MR-1: The Four-Inch Flight

November 21, 1960, marked the absolute nadir of morale among all the men at work on Project Mercury. That was the day the MR-1 countdown reached zero, and when "all we did was to launch the escape tower."

Capsule No. 2 had been checked out at Huntsville on July 21 and shipped to the Cape the next day. The final standard trajectory was published on August 1, and the Redstone booster was delivered two days later. From July 23, when the capsule was airlifted to the Cape, until October 7, extensive internal reworking was required. Since this was the first complete capsule to be subjected to preflight checks, it was impossible to know precisely how long the checkout would take. Gleason of NASA Headquarters had explained these scheduling gymnastics to the Senate committee staff on November 3:

> Between October 6 and October 31, 1960, the work proceeded exceedingly well. By October 24, for example, first mate had been completed. The rework had been accomplished and the simulated mission and servicing had been carried out. Not only had none of the contingency period been used up, but preparations were actually two days ahead of schedule! It was, therefore, hoped for the first time, that the working level target date might actually be met, assuming that some as yet unresolved electrical troubles would not cause any real delays.
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> On October 31, the final mating of the capsule and booster was accomplished. Still two days ahead of the target date established on October 7. Therefore, it became clear, upon examination of the remaining work, that the launching might take place on November 7. Accordingly, the Project Mercury operations director requested range clearance for November 7 and also requested support by Naval recovery forces for this date.
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> Because of the continuing great urgency of Project Mercury, and because each succeeding launching hinges critically on the dates of previous launchings, the selection of November 7 as a launch date for MR-1 was the only possible [294] course of action to take for the operations director. In making this decision, he recognized that he was merely identifying the earliest possible launch date, and that this date might well be delayed if difficulties were to be encountered during the final checkout, or if bad weather was encountered. A later decision, on the other hand, would have been inexcusable for this might have caused unnecessary delays if all went well during the final checkout period.[72]

MR-1 was on the launch table on November 7, 1960, when the helium pressure dropped from 2,250 pounds per square inch to 500 pounds in the capsule control system, and the mission was scrubbed again. The capsule was removed from its booster and the heat shield was removed from the capsule so that a helium relief valve and the toroidal hydrogen peroxide tank could be replaced. A wiring change was made to avoid a failure of the Little Joe variety, and electrical sequence checks were redone as reassembly proceeded. Then, on November 21, MR-1 was reassembled and the final countdown proceeded normally, with the exception of a one-hour hold to fix another leak in the capsule's hydrogen peroxide system. The Mercury Control Center was manned for the first time. At 9 a.m. Redstone ignition occurred precisely as scheduled.

The expected blast momentarily churned the air around launch complex No. 56. But then the roar

stopped as suddenly as it had started. Watching by periscope from the blockhouse, the startled engineers saw the booster wobble slightly on its pedestal and settle back on its fins after, at the very most, a four- or five-inch liftoff. The Rocketdyne A-7 engine shut down, and the escape pylon zipped up 4,000 feet and landed about 400 yards away from the launch site. Three seconds after the escape rocket blew, the drogue package shot upward, and then the main chute spurted out of the top of the capsule followed by the reserve parachute, and both fluttered down alongside the Redstone.

Mercury-Redstone 1 was the most distressing, not to say embarrassing, failure so far in Project Mercury. Critics waxed unrestrained. Even the Redstone experts seemed disconcerted.[73] Technically it seemed inexplicable that the normal, instead of the abort ejection, sequence had followed engine shutdown. George Low later that day carried STG's report to the NASA Headquarters staff on what they thought had happened:

> Apparently, sufficient thrust had developed to lift the booster at least 3/32 inch, thereby activating all the systems. (This would require more than 85% of nominal thrust.) The booster settled back down on the pad, damaging the tail fins, and perhaps the structure as well (some wrinkles are visible in the shell). The reason for this shutdown is unknown - the only shutdown to the booster could have come from the booster programmer, at the end of the normal flight sequence. Just how this programmer malfunctioned cannot be determined without a detailed inspection.
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> The capsule sequence . . . was a normal one for the type of signal it received. A closed-loop abort sensing system would have given an abort signal under the conditions of this launching, carrying the capsule away in a regular off-the-pad abort sequence.
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> At the time of this writing, the booster destruct system is still armed, and [295] cannot be disarmed until the battery depletion during the morning of November 22. Capsule pyrotechnics (including posigrade and retrograde rocket) are also armed. The problem is further complicated by the fact that the main parachute is still hanging from the capsule; thus the booster could be blown over in a high- wind condition. Weather predictions, however, are good. It is planned to put the gantry around the booster in the morning, under the assumption that the Redstone has not shifted sufficiently to make this impossible. This will be followed by booster and capsule disarming and sequence checks to determine the cause of the failure.
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> The extent of damage to the capsule has not yet been assessed. Assuming a minimum of damage, it is planned to use the same capsule, together with the MR-3 booster, for the MR-1 firing. It will probably take a month before this launching can take place.[74]

[296] The day after the MR-1 attempt, Walter Burke of McDonnell volunteered to lead a squad of men to disarm the pyrotechnics and umbilical cable still hanging fire. Two days later, after intensive on-the-scene investigations of the puzzle presented by MR-1, Low reported a better consensus of expert opinion:

> The MR-1 failure is now believed to have been caused by a booster tail plug which is pulled out about one inch after liftoff.
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> It has been determined that this two-prong plug is designed so that one prong disconnects about one-half inch before the second one does. This time interval between disconnect of

> the first and second prongs for MR-1 was 21 milliseconds.
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> The booster circuitry is such that if one of these prongs is disconnected prior to the other and while the booster is not grounded, a relay will close giving a normal engine cutoff signal. The time interval between successive disconnects was apparently just sufficient to allow the relay to close.
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> It is reasoned that Redstone missiles are somewhat lighter than the Mercury Redstone (with its extended tank), thereby giving higher initial acceleration and shorter time intervals between disconnects between the two prongs. This shorter time interval would be sufficient to allow the relay to close, thus having avoided this type of failure in the past.
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> This relay behavior could not be detected during checkout procedures since it will only occur when the booster is not grounded.
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> The above theory of failure was advanced by Marshall personnel at Cape Canaveral and has not been confirmed by Marshall-Huntsville. It is planned to continue tests at Huntsville using the Mercury-Redstone No. 2 booster to verify this hypothesis.[75]

Within a week, MR-1 was rescheduled for December 19, and MR-2 and MR-3 had been postponed until 1961. Low informed Silverstein that "The MR-1 capsule will be used as is, together with the escape tower from Capsule 8, and the antenna fairing from Capsule 10. The MR-3 booster will be used for this shot."[76] There was no longer any question that the mating of booster and spacecraft should be done at the Cape.

Physicists observing MR-1 might have expected someone among the 5,000 members of the Marshall Center to have guarded against the relativity of simultaneity where electrical signals were concerned, but McDonnell and Task Group engineers dared not taunt their fellow workers on the Redstone about the cause of the "four-inch flight" of MR-1. They were happy that the sequence system on the capsule performed perfectly, but they too felt responsible for the failure of the MR-1 capsule to abort. Meanwhile Joachim P. Kuettner and Earl Butler at Huntsville, and Kurt Debus and Emil P. Bertram at the Cape, frantically drove the men of their respective Redstone-Mercury Office and Launch Operations Directorate to hasten preparations for MR-1A. By mid-December 1960, the Redstone team assured Washington that the repeat flight was almost ready:

> The November 21 type event will be avoided, in the future, by the addition of a ground cable sufficiently long to maintain a good ground connection until all umbilical plugs are pulled. In addition, the booster circuitry has been [297] modified so that a cutoff signal can only get to the capsule after 130 seconds of booster thrust (normal cutoff occurs at 140 seconds). Before that time, the capsule can only be released from the booster through an abort signal, manually given from the ground.[77]

Minor additional improvements were made to the capsule systems, a revised master operational schedule was issued, the Mercury ground control operations team was brought up to full strength, and Jerome Hammack, STG's Redstone project engineer, along with Paul C. Donnelly, the Mercury-Redstone test conductor in the blockhouse, worried through each day, hour, and minute before December 19.

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[72] Letter, Gleason to BeLieu, Nov. 3, 1960. For the description of events following, see memos, Low to

Administrator, "MR-1 Launching," Nov. 7, 1960; Low to Dir., Space Flight Programs, "Mercury-Redstone 1 Launching," Nov. 14, 1960; Low to Administrator, "MR-1 Launching," Nov. 18, 1960.

[73] For news criticism in the wake of MR-1, see William Hines, "Mercury Failure Puts Early Flight in Doubt," Washington *Evening Star*, Nov. 21, 1960; "Astronaut Flight Still Slated in '61," *New York Times*, Nov. 26, 1960; Louis Kraar, "Man in Space Tests Far Behind Schedule," *Wall Street Journal*, Nov. 28, 1960; and "Space Experts Sniping at Mercury," *Space Age News*, Nov. 21, 1960.

[74] Memo, Low to Administrator, "Attempted Launching of MR-1," Nov. 21, 1960; Hammack, interview, Houston, Feb. 13, 1964; and memo report, Hammack for Proj. Dir., "Attempted Launch of Mercury-Redstone No. 1 Mission on November 21, 1960," Nov. 23, 1960.

[75] Memo, Low to Administrator, "Explanation of MR-1 Failure," Nov. 23, 1960; Joachim P. Kuettner, interview, Huntsville, April 28, 1964.

[76] Memo, Low to Dir., Space Flight Programs, "PMP Briefing on December 2, 1960, Project Mercury," Nov. 28, 1960; and Low comments.

[77] Memo, Low to Administrator, "MR-1 Launch Information," Dec. 15, 1960. For retest preparations, see "Mercury-Redstone, NASA, LOD-LOB, Master Operational Schedule," rev. Nov. 15, 1960, for MR-1, Report No. M-LOD-G-TR-49.4-60; rev. Dec. 2, 1960, for MR-1A, Marshall Space Flight Center. Ms., "MR-1A Review," STG, Dec. 17, 1960.

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