REVOLUTION

Apollo 13… a close call for NASA… and Omega

VINTAGE
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Shaky Beginnings

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At 19.13 GMT on 11th April 1970, Apollo 13 lifted off from Launch Complex 39A at Kennedy Space Center, destined for the Frau Mauro highlands of the Moon. The run-up to launch had not gone smoothly, the command module pilot, Ken Mattingly had to be substituted at the last minute, having been exposed to measles and not having immunity; a helium tank in the Lunar Module was suspected of being poorly

insulated, necessitating a changed flight plan to allow inspection. After only 5 minutes 30 seconds, the center engine of the S-II stage shut down, 2 minutes earlier than planned, requiring the remaining engines to burn for longer to get the spacecraft into orbit. Despite these issues, the first 2 days of the mission were otherwise uneventful, leading Joe Kerwin, the duty NASA communicator to tell the crew, “The spacecraft is in real good shape as far as we are concerned. We’re bored to tears down here.”

Apollo 13 launches (Image: NASA)

The Time Bomb

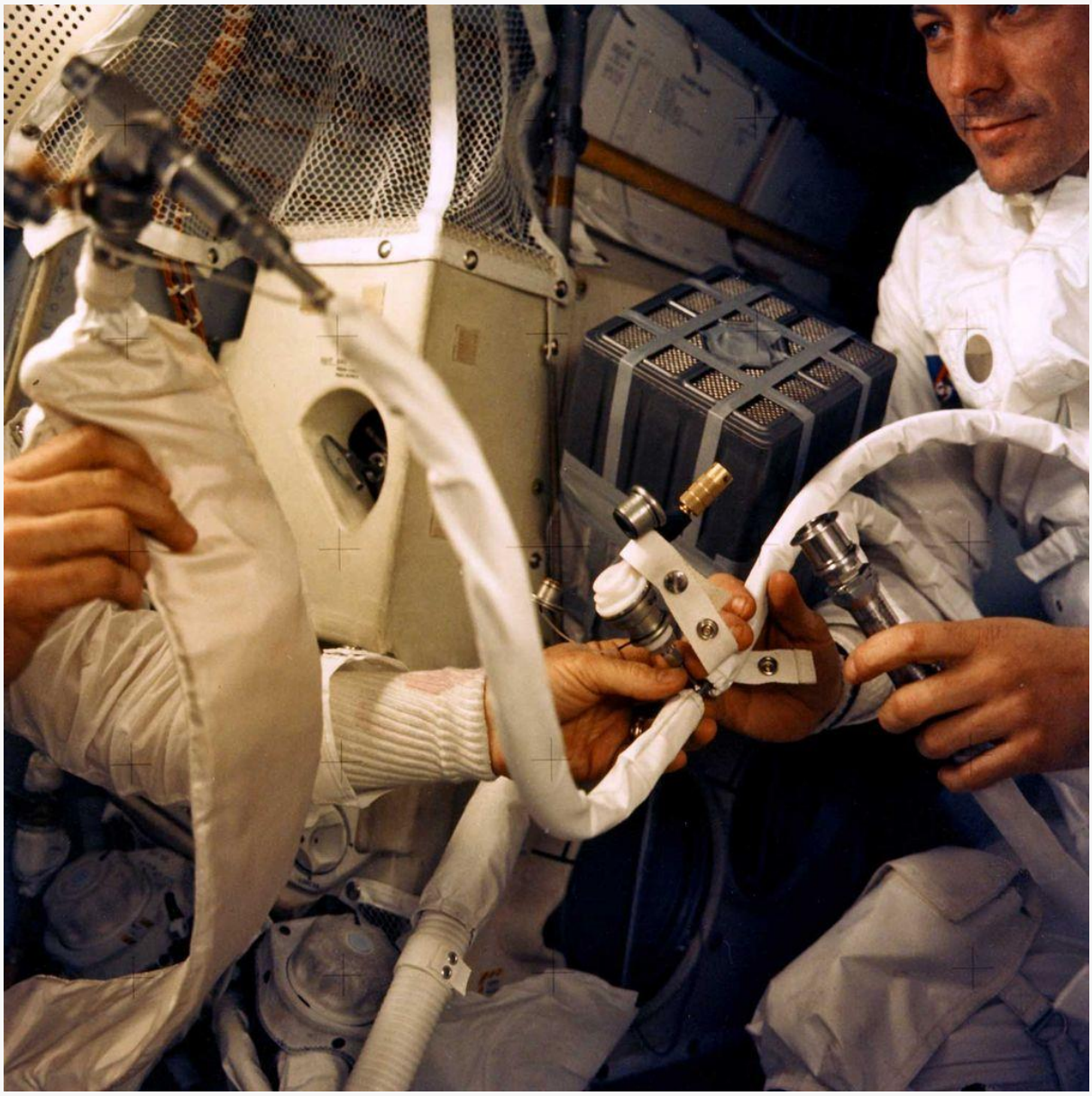
In the service module, oxygen tank No. 2 was a literal time-bomb, waiting to go off. It had previously been installed on Apollo 10 but was removed for modification and subsequently damaged. Having been fixed and tested at the factory, and again at the Space Center, it was found not to be emptying correctly. A decision was taken to 'boil off' the remaining liquid oxygen using the tank's internal heaters but unbeknownst to NASA, the lengthy process damaged the heating elements. Forty-six hours into the flight these heaters were to prove critical when they were switched on, alongside the stirrers to agitate the gas in the tanks and provide accurate pressure readings to the crew. At 55.54.53hrs, approximately 200,000 miles from home, the tank blew taking oxygen tank No. 1 with it. Jack Swigert uttered his immortal but oft misquoted 'I believe we've had a problem here', followed by Jim Lovell's 'Houston, we've had a problem'. The Command Module was without electricity, light or water and the mission had changed from one of exploration to one of survival.

View of the severely damaged Apollo 13 Service Module after separation, 17 April 1970. (Image: NASA)

A Team Game

In the early days of space travel, the modules were largely remote-controlled by the team back on earth, with the astronaut as little more than a passenger, or ‘Spam in a can’ as test pilot Chuck Yeager derisorily put it. The importance of the astronaut’s own pilot skills was first shown by Gordon Cooper in 1963 aboard Mercury-Atlas 9. After a catastrophic electrical failure, Cooper used manual control to achieve a safe return. “So I used my wristwatch for time,” he later recalled, “my eyeballs out the window for altitude. Then I fired my retrorockets at the right time

and landed right by the carrier." He was wearing both an Omega CK2998 and a Bulova Accutron Astronaut so we will never know which wristwatch he actually used. By the time of Apollo 13, the control of the spacecraft was a joint effort between the crew and mission control. Reading the transcript of the flight, it is clear that both teams rely on each other. Once news of the desperate situation got out, many off-duty technicians came back in to help, possible solutions were modelled and then tested in the ground-based simulators before being fed up to the crew for them to implement.



Interior view of the Apollo 13 Lunar Module (LM) during the journey back to Earth, showing some of the temporary survival apparatus rigged up with instructions from ground control staff. (Image: NASA)

Mission Control during final 24 hours of Apollo 13 mission. (Image: NASA)

The Burns

The pivotal point in the mission from a horological and cinematic perspective is the timing of the 14 second course correction rocket burn, using the Omega Speedmaster as the star of the show. While the narrative arc focusses on this one burn, there were 5 burns as part of the mission, 4 of which took place after the accident and all of which were essential to survival.

On its initial path, Apollo 13 would have looped around the back of the Moon and come straight back to Earth, what it is known as a 'Free-return trajectory'. The first burn took place 30hrs into the flight, lasted for 4 seconds and took the craft out off this course to allow it to land on the Moon. The first step after the explosion was to put Apollo 13 back on a free-return trajectory, done by a 35 second burn using the Lunar Module Descent Propulsion System.

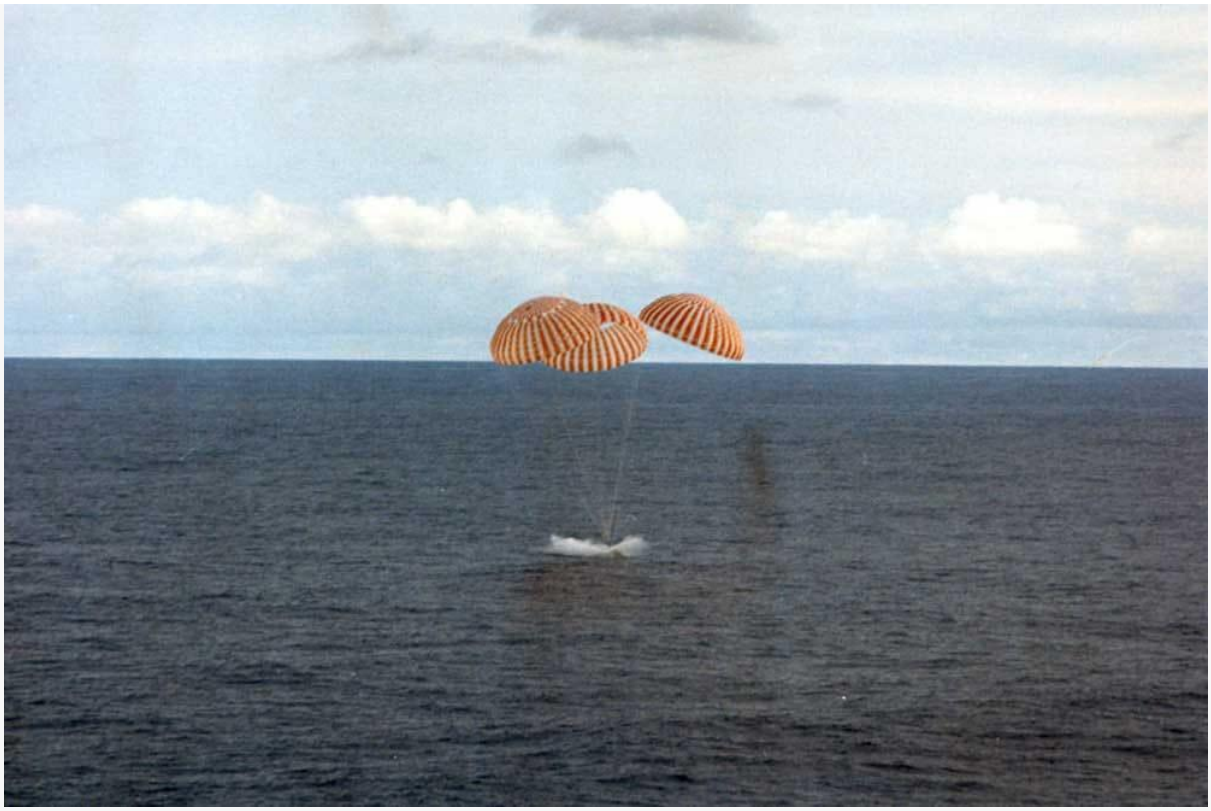
The second consideration was speed. Leaving the craft on its course would see a return in 155 hours; this was pushing the limits of survival

for the crew, with limited oxygen and water. The availability of the Lunar Module rockets meant such a slow return was unnecessary. In theory, they could have got the astronauts back in 118 hours but that would have left no propellant left for course corrections. Another option could have got them back in 133 hours but would have meant a splash-down in the South Atlantic and there was no time to move the recovery vessels from the Pacific. The final decision was to go for a Mid-Pacific landing in 143 hours requiring a 4 minute 24 second burn from the Lunar Module to pick up the pace.

The third and most famous burn was a minor course correction to ensure the correct angle of re-entry: too shallow and they could bounce off the atmosphere, too steep and there was a risk of burning up. Mission Control worked out that they were off course by roughly 60 to 80 nautical miles, entering at an angle that was too shallow, requiring a 14 second burn. Lovell fired the rockets, keeping his eyes on the earth's horizon as a guide, Fred Haise checked that the craft didn't slip sideways, and Jack Swigert timed the burns on his Speedmaster.

View of Earth from Apollo 13 (Image: NASA)

Just 5 hours before splash-down, a final course correction burn was made using the Lunar Module Reaction Control System. This burn lasted for 22 seconds and brought the Command Module down within a mile of the recovery ship the USS Iwo Jima, returning 3 tired, dehydrated and frozen astronauts back to safety.



The Apollo 13 Command Module splashdown (Image: NASA)

What if...?

The NASA post-mission report makes interesting reading, both for what went wrong and what was deemed a success. One minor failure report poses an intriguing counterfactual possibility that might have denied Omega its heroic role. Stowed aboard Apollo 13 was the Command Module Interval Timer. This is basically a glorified, over-engineered, NASA-approved egg-timer and was used for just such things as timing rocket burns. Prior to the 55-hour explosion, a crew member went to use the timer – only to have the knob come off in his hand. The fixing screw had been secured with Loctite and the vibrations of the flight had allowed it to work loose. This is confirmed in the report and the knob attachment was changed to a split-pin design before Apollo 14. Had the timer been functional, it would have continued in use and been first choice to time all the manually controlled burns. Maybe the owners of Snoopy Speedies need to credit the bravery and skills of the mission crew, the expertise of the NASA ground team...and a faulty knob.

Command Module Interval Timer from Apollo 12, in stainless steel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