

MQF – LRD's Airstream

The Mobile Quarantine Facility (MQF), a highly modified Airstream travel trailer, was the recovery quarantine home for returning lunar-landing crews on Apollos 11, 12, and 14. In 1963, a special subcommittee of the Space Science Board of the National Academy of Sciences recommended that NASA establish a quarantine program¹. An Interagency Committee on Back Contamination (ICBC) was established in 1966 and included the federal agencies responsible for protecting public health, agriculture, and other living and natural resources (National Academy of Sciences and representatives from the U.S. Public Health Service, U.S. Department of Agriculture, and U.S. Department of Interior). By late August 1966 it had been agreed jointly with NASA that a "mobile quarantine facility" would be used to transport the astronaut crews from the prime recovery ship in the Pacific Ocean to the Lunar Receiving Lab (LRL) in Houston following an Apollo lunar-landing mission². (The Apollo Back-Contamination Program flow from Reference 1 is shown in Photo #1.)

The recovery phase of lunar quarantine began as soon as the Command Module had been located and the flotation collar installed by swimmers, and the MQF was an integral part of the recovery phase. General requirements of the recovery quarantine operation were as follows¹:

1. *Crew Safety*. To provide a safe method for the retrieval and return of crew and spacecraft.
2. *Biological Isolation*. To provide isolation during the recovery operation and during the movement of the crew and equipment from the recovery area to the LRL.
3. *Sustenance Provisioning*. To provide eating, sleeping, and hygienic facilities for the crew and technical personnel during the return phase.
4. *Medical and Debriefing Provisioning*. To provide some limited medical facilities and interfaces during the recovery and transportation phases.
5. *Transportation*. To provide suitable hardware for the transportation of the crew, CM, and hardware by ship, aircraft, and truck.

The Landing and Recovery Division (LRD) at the Manned Spacecraft Center (MSC) in Houston was responsible for the project to design and fabricate the MQF, and LRD's Rod Bass was the contract technical monitor and John Hirasaki was the lead project engineer. Melpar of Falls Church, Virginia, was awarded the contract for recovery quarantine equipment on June 17, 1967³, including four MQF's. The number of MQF's was decided by the requirement for primary and backup MQF's on the prime recovery ship and the short turnaround between lunar missions as well as a large landing footprint with uprange and downrange destroyers - initially, at least

five MQF's were considered to be required before the Apollo landing footprint was refined. Melpar was the MQF prime contractor with a subcontract to the Airstream Company of Jackson Center, Ohio. The Airstream approach had been first proposed by LRD's Pete Armitage, who had experience with travel-trailers and considered Airstream the best high-quality design suitable for self-contained living quarters and able to meet the transportation handling requirements aboard ship and transport aircraft⁴. After surveying available travel trailer designs, Melpar indeed selected Airstream, which was a natural choice for the MQF with its aircraft-like construction featuring a riveted aluminum shell.

The MQF was essentially a 35-foot Airstream trailer with special modifications for its recovery quarantine role to provide self-contained living accommodations and biologically isolate up to six people for ten days⁵. It was designed with a lounge, galley, and sleeping and toilet facilities and was powered internally by a diesel generator and battery systems and externally through several systems interfacing with various ships, aircraft, and transportation vehicles (Photo #2). The MQF aluminum body shell was sealed making it airtight with exhaust fans and filters to provide an internal negative pressure required for biological isolation. A decontamination transfer lock was installed to provide the capability for expedited return of lunar samples ahead of the MQF arrival at the LRL. Two decompression blowout panels provided safety to the MQF occupants and transport aircraft in the event of a rapid decompression while in flight back to Houston. The MQF was constructed on a skid pallet (Photo #3) instead of wheels for transportation in recovery operations transfers between ship, shore, and aircraft. The lounge area featured six aircraft-type seats and emergency passenger oxygen in the event of a rapid transport aircraft decompression. Additionally, the interior was coated with fire-retardant material.

The final design review for the MQF was held September 7-8, 1967, followed by delivery of MQF-001 on February 28, 1968⁶. MQF-001 underwent altitude chamber tests (Photo #4 & #5) at MSC on February 4-7, 1969, to verify the emergency oxygen system under altitude conditions⁷ followed by shipboard and aircraft qualification tests on an USAF C-141 military cargo jet (Photo #6) and a Navy destroyer USS Fox (Photo #7). For the destroyer test, the MQF was lashed to the aft flight deck and halfway housed in the DASH drone helicopter hangar. Following an operational dry run aboard an aircraft carrier, USS Guadalcanal in March 1968, a second final design review was held on April 29-30, 1968, followed by the retrofitting and re-delivery of MQF-001 on October 28, 1968, with modifications approved at the design review. The retrofitting included modifications to eliminate flammable materials as a result of the Apollo 1 fire. Deliveries of MQF-002, MQF-003, and MQF-004 were made

respectively on May 7, 1969; May 27, 1969; and June 27, 1969. The four MQF's were housed at MSC in the Building-228 MQF "barn" featuring two bays, each accommodating two MQF's in tandem, for pre-mission preparation and checkout and secure post-mission storage.

A recovery quarantine operational dry run with the MQF was conducted simultaneously with Apollo 9 aboard the prime recovery ship, USS Guadalcanal⁸ (Photos #8, #9, #10, & #11). The dry run started four days before the end of the Apollo 9 mission and followed a complete recovery quarantine flow including recovery of a substitute command module (BP-1102A), living inside the MQF, transfer of equipment, and MQF transfers ship-to-shore-to-aircraft-to-LRL. Participants included MQF recovery engineer John Hirasaki, flight surgeon Dr. William Carpentier, and test subjects Paul Kruppenbacher, Tex Ward, and Art Lizza, who served as the astronaut crew. NASA-provided packaged meals were found to be too highly spiced/seasoned for the MQF closed confinement in the event of nausea/vomiting and were toned down for the Apollo 11, 12, and 14⁹. (The meals were primarily precooked frozen entrees reconstituted in the MQF microwave oven.)

MQF's were utilized on three Apollo missions – Apollo's 11, 12, and 14. (Apollo 13 aborted and did not land on the lunar surface thereby eliminating the need for quarantine.) The quarantine program was suspended for crews after Apollo 14 since no harmful pathogens were found in returned lunar material, and returning crews' health was not degraded. Four LRD recovery engineers trained to operate the MQF in quarantine: John Hirasaki (Apollo 11), Randy Stone (Apollo 12), Ralph Culbertson (Apollo 14), and Frank Janes, who missed out on his MQF mission because quarantine and MQF usage after Apollo 14 were ruled out.

Apollo 11:

The Apollo 11 recovery quarantine operations went as planned from splashdown to the end of quarantine. MQF recovery engineer John Hirasaki and flight surgeon Dr. William Carpentier were isolated eight days before splashdown so they would not contract an illness before quarantine with the astronauts. Dr. Carpentier greeted the astronauts as they were lifted, one by one, from the bobbing decontamination raft into the recovery helicopter while encased in their Biological Isolation Garments (BIG). After landing aboard the USS Hornet (CVS-12), he accompanied them from the helicopter into the MQF where Hirasaki awaited (Photo #12). A second MQF was parked in front of the primary MQF and was available as backup should it be needed (Photos #13 & #14). President Nixon was on the carrier for the recovery and was briefed by John Stonesifer, NASA Recovery Quarantine Leader (Photo #15). Inside the MQF, the astronaut

crew (Commander Neil Armstrong, Lunar Module Pilot Buzz Aldrin, and Command Module Pilot Michael Collins) removed their BIG's, showered, suited up in NASA jump suits, underwent medical exams, worked on technical reports, spoke to President Nixon (Photo #16), and in general, ate, slept, and relaxed. Armstrong wrote, "The quarantine process, rather than a nuisance, provided us the opportunity to do the work that needed to be done. In view of the intense public interest in the flight, that would have been very difficult without the quarantine requirement."¹⁰ From entering the MQF aboard the USS Hornet to entering the LRL, the Apollo 11 astronaut crew spent 88 hours inside the MQF¹¹. Astronaut Collins described the MQF: "The mobile quarantine facility is simply a glorified trailer without wheels, modified with filters, water tanks, etc., to provide a biological barrier between those inside and the 3 billion outside."¹²

While Hirasaki operated the MQF from inside, a supporting MQF group (backup MQF engineer Randy Stone and flight surgeon Dr. Clarence Jernigan, electronics and mechanical engineers, quarantine control officer, etc.) managed the exterior. LRD electronics/communications engineer Carl Koontz assured all communications to and from the MQF worked flawlessly for the President's exchange with the crew, the world broadcasts, and the sailors' reenlistment ceremonies conducted by the astronauts. One of the most important tasks was to expedite the transfer of the two Lunar Sample Return Containers and other early return items like film from the MQF to Houston¹³. Hirasaki removed early return items from the Command Module through the transfer tunnel to the MQF, bagged, and transferred them through the decontamination transfer lock. The two lunar rock boxes accompanied by NASA couriers (LRD's Mike Collins and Buddy Culbertson) were transferred separately by carrier onboard delivery (COD) aircraft to Johnson Island and Hickam AFB in Hawaii where USAF aircraft, C-141 and EC-135B ARIA, stood by for transit back to Ellington Field and then to the LRL.

After the USS Hornet reached port in Hawaii, the MQF was offloaded (Photo #17) and trucked to Hickam AFB for loading on an USAF C-141 for the flight to Houston (Photo #18). After arrival at Ellington Field in Houston, the MQF was trucked to MSC's LRL for transfer of quarantined personnel and equipment (Photo #19). The MQF was backed up to the LRL and mated with a door gasket to maintain quarantine before the personnel exited from the MQF. The MQF was then locked and stored onsite in MSC Building-228 for the remainder of the 21-day quarantine period while power and quarantine were maintained.

Apollo 11 NASA MQF recovery engineer John Hirasaki recalls that Michael Crichton had published and released his book titled "The Andromeda

Strain" a few months before the Apollo 11 mission. Even though the story was fiction, it caused a quite a bit of a stir because the premise of the story about extraterrestrial pathogens causing widespread damage to the earth's biosphere seemed to elevate the public's concerns about back contamination from the lunar surface. Another interesting item that Hirasaki noticed was that the Apollo 11 Command Module (CM) had an unusual scent when he opened the hatch for the first time after recovery for removal of early return items. The scent was that of burnt black powder or the scent of flint striking steel. The previous Apollo CM's did not have that scent when he worked on them, and he attributed this unique scent to the presence of lunar dust that was scattered around the interior of the CM and on the suits that the crew brought back with them from the lunar surface.

Other crews of lunar landing missions have also mentioned this unusual scent. (Google "Smell of Moondust" for more information.) For more Apollo 11 MQF details, read Hirasaki's oral history¹⁴.

Apollo 11 NASA Recovery Quarantine Manager John Stonesifer briefed President Nixon at the MQF (Photo #15) shortly before splashdown about the importance of the quarantine program and the precautions taken. Stonesifer recalls "at one point in the conversation, I explained that two NASA folks had volunteered to enter quarantine with the astronauts, one a doctor to examine the astronauts and administer care if required, and a MQF engineer to keep all the systems operating until they got back to Houston. President Nixon put his hands on his hips and said, 'When I was in the Navy I never volunteered for anything.' We all had a great chuckle!"¹⁰ For more Apollo 11 recovery quarantine details, read Stonesifer's oral history¹⁵.

During the mission, people with press credentials were escorted through a MQF parked close to the PAO building onsite at MSC. The most interesting visit was from author Norman Mailer, who was on assignment for *Life* magazine and was quietly contemplative during his MQF walk-through. *Life* serialized his Apollo prose in three installments, which Mailer published later in his book, *Of A Fire On The Moon*¹⁶.

Apollo 12:

Basically, the Apollo 12 recovery quarantine operations flow mirrored Apollo 11's. A second MQF was parked next to the primary MQF and was available as backup should it be needed as done on Apollo 11. MQF recovery engineer Randy Stone and flight surgeon Dr. Clarence Jernigan, who were backups for Apollo 11, assumed the primary roles for Apollo 12. One change for Apollo 12 was the astronaut crew's use of respirators and jump suits in place of the Biological Isolation Garments worn by the Apollo 11 astronaut crew. Dr. Jernigan followed the Apollo 12 astronaut crew

(Commander Pete Conrad, Lunar Module Pilot Alan Bean, and Command Module Pilot Richard Gordon) walking from the helicopter into the MQF with Randy Stone also entering and closing the MQF door (Photo #20). From entering the MQF aboard the USS Hornet to entering the LRL, the Apollo 12 astronaut crew spent 89 hours inside the MQF¹⁷. Equipment transfers were handled the same as Apollo 11, and the astronauts spoke by telephone to President Nixon (Photo #21). The Apollo 12 astronaut crew and Stone and Jernigan spent Thanksgiving inside the MQF and had a turkey dinner. (For more Apollo 12 MQF details, read Stone's oral history¹⁸.)

Apollo 14:

The Apollo 14 recovery quarantine operations flow was changed by eliminating the time-consuming MQF ship-to-shore-to-aircraft transfers. After 41 hours in the MQF aboard the USS New Orleans, the astronaut crew (Commander Alan Shepard, Lunar Module Pilot Ed Mitchell, and Command Module Pilot Stu Roosa - Photo #22) and MQF recovery engineer Ralph Culbertson and NASA Flight Surgeon Dr. William Carpentier were flown by helicopter from the USS New Orleans to the Pago Pago Airport in American Samoa where John Hirasaki was waiting as exterior NASA MQF recovery quarantine engineer with a second MQF aboard a USAF C-141 to continue their return by air to Ellington AFB (Photo #23). From entering the MQF aboard the USS New Orleans to entering the LRL, the Apollo 14 astronauts spent 59 hours (including helicopter flight time) inside the two MQF's, which shortened their MQF time by about 30 hours before entering the LRL in Houston¹⁹. Equipment transfers were handled the same as Apollo 11 and Apollo 12.

The four MQF's built by Melpar/Airstream are:

MQF-001 is the MQF planned for use on Apollo 13 and was the first MQF delivered to NASA in March 1968 and used for initial systems tests. MQF-001 was transferred to the Department of Agriculture for field work, and its final disposition is unclear.

MQF-002 is the MQF used on Apollo 12 and is currently located at the U.S. Space and Rocket Center at MSFC. MQF-002 was transferred to the CDC in mid-1970's, USGS in early 1990's, Alabama Department of Conservation in 1998 and being "lost" until an alert new director of the Alabama Department of Conservation's Aquatic Biodiversity Center at Marion recognized its identity as an Apollo Program MQF²⁰. A transfer to MSFC was arranged followed by restoration and public display beginning in 2008.

MQF-003 is the MQF used on Apollo 11 and is currently located at the Smithsonian National Air & Space Museum (NASM) Stephen F. Udvar-Hazy Center in Chantilly, Virginia (Photo #24). MQF-003 was used briefly by the U.S. Public Health Service in 1972 before being displayed at MSFC for 30 years prior to going to NASM. MQF-003 is Smithsonian National Air & Space Museum Collection Object No. A19740677000.

MQF-004 is the MQF used on Apollo 14 aboard the USS New Orleans and is currently located at the USS Hornet Museum in Alameda, California.

Post-Apollo, MQF's were utilized by the USAF to support the U.S. Health Service, and Department of Agriculture for various field operations. A MQF was loaned to the USAF for another quarantine mission in 1972 - an outbreak of the contagious Lassa Fever encountered in the West African nation of Sierra Leone by members of the U.S. Public Health Service team from the Center for Disease Control (CDC) there studying Lassa Fever and rendering assistance to the local population²¹. Additionally, the Skylab Mobile Laboratory (SML) operations aboard the prime recovery ships for the three manned Skylab missions – Skylab 2, Skylab 3, Skylab 4 – benefitted from the knowledge of MQF logistics operations. The SML was used in a dry run during the Apollo 17 recovery aboard the USS Ticonderoga in December, 1972²².

The MQF continues to be recognized for its key role in the Apollo Program through museum exhibitions of the three surviving units at the Smithsonian Air & Space Udvar-Hazy Center (<http://airandspace.si.edu/visit/udvar-hazy-center/>) in Virginia, the Marshall Spaceflight Center U.S. Space and Rocket Center (<http://rocketcenter.com/>) in Alabama, and the USS Hornet Museum (<http://www.uss-hornet.org/>) in California.

Thanks to John Stonesifer, John Hirasaki, and Bob Fish for their inputs/comments to the MQF story.

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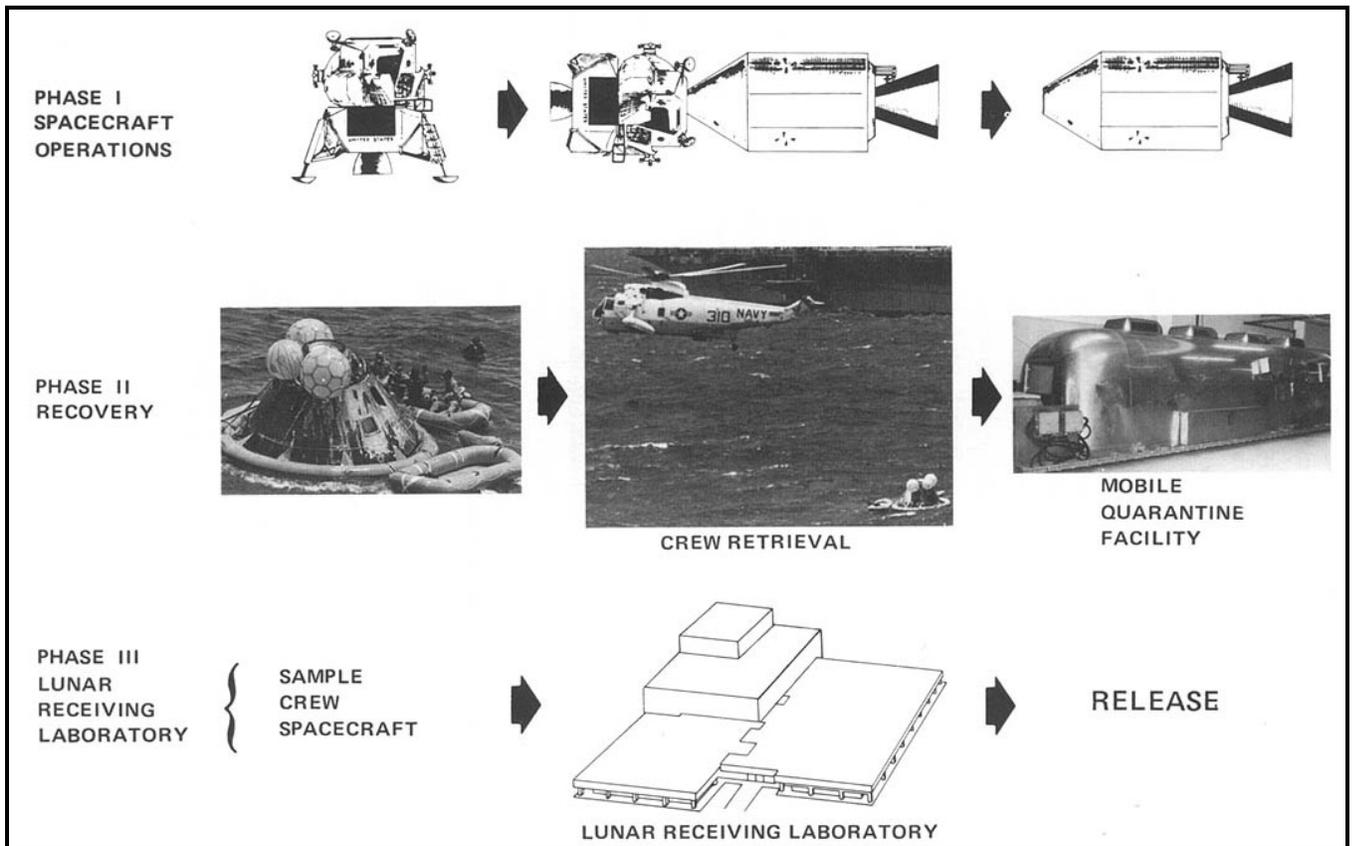
Written By:

Coye Mac Jones

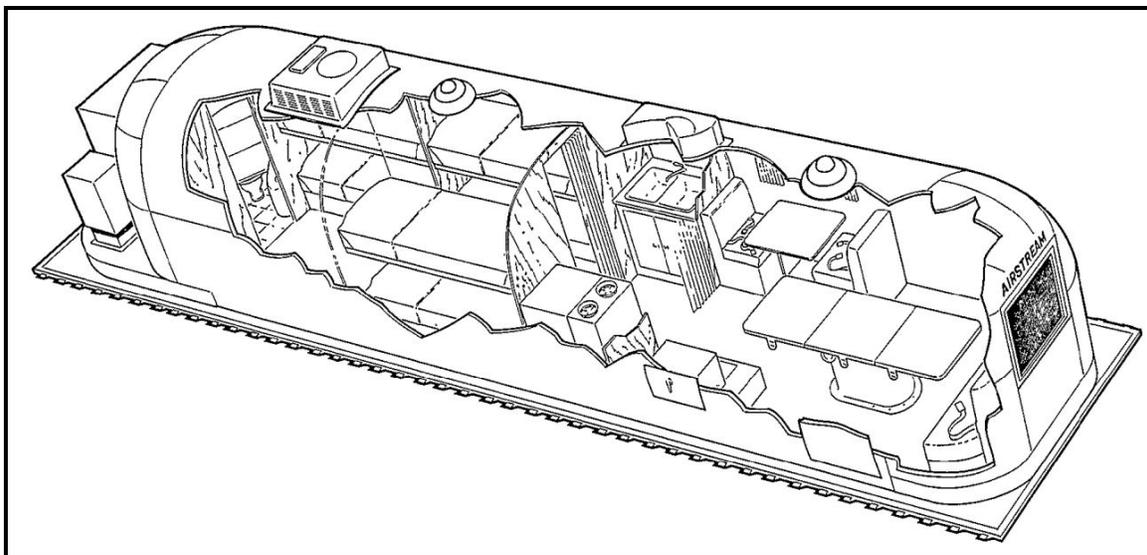
NASA-MSC/LRD Vehicle Project Engineer in 1964-71

Retired NASA-Johnson Space Center/Houston in January 2003

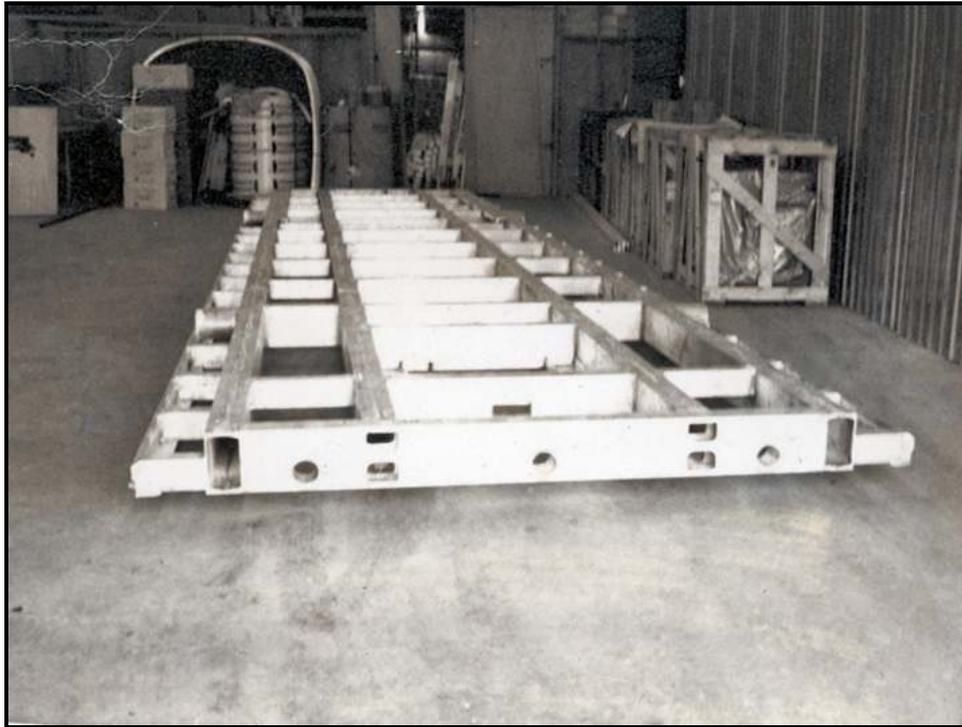
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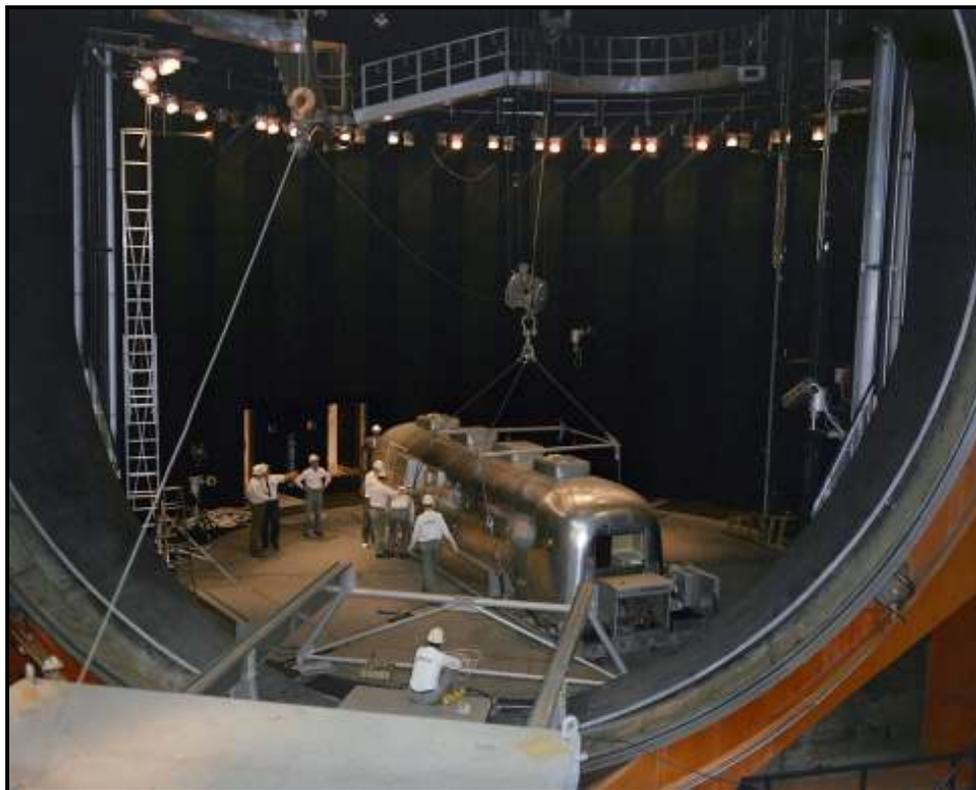
1. Apollo Back-Contamination Program Flow. (Photo Credit: NASA SP-368)



2. MQF original concept with (right to left) lounge, galley, sleeping and toilet facilities. (Photo Credit: Melpar)



3. MQF base skid pallet before MQF body added.
(Photo Credit: Melpar)



4. MQF-001 in Altitude Chamber A on February 6, 1969, at MSC.
(Photo Credit: NASA)



5. Test subject crew in MQF-001 Altitude Chamber A on February 6, 1969, at MSC. (Photo Credit: NASA)



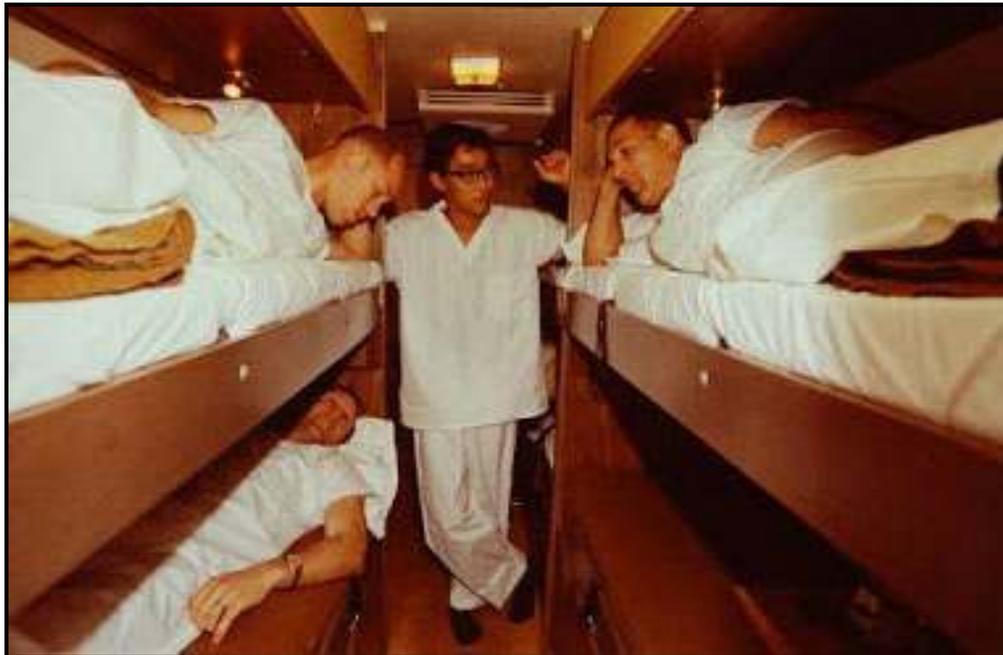
6. MQF-001 prepares for loading aboard USAFC-141 on January 21, 1969. (Photo Credit: NASA)



7. MQF aboard USS Fox for shipboard qualification tests. (Photo Credit: NASA)



8. JSC recovery engineers prepare transfer tunnel prior to erecting in USS Guadalcanal hangar deck on March 3, 1969. (Photo Credit: NASA)



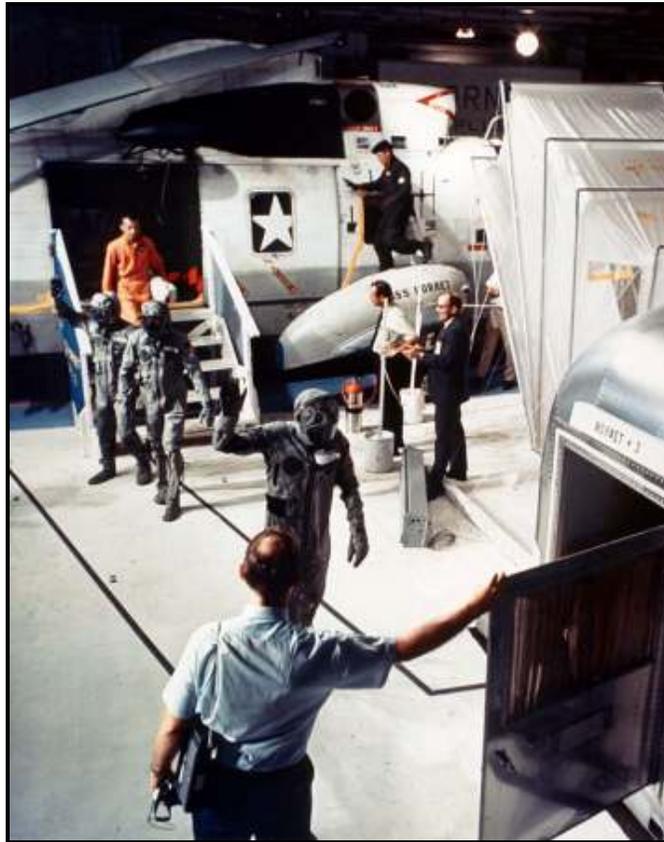
9. MQF operational dry run aboard USS Guadalcanal in March 1969 with NASA MQF recovery engineer John Hirasaki (standing) and NASA test subjects (reclining Left to Right: Paul Kruppenbacher, and Tex Ward, and Art Lizza. (Photo Credit: NASA)



10. John Hirasaki, NASA MQF recovery engineer, is shown next to the MQF control panel during the operational dry run aboard the USS Guadalcanal in March 1969. (Photo Credit: NASA)



11. Apollo 9 astronaut crew (McDivitt Scott, Schweickert) inspect the MQF during operational dry run aboard USS Guadalcanal in March 1969 following the Apollo 9 recovery. (Photo Credit: NASA S69-20309)



12. Apollo 11 astronaut crew in Biological Isolation Garments followed by NASA Flight Surgeon Dr. William Carpentier walk from their recovery helicopter to the MQF aboard the USS Hornet on July 24, 1969. (Photo Credit: NASA S69-40753)



13. Primary and backup MQF's for Apollo 11 recovery quarantine being barged to USS Hornet in July 1969. (Photo Credit: Navy)



14. Primary and backup MQF's positioned in hangar deck of USS Hornet for Apollo 11 recovery quarantine in July 1969. (Photo Credit: Navy)



15. President Nixon being briefed by NASA Recovery Quarantine Manager John Stonesifer about quarantine aboard the USS Hornet shortly before the Apollo 11 splashdown on July 24, 1969. (Photo Credit: Navy)



16. President Nixon speaks with the Apollo 11 astronaut crew (Left to Right: Armstrong, Collins, Aldrin) inside the MQF aboard the USS Hornet on July 24, 1969. (Photo Credit: S69-21365)



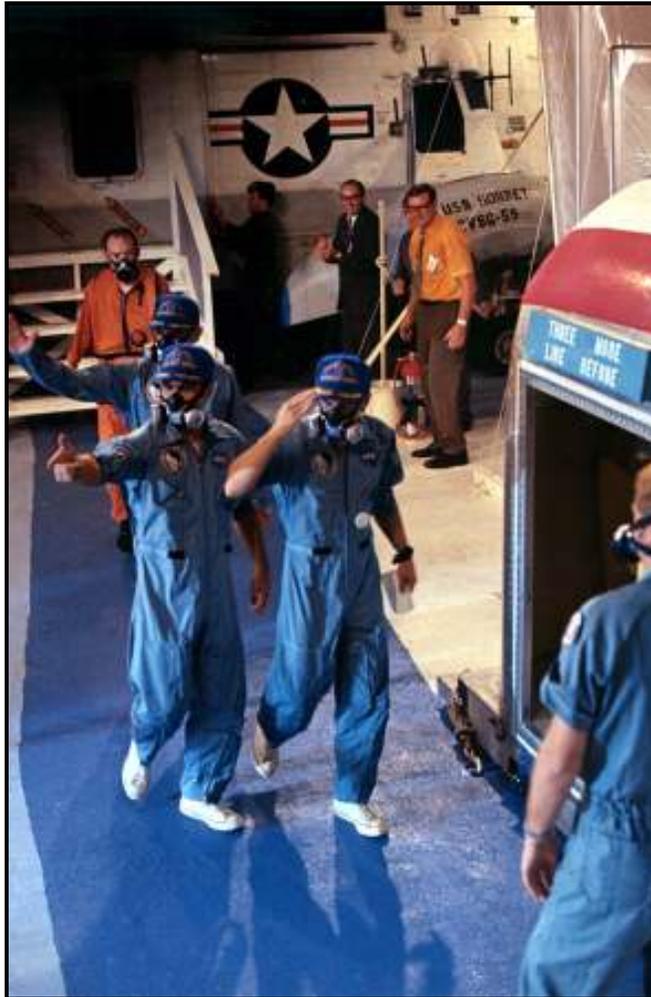
17. Apollo 11 MQF with astronauts offloaded from USS Hornet on July 27, 1969. (Photo Credit: NASA S69-21881)



18. Apollo 11 MQF aboard USAF C-141 for flight back to Houston with astronaut crew (Left to Right: Aldrin, Armstrong, Collins) inside MQF and MQF support group (Left to Right): Dr. Clarence Jernigan (NASA Flight Surgeon), Ben James (NASA-JSC Public Affairs), Harold Eitzen (NASA Quarantine Protocol Officer); and LRD personnel Randy Stone (backup NASA MQF recovery engineer), Carl Koontz (NASA electronics/comm engineer), Rod Bass (NASA MQF Technical Monitor), and John Stonesifer (NASA Recovery Quarantine Manager) on the flight from Hickam AFB in Hawaii back to Houston aboard an USAF C-141 aircraft on July 27, 1969.
(Photo Credit: NASA S69-53173)



19. Apollo 11 MQF with astronauts being unloaded from USAF C-141 at Ellington Field in Houston on July 28, 1969. (Photo Credit: NASA)



20. Apollo 12 astronaut crew (Conrad, Bean, and Gordon) followed by NASA Flight Surgeon Dr. Clarence Jernigan walk to the MQF where NASA MQF recovery engineer Randy Stone is at the door aboard the USS Hornet on November 24, 1969. (Photo Credit: NASA S69-22849)



21. Apollo 12 astronaut crew (Left to Right: Pete Conrad, Dick Gordon, and Al Bean) speak with President Nixon by phone from the MQF aboard the USS Hornet on November 26, 1969. (Photo Credit: NASA 69-H-1884)



22. Apollo 14 astronaut crew (Left to Right: Stu Roosa, Alan Shepard, Ed Mitchell) in MQF aboard USS New Orleans on February 9, 1971. (Photo Credit: NASA S71-18557)



23. Apollo 14 astronaut crew (Shepard, Mitchell, Roosa) followed by MQF recovery engineer Ralph Culbertson and NASA Flight Surgeon Dr. William Carpentier walk from helicopter to their MQF aboard an USAF C-141 for their flight to Houston on February 11, 1971. (Photo Credit: NASA)



24. Apollo 11 MQF (MQF-003) exhibited in the NASM Udvar-Hazy Center McDonnell Space Hangar next to Apollo BP-1102A Astronaut Water Egress Trainer. (Photo Credit: Personal photo of C. Mac Jones)

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