= Mercury @-@ Atlas 8 =

Mercury @-@ Atlas 8 (MA @-@ 8) was the fifth United States manned space mission , part of NASA 's Mercury program . Astronaut Walter M. Schirra , Jr . , orbited the Earth six times in the Sigma 7 spacecraft on October 3 , 1962 , in a nine @-@ hour flight focused mainly on technical evaluation rather than on scientific experimentation . This was the longest U.S. manned orbital flight yet achieved in the Space Race , though well behind the several @-@ day record set by the Soviet Vostok 3 earlier in the year . It confirmed the Mercury spacecraft 's durability ahead of the one @-@ day Mercury @-@ Atlas 9 mission that followed in 1963 .

Planning began for the third U.S. orbital mission in February 1962 , aiming for a six @-@ or @-@ seven @-@ orbit flight to build on the previous three @-@ orbit missions . NASA officially announced the mission on June 27 , and the flight plan was finalized in late July . The mission focused on engineering tests rather than on scientific experimentation . The mission finally launched on the morning of October 3 , having been delayed two weeks because of problems with the Atlas booster . A series of minor booster problems during launch and a faulty temperature controller in Schirra 's pressure suit were the only technical problems noted during the flight . The spacecraft orbited in both automated and passive flight modes for prolonged periods while the pilot monitored it and carried out some minor scientific experiments . After six orbits , the capsule landed in the Pacific Ocean half a mile from the recovery carrier , and was hoisted aboard for Schirra to disembark .

The scientific results of the mission were mixed . The astronaut returned healthy after nine hours of confinement in a low @-@ gravity environment . Observation of the Earth 's surface proved unproductive , however , because of heavy cloud cover and bad photographic exposures . The public and political reaction was muted compared with that of earlier missions , as the Cuban Missile Crisis soon eclipsed the Space Race in the news . The mission was a technical success : all the engineering objectives were completed without significant malfunctions , and the spacecraft used even less fuel than expected . This confirmed the capabilities of the Mercury spacecraft and allowed NASA to plan with confidence for a day @-@ long flight , MA @-@ 9 , which had been an early goal of the Mercury program .

= = Crew = =

= = = Backup crew = = =

= = Mission parameters = =

Mass : 1 @,@ 964 kilograms (4 @,@ 330 lb)
Perigee : 156 km
Apogee : 285 km
Inclination : 32 @.@ 5 °
Period : 88 @.@ 91 min

= = Background = =

By 1962 , both the United States and the Soviet Union had flown two solo spaceflights in the Space Race . There was a widespread perception , however , that the United States was falling behind ; its two missions had been suborbital and had lasted only a few minutes . The Soviet missions had both orbited the Earth , and the second , Vostok 2 , had remained in orbit for a full day . Using the new high @-@ powered Atlas booster , the coming orbital Mercury missions were expected to reduce the gap between the two countries .

NASA announced the first two orbital missions at the end of November 1961 , shortly after the Mercury @-@ Atlas 5 (MA @-@ 5) test flight , which had carried a chimpanzee and twice orbited

the Earth . MA @-@ 6 was planned as the first orbital flight , with John Glenn as the primary crew and Scott Carpenter as his backup . The follow @-@ up mission , MA @-@ 7 was to be crewed by Deke Slayton , with Wally Schirra as his backup . In February 1962 , the first draft planning began for MA @-@ 8 , the third orbital mission , with a goal of " six or seven " orbits , as an intermediate step towards a day @-@ long 18 @-@ orbit flight . The decision to move to six orbits rather than seven was driven by the mission rules on contingency recovery operations ; a seventh orbit would have required significant additional recovery forces to be able to reach the capsule anywhere on its trajectory within eighteen hours . The six @-@ orbit profile had other effects on the recovery plans ; the optimum recovery point was moved to the Pacific Ocean , rather than the Atlantic .

On March 15 , 1962 , NASA announced that Slayton was medically unfit and would be replaced by Scott Carpenter as the prime crew for the MA @-@ 7 mission . The decision to replace him with Carpenter , rather than his official backup Schirra , was justified by the large amount of training Carpenter had managed while preparing for the long @-@ delayed MA @-@ 6 mission . After the success of the MA @-@ 6 and MA @-@ 7 missions , both of three orbits , pressure began to mount to fly an extended mission . On June 27 , 1962 , NASA first announced its plan for the upcoming MA @-@ 8 mission , which would last for " as many as six " orbits . Schirra was named as the prime crew for MA @-@ 8 , with Gordon Cooper as his backup , repeating the backup @-@ one fly @-@ one pattern set by the previous two missions . The pattern would be repeated for MA @-@ 9 , flown by Cooper , and the planned but cancelled MA @-@ 10 , which would have been flown by Cooper 's backup , Alan Shepard .

The Soviet Union had not flown any further flights by the time MA @-@ 7 landed , putting both sides of the Space Race even at two orbital flights each . While the Soviets had flown for longer , the Mercury program was gaining momentum , with a six @-@ orbit mission currently planned and press speculation about a one @-@ day mission . However , in mid @-@ August , the Soviet Union launched two orbital missions , Vostok 3 and Vostok 4 , within a day of each other . The two craft were in intersecting orbits , but despite much speculation did not attempt to rendezvous ; they completed missions of 64 and 48 orbits respectively , just under four and three days , landing within a few minutes of each other on August 15 . This was far ahead of anything currently planned for Mercury , and NASA quickly considered the prospect of modifying a capsule to have an active manoeuvring and rendezvous capability , using technology being developed for the Gemini program . However , after examining the time and safety implications of this proposal , it was decided to abandon the idea and continue with the planned six @-@ orbit mission .

= = = Mission objectives = = =

The original MA @-@ 8 flight plan was issued on July 27 ; although it was revised slightly in August and September , it remained broadly unchanged until launch . This was an improvement on the situation with MA @-@ 7 , which had had frequent and extensive alterations , making it difficult for the pilot to train efficiently . The aim was for the flight to be an engineering @-@ oriented mission , focusing on the operation of the spacecraft rather than on scientific experimentation , to help pave the way for a future long @-@ duration mission . Schirra chose the name Sigma 7 for the capsule in reflection of this focus. using the mathematical symbol for summation as appropriate for an " engineering evaluation " , and the " 7 " to refer to the seven Mercury astronauts .

The mission objectives involved evaluating the performance of the spacecraft over six orbits , as well as the effect of prolonged microgravity on the pilot . The specific spacecraft systems would also be evaluated and tested , and the worldwide tracking and communications network would be tested to see how well it would stand up in an extended mission . The flight control experiments included manually turning the spacecraft around , yaw and pitch manoeuvres to determine how easy it was to control the spacecraft attitude , realignment of the onboard gyroscopes in flight , and leaving the spacecraft to drift on @-@ orbit .

Four non @-@ engineering scientific experiments were planned , two requiring the active involvement of the astronaut and two completely passive . The first involved the astronaut watching for four high @-@ powered flares while passing over Woomera , Australia , and for a xenon arc

lamp while passing over Durban , South Africa . The second involved two sets of photographs to be taken using a 70mm Hasselblad camera as well as conventional color photographs of the Earth from orbit . Focusing on geological features and cloud patterns , photographs were to be taken through a set of colored filters provided by the U. S. Weather Bureau . The latter were intended to help calibrate the spectral reflectivity of clouds and surface features , which in turn would help improve the cameras on future weather satellites . The passive experimentation packages were two sets of radiation @-@ sensitive photographic films , from the Goddard Space Flight Center and the U. S. Navy School of Aviation Medicine , and a set of eight different experimental ablative materials attached to the outside of the spacecraft to test their performance during re @-@ entry .

= = = Spacecraft modifications = = =

The spacecraft and booster were almost identical to those used on the two preceding Mercury orbital flights . The spacecraft had heating blankets removed from the retrorocket motors , to save weight , and a SOFAR bomb was added . This would be ejected at the time the main parachute was deployed , and would help recovery crews find the spacecraft after it landed . A number of modifications were made to the reaction control system , and the communications equipment was upgraded .

The Atlas booster had been modified since the previous flight , and now included baffled fuel injectors and a new hypergolic fuel igniter instead of the original pyrotechnic igniter . This would completely eliminate problems with combustion instability and allow the booster to be released immediately upon attaining full thrust instead of being held on the pad for a few moments .

= = Mission preparation = =

The capsule built for the mission , Mercury Spacecraft No. 16 , had been delivered to Cape Canaveral on January 16 , 1962 . The Atlas LV @-@ 3B booster assigned to the mission , No. 113 @-@ D , was accepted by NASA at the Convair plant on July 27 and delivered on August 8 . In late July , the launch date was set for September 18 , but delays with the Atlas booster 's delivery and a series of technical concerns with the safety of the rocket motors caused it to be pushed back several weeks . Some of this had to do with the modified propulsion system , but also concern over Atlas ICBM tests earlier in the year . There had been no Atlas failures caused by the turbopumps for almost three years , but in late 1961 @-@ early 1962 , two static firing tests experienced pump failure and explosion of the engine , followed by an Atlas missile in April 1962 that exploded almost immediately at liftoff due to a failure of the sustainer turbopump . Analysis of these incidents failed to locate any specific cause for the pump explosions , but all of them occurred when running untested hardware modifications and during movement of the sustainer inlet valve to the flight @-@ ready open position . It was thus decided to give MA @-@ 8 's booster a thorough checkout before it could be deemed flight @-@ worthy . On September 6 , the tests were scheduled to continue until September 24 , which allowed for a probable launch on October 3 . A static firing test on the pad would expose the sustainer turbopump to the failure mode in question . This was carried out on September 8 and the booster reported as ready for assembly on September 18 .

Concerns had been raised that the radiation belt produced in orbit by the recent Operation Dominic nuclear tests would be dangerous to manned space missions , but an extensive study announced in early September declared that it was safe to fly . While the outside of the capsule was expected to receive a dosage of around 500 röntgens , the study concluded that shielding and the effect of the spacecraft structure would reduce this to around 8 röntgens experienced by the astronaut , well within established tolerance limits .

Schirra began training for the mission in early July , logging 29 hours in simulators as well as 31 hours in the spacecraft itself . This included multiple systems tests and three simulated flights , culminating in a six @-@ and @-@ a @-@ half @-@ hour simulated flight on September 29 , with the spacecraft and booster fully stacked on the pad . Highlights of the training period included a visit from President John F. Kennedy on September 11 .

The mission was reported as ready to go ? " except for the weather " ? on October 1 . The major concern with the weather was a major tropical storm in the Atlantic , though there were also worries over a series of typhoons in the Pacific which could pose a problem for recovery operations . On the evening of October 2 , the decision was taken to launch the next morning .

= = Launch = =

Schirra was awakened at 1 : 40 am ET on the morning of October 3 , and after a hearty breakfast ? including a bluefish he had speared the day before ? and a brief physical he left for the launchpad at around 4 am . He entered the spacecraft at 4 : 41 am ET , where he found a steak sandwich left for him in the ' glove compartment ' , and began the pre @-@ launch checks . The launch countdown proceeded as planned until 6 : 15 , when there was a 15 @-@ minute hold to allow the Canary Islands tracking station to repair a radar set . The countdown resumed at 6 : 30 and proceeded to booster ignition with no further delays . Liftoff proceeded smoothly , but there was a momentary clockwise roll transient at liftoff , which reached 7 @.@ 83 ° per second and approached 80 % of the required threshold to trigger the ASIS abort system . This was later identified as being due to a slight misalignment of the main engines and was kept under control by the booster 's vernier thrusters .

Around three and a half minutes into the flight , Deke Slayton , the capsule communicator , cut in to ask Schirra " Are you a turtle today ? " Schirra , nonplussed , announced that he was switching to the on @-@ board voice recorder (rather than the broadcast radio circuit) to leave his answer ; the mission communications transcript noted this as " [correct answer recorded] " . The " turtle club " was a recurrent joke among the astronaut corps ; on being challenged with this question , the correct response was " you bet your sweet ass I am " , with a failure to give the password being punishable by buying a round of drinks . Schirra noted later that he " wasn 't ready for all the world to hear it " , and chose to use the on @-@ board recorder to avoid saying the answer over the air .

Because the Atlas was flying on a slightly lofted trajectory , the booster engines cut off 2 seconds earlier than planned , but the sustainer engine burned for about 10 seconds longer than intended , giving an extra 15 feet per second (4 @.@ 6 m / s) of velocity and putting the spacecraft in a slightly higher orbit than planned . Initial analysis of the trajectory confirmed that the capsule could remain in a stable orbit for at least seven orbits , ensuring there would be no need for an early de @-@ orbit .

= = Orbital activities = =

After separating from the Atlas booster , Schirra stabilized the spacecraft and slowly cartwheeled into the correct attitude ; he deliberately kept the motion slow to conserve fuel , and was able to position the capsule using half a percent of his fuel reserves . He briefly tracked the spent booster , which was rotating slowly past , but made no attempt to move towards it . As the spacecraft moved across the Atlantic , he turned his attention to testing manual control of the spacecraft , which he found sloppy compared to the fly @-@ by @-@ wire system .

Crossing over the eastern coast of Africa , he began to feel overheated ; this problem was also apparent to the ground controllers , who were having a debate with the flight surgeon over whether it was safe to continue or if the mission should be ended after the first orbit . The flight director , Christopher Kraft , followed the surgeon 's advice to see if the problem would settle , and gave the go for a second orbit . Schirra eventually stabilized the problem over time , slowly dialing the suit 's control knob to a high cooling setting ; he compared the heat to that of " mowing a lawn in Texas " .

Over Australia , Schirra watched for a flare launched from the ground , but it was occluded by clouds ; he , was however , able to see lightning and the lit outline of Brisbane . Through the night pass over the Pacific , he tested the capsule 's on @-@ board periscope , though he found it difficult to use and quickly covered it up as soon as the sun rose . Crossing over Mexico , he reported that he was in " chimp configuration " , with the capsule running entirely on automatic without any input from the pilot , and as he began his second orbit began testing a yaw maneuver using the Earth through the main window as a reference , rather than via the much @-@ maligned periscope .

On the second orbit , he confirmed the existence of Glenn 's " fireflies " , the shower of small bright particles first reported on MA @-@ 6 , and during the night section practiced yaw manoeuvres using first the Moon and then known stars as reference points . The second proved difficult to work with , as the small windows of the Mercury capsule gave a very limited field of view , making it hard to identify constellations . Travelling across the Pacific , he again fell back into automatic flight , chatting with Gus Grissom at the Hawaiian tracking station about the qualities of the manual control system .

As he began the third orbit , Schirra disconnected the spacecraft 's gyroscopes , turned off part of the electrical power system , and let the capsule drift . He took advantage of this quiet period to test his spatial awareness and motor control , which he found was broadly unaffected by weightlessness , and to eat a light meal . He powered the spacecraft back up over the Indian Ocean , and continued over the Pacific . At Hawaii , he was given clearance for a full six @-@ orbit mission , and as he crossed over towards California shut down the electrical power for a second period of drifting flight , during which he occupied himself taking photographs with the onboard camera .

On the fourth orbit , drifting in an inverted spacecraft with the Earth ' above ' him , Schirra continued his photography and attempted ? unsuccessfully ? to spot the Echo 1 satellite while passing over East Africa . As he approached California , he spoke briefly to John Glenn in a two @-@ minute conversation broadcast live across the United States on radio and television . Problems began to recur with the pressure suit , with water condensing on the faceplate ; Schirra , concerned about the internal temperature , avoided opening the visor to clean it for fear that the suit temperature would misbehave again .

By the fifth orbit , Schirra had begun to relax , commenting that it was the first rest he had had since December 1961 . He used a small bungee cord exercise device for " a little bit of stretching " , before dropping into manual attitude control , where he reported a sudden burst of oversteering and high fuel use . Over the Atlantic he returned to observation and photography ; he failed to spot the planned high @-@ power light near Durban , in South Africa , due to cloud cover , but did make out the brightly lit city of Port Elizabeth . Over the Philippines , he reported on his fuel status ; after four and a half of the planned six orbits , he still had eighty percent remaining in both manual and automatic fuel tanks . Passing over Quito , Ecuador , towards the end of his fifth orbit , Schirra was asked by the tracking station if he had any message to pass on " in Spanish to the fellows down here " , and he made some comments on how beautiful the country appeared from orbit , ending with a cheery " Buenos Dias , y 'all ! " Schirra later noted that he was " furious " at this point ? he was preparing for re @-@ entry and didn 't want to be distracted with making public statements .

The sixth orbit was dominated by preparations for re @-@ entry , though Schirra was able to take a last set of photographs of South America and try another set of spatial @-@ orientation tests . He armed the retrorockets passing over the western Pacific , and fired the first one at 8 : 52 mission elapsed time . The automatic control system held the capsule " steady as a rock " during this period , though after the retrorockets had stopped firing Schirra noted that the system had burned almost a quarter of its fuel in the process .

= = Reentry and recovery = =

As the spacecraft continued towards re @-@ entry after the de @-@ orbit burn , Schirra used the high @-@ power thrusters to put the capsule in the correct orientation , noting that the attitude control felt " sloppy " . He then enabled the rate stabilization control system , an automatic control method which used up fuel at a very high rate , to maintain control during re @-@ entry ; this was a specific engineering request , and it dismayed Schirra to see the fuel he had husbanded for six orbits be used so quickly .

The local recovery group in the prime target area , in the central Pacific , consisted of an aircraft carrier , USS Kearsarge , in the center of the landing area , with three destroyers strung out along the orbital path . Four search aircraft were also assigned to the area , and three recovery helicopters were based aboard Kearsarge .

Kearsarge picked up the capsule on radar while still 200 miles (320 km) from landing ; 90 miles (

140 km) further up the landing path , the destroyer USS Renshaw reported a sonic boom as it passed overhead . At 40 @,@ 000 feet (12 @,@ 000 m) , Schirra deployed the drogue parachute , and then the main parachute at 15 @,@ 000 feet (4 @,@ 600 m) . The landing was surprisingly precise , 4 @.@ 5 miles (7 @.@ 2 km) from the target point and 0 @.@ 5 miles (0 @.@ 80 km) from Kearsarge , and Schirra joked that he was on course for the recovery carrier 's " number three elevator " . The capsule hit the water , sank and bobbed to the surface again , righting itself after about 30 seconds . Three pararescue swimmers were dropped by one of the helicopters to help him climb out , but Schirra radioed that he would prefer to be towed to the carrier , and a whaleboat from Kearsarge was sent with a line .

Forty minutes after landing , Sigma 7 was hoisted aboard Kearsarge ; five minutes later , Schirra blew the explosive hatch and climbed out to a waiting crowd . After doing this , examinations showed clear bruising on his hand from operating the heavy ejector switch , which he felt provided an important vindication for fellow pilot Gus Grissom 's hatch expulsion accident during the Liberty Bell 7 mission . Grissom had maintained that the hatch blew without his input ; the fact that he had no bruising was seen as evidence that he had not blown the hatch early and sunk his capsule , but that it was a mechanical malfunction . Schirra remained aboard for three days of medical tests and debriefing before disembarking , while the spacecraft was offloaded at Midway Island and transferred to an aircraft for further transport . It was returned to Cape Canaveral for analysis , with the long @-@ term intention of putting it on permanent display .

The spent Atlas booster re @-@ entered the atmosphere on October 4 , the day after the launch , and burned up . After display at the U.S. Space & Rocket Center and Johnson Space Center , the capsule is currently displayed at the United States Astronaut Hall of Fame near Titusville , Florida .

= = Post @-@ flight = =

The post @-@ flight analysis reported no major malfunctions ? the only troublesome anomaly being the suit temperature controls ? and all the engineering objectives of the mission were deemed successfully completed . The fuel @-@ conservation measures were found to have worked particularly well , with even less fuel than anticipated being consumed ; despite the technical changes , the official report gave full credit for this to the pilot . The medical analysis found no significant physiological effects from nine hours of weightlessness , and noted that Schirra had received no significant radiation exposure . Analysis of the radiation @-@ sensitive plates confirmed that there had been a very low radioactive flux inside the spacecraft , and the six ablative materials tested were all deemed broadly satisfactory despite some difficulty comparing them to each other .

Scientifically , the light @-@ observation experiments were unsuccessful , as both target locations were covered by thick cloud cover . However , Schirra was able to view lightning near Woomera , and noted the lights of a city a few hundred miles from Durban . The filtered photography for the Weather Bureau worked as planned , with 15 photographs taken ; the conventional color photography was less successful , with several of the 14 photographs unusable due to overexposure or excess cloud cover . In the end , the conventional photographs were not used for scientific examination due to these problems . Schirra noted that the sheer amount of cloud coverage , worldwide , could provide problems for future activity of this kind ; however , Africa , and the south @-@ western United States , were perfectly clear . Postflight medical examination of Schirra disclosed nothing significant other than a degree of orthostatic hypotension caused by sitting inside the cramped capsule for hours .

Schirra 's post @-@ flight report noted the " fireflies " seen on the previous two missions , and emphasized the remarkable visual effect of the thick band of the atmosphere visible around the horizon . However , he was unimpressed with the view of Earth from space ; the amount of detail he could make out compared well with that from high @-@ flying aircraft , and he told debriefers that it was " nothing new " compared to flight at 50 @,@ 000 feet (15 @,@ 000 m) . Overall , he concluded that Sigma 7 was on " the top of the list " of aircraft he had flown , displacing the F8F Bearcat , a naval piston @-@ engined fighter , while the mission itself had been " textbook " .

Schirra gave a public lecture at Rice University after returning to Houston , where he received a

motorcade through the city . However , the Cuban Missile Crisis had been steadily escalating through September , and helped drive discussion of Schirra 's successful flight down the news schedules ; public concern about the relative effectiveness of Soviet and American space launchers was displaced by a more pressing concern over Soviet military rockets . He visited Washington , D.C. , to receive the NASA Distinguished Service Medal from President Kennedy on October 16 , the same day Kennedy had first seen U @-@ 2 photographs of missile sites in Cuba ; the meeting was friendly and informal despite the circumstances . Robert Kennedy , Schirra later noted , took him aside and sounded him out about a potential political career , the same way he had sounded out John Glenn a year earlier . Unlike Glenn , however , Schirra politely turned the suggestion down , and chose to remain with NASA . His later career saw him commanding the backup crew for the first Gemini mission , then the prime crew for the 1965 Gemini 6A mission , where he flew the first active rendezvous between two spacecraft - earlier plans for it to conduct the first on @-@ orbit docking had been cancelled - and finally commanding the first Apollo mission , Apollo 7 , in 1968 . He retired from NASA in the summer of 1969 , the only astronaut to fly on Mercury , Gemini , and Apollo .

The success of MA @-@ 8 made the preparation for MA @-@ 9 " considerably easier " , though it did cause some observers to suggest the program should be ended abruptly in order to conclude on a clear note of success , rather than risking another ? potentially catastrophic ? flight . However , this was not a view shared by the NASA planners , who had been pressing for a one @-@ day Mercury mission since mid @-@ 1961 , when it first began to seem technically feasible . To prepare the spacecraft for a long @-@ duration mission involved trimming as much on @-@ board weight as possible to offset the additional consumables required . The changes made to the capsule hardware on MA @-@ 8 were now used to justify the removal of 12 pounds (5 @.@ 4 kg) of control equipment and 5 pounds (2 @.@ 3 kg) of radio equipment , as well as the 76 pounds (34 kg) periscope which Schirra had found so unhelpful . In total , there were 183 alterations listed between the capsules for the MA @-@ 8 and MA @-@ 9 missions . The spacecraft was to be equipped with several cameras , building on Schirra 's photographic work , though weight and power limitations did restrict the amount of scientific experiments that could be scheduled .

= = Spacecraft location = =

The spacecraft is on display at the United States Astronaut Hall of Fame , Florida .