system then ejected from the spacecraft as it was supposed to do during a normal flight sequence. The parachute recovery system deployed when sensors detected that the capsule was below the deployment altitude.

A reflight was scheduled for Capsule No. 2, using an escape tower and antenna section borrowed from other capsules. The damaged MR-1 Redstone booster was replaced by booster MR-3. The new mission, named MR-1A, flew on December 19, 1960. Mercury capsule No. 2 reached an altitude of 130.7 statute miles, landed 235 miles downrange, and was successfully recovered.

Heartened by this success, NASA launched chimpanzee "Ham" on mission MR-2 on January 31, 1961. The MR-2 Redstone burned its liquid oxygen supply too quickly, causing an early engine shutdown after 137 seconds. This triggered the Mercury abort system, which fired the escape rockets. Mercury capsule No. 5 was overaccelerated to 5,857 mph, reaching an altitude of 157 miles and landing 422 imles downrange. After more than two hours, recovery crews rescued Ham in good condition from a capsule that had begun to take on water.

Von Braun's Redstone engineers asked for an additional flight to verify fixes to the MR-2 problems. The flight, named MR-BD, used booster MR-5 to successfully boost a boilerplate Mercury capsule on March 24, 1961. The next Mercury Redstone would carry a man.

On May 5, 1961, Redstone booster MR-7 carried America's first astronaut, Alan Shepard, in Mercury capsule No. 7 on a successful suborbital flight from Cape Canaveral Pad 5. The mission itself was called MR-3. Shepard named his spacecraft "Freedom 7", with the "7" denoting the capsule number. Capsule No. 7 had two 10-inch diameter porthole-style windows and a heavy manual latching-style hatch.



Booster MR-8, the last Mercury-Redstone and the last Redstone to be launched from Cape Canaveral, awaits launch of mission MR-4 with astronaut Virgil Grissom.*NASA Photo*

Astronaut Virgil Grissom rode Redstone booster MR-8 and Mercury capsule No. 11 aloft on July 21, 1961. This was mission MR-4. Grissom chose to name his capsule "Liberty Bell 7", with the "7" used to denote the number of original Mercury astronauts. Grissom's spacecraft was the first with a centerline window and a lightweight explosive hatch cover. After a smooth flight, the spacecraft sank during recovery operations in the Atlantic after the explosive hatch blew prematurely. Grissom just barely avoided drowning.

Two Mercury Redstone boosters remained, but additional flights were cancelled after MR-4. The Soviets had successfully orbited two cosmonauts during mid-1961, so NASA decided to focus on the Mercury-Atlas effort. Astronaut John Glenn, who had trained for suborbital Mercury-Redstone mission MR-5, now began training for America's first man-in-orbit flight - Mercury-Atlas 6.

Redstone faded from the scene after its project Mercury contribution. After eight years and dozens of launches, no more Redstones would fly from Cape Canaveral. Von Braun's group was, by mid-1961, already busy developing the Saturn 1 booster. Redstone missile training missions would, however, continue at White Sands Missile Range for two more years, and ten more Redstones would be launched from Woomera, Australia in 1966-67.

Mercury Redstone Firing History

Mission/Vehicle	Date	Site	Comments
MR-1 (MR-1)	11/21/60	CC5	Failed; Engines shut down after less than 1 sec; booster settled hard on pad; escape tower and parachute activated; MR-1 booster damaged

MR-1A	(MR-3)	12/19/60	CC5	Success; 130.7 x 235 st. mi alt x rng; 4909 mph max velocity
MR-2	(MR-2)	1/31/61	CC5	Partial; Chimp "Ham" on board; Redstone overspeed caused excessive g-load; Ham recovered ok; 157 x 422 st. mi alt x rng; 5857 mph
MR-BD	(MR-5)	3/24/61	CC5	Success; Verified fixes for MR-2 overspeed with boilerplate Mercury capsule; 113.5 x 307 st. mi. alt x rng; 5123 mph
MR-3	(MR-7)	5/5/61	CC5	Success; Astronaut Allen Shepard in capsule "Freedom 7"; 116.5 x 303 st. mi alt x rng; 5134 mph
MR-4	(MR-8)	7/21/61	CC5	Success; Astornaut Virgil Grissom in capsule "Liberty Bell 7" 118.3 x 302 st. mi alt x rng; 5168 mph; capsule sank during recovery

==========

CC = Cape Canaveral,

Last Modified: January 20 2002