

SpaceX Starship effectively grounded by FAA after in-flight explosion

May 1 2023, by Matt Williams



SpaceX's Starship and Super Heavy booster stand tall on the Starbase launch pad in Texas. Credit: SpaceX via YouTube

It was an exciting time when, two weeks ago, SpaceX got the clearance it needed to conduct its first orbital flight test with the Starship and Super Heavy launch system. After years of waiting, SN flight tests, static fire tests, and stacking and unstacking, the long-awaited test of the SN24 Starship and BN7 Booster prototype was on. For this flight, SpaceX

hoped to achieve an altitude of at least 150 km (90 mi) above sea level, crossing the 100 km (62 mi) threshold that officially marks the boundary of "space" (aka. the Karman Line) and making a partial transit around the world before splashing down off the coast of Hawaii.

Unfortunately, things began to go awry a few minutes into the flight as the Starship prototype failed to separate from the booster, sending the rocket into a spin that ended in an explosion. While Musk and SpaceX issued statements that the test was largely successful and lots of valuable data was obtained, residents and environmental researchers claim the explosion caused damage to houses in the area and the local environment. In response, the FAA has launched a "mishap investigation," temporarily grounding the Starship until the explosion's impact can be assessed.

The timing of the flight test was certainly fortuitous, falling on April 20th (4/20) exactly as Musk had previously predicted. Everything appeared to be in the green as all 33 engines of the BN7 booster fired, and the fully stacked and fueled prototype lifted off without incident. About three and a half minutes into the flight, when stage separation was supposed to occur, the Starship began an uncontrolled tumble and was destroyed by onboard charges. The SN24 and BN7 managed to reach an altitude of 40 km (25 miles) before the anomaly occurred.

Musk commended the ground teams, tweeting, "Congrats @SpaceX team on an exciting test launch of Starship! Learned a lot for next test launch in a few months." At the same time, it was clear that some sizeable changes needed to be made. In addition to the mid-air explosion, the launch also destroyed the launchpad, which sent debris flying in all directions. This raised the issue of a deluge system that the Boca Chica launch site does not have (unlike other launch facilities). These systems rely on a "flame trench" to channel rocket exhaust and water or foam to suppress shockwaves and flames.

Musk was sure to temper expectations before the flight, saying in a Twitter discussion on April 16th that when you have a spacecraft that's got "33 engines on the booster, got six engines on the upper stage of the ship. It's a lot of engines! It's like having a box of grenades, really big grenades." He was also sure to cite SpaceX's track record with rapid prototyping, which has always involved "testing to failure" and a lot of trial and error:

"This is really kind of the sort of first step in a very long journey that will require many, many flights. For those that have followed the history of Falcon 9, and Falcon 1 actually, and our attempts at reusability, I think it might have been close to 20 attempts before we actually recovered a stage. And then it took many more flights before we had reusability that was meaningful, where we didn't have to rebuild the whole rocket."

To residents and environmentalists, the test was not an occasion for celebration. Ever since SpaceX broke ground in Boca Chica and began testing, Musk has had a strained relationship with the locals, who have frequently complained about noise and the impact these tests have on their communities and the natural environment. According to Pablo De La Rosa, a reporter with Texas Public Radio (TPR) and NPR, there were multiple reports of "particulates" raining down on South Padre Island up the coast and on the nearby town of Port Isabel.

Residents in the town also reported broken windows "and ash-like particles covering their homes and schools." The Sierra Club cited similar reports, with Dan Cortez (Lone Star chapter director) stating in an interview with CNBC that the destruction of the launchpad caused collateral damage that could have been much worse. "Concrete shot out into the ocean, and risked hitting the fuel storage tanks which are these silos adjacent to the launch pad," he said. With mid-air explosions, there are also concerns that residual propellant (which are often toxic) could

rain down on the surface, causing environmental damage.

A post-launch assessment by the Federal Aviation Administration (FAA) is standard practice in cases like this. As the Administration explained in a statement regarding Recent Aviation Accidents and Incidents (issued on April 20th):

"The FAA will oversee the mishap investigation of the Starship / Super Heavy test mission. A return to flight of the Starship / Super Heavy vehicle is based on the FAA determining that any system, process, or procedure related to the mishap does not affect public safety. This is [standard practice](#) for all mishap investigations. The FAA is responsible for protecting the public during commercial space transportation launch and reentry operations."

In other words, the FAA has effectively grounded SpaceX's testing efforts at Boca Chica until they can determine if future flight tests will threaten public health, safety, and the local environment. This will likely result in a list of mandatory actions that SpaceX must complete to keep its license and resume testing. At this juncture, Musk is already prepared to address the issue of a deluge system, which he has admitted his crews looked at in the past but decided was unnecessary. Nevertheless, he also hinted before the launch that "melting the launch pad" was a real possibility.

In any case, Musk appeared to be admitting on April 21st that the decision to proceed without first installing a cooling system beneath the launchpad was a mistake, tweeting: "3 months ago, we started building a massive water-cooled, steel plate to go under the launch mount. Wasn't ready in time & we wrongly thought, based on static fire data, that Fondag would make it through 1 launch. Looks like we can be ready to launch again in 1 to 2 months."

At this juncture, a month or two seems optimistic, considering that the full impact could take weeks and corrective actions could take much longer to implement. It could turn out that the FAA will demand that a full deluge system is necessary, that additional protections are needed to prevent debris from striking fuel tanks, and that SpaceX install a launch abort system that will force the Starship and Super Heavy to separate in the event of an anomaly. This last item would ensure that at least the booster (the most explosive element) can remove itself and return safely to a landing site.

It's even also remotely possible the FAA will revoke SpaceX's license, and Musk will decide to relocate all testing to Cape Canaveral, where SpaceX is still working on a second launch facility. Then again, this may all be resolved shortly, and SpaceX could be testing prototypes again by mid-summer. As the company's adage famously goes, "Launch. Recover. Repeat." In this case, "recover" may mean repairing the damage caused by a test gone wrong and ensuring it never happens again. But the next step remains the same—Repeat.

Or, to paraphrase another famous adage, "Explosion will continue until launches improve!"

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