How dangerous is Polaris Dawn space walk from SpaceX Crew Dragon?

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Billionaire Jared Isaacman could make history for all the right reasons during his Polaris Dawn mission when the hatch opens on a SpaceX Crew Dragon and he ventures out into the vacuum of space.

He's sold on its safety, especially the sheer amount of development time in the new extravehicular activity suits all four members of the crew will have to wear during what would be the first commercial space walk in history.

"I mean, an absolutely extensive amount of time has gone into it," he said during a press conference after arriving to KSC last week. "It is rightfully. Why would it be the riskiest part? Because you're throwing away all the safety of your vehicle, right? And it now comes down to your suit becomes your spaceship."

Isaacman and crewmates Scott Poteet, Sarah Gillis and Anna Menon are set to launch in the Crew Dragon Resilience atop a Falcon 9 rocket from KSC's Launch Pad 39-A early Tuesday, targeting liftoff at 3:38 a.m. Eastern time during a roughly four-hour window.

Poteet is a former Air Force pilot, while Gillis and Menon are SpaceX employees as the Polaris Program, which will feature up to three spaceflights including this one, is a partnership between Isaacman and Elon Musk's company to push the boundaries for commercial space.

Resilience is the same spacecraft Isaacman flew in for the Inspiration4 mission back in 2021 on what was the first all-commercial passenger spaceflight. For that orbital mission, SpaceX installed a cupola window to offer spatial views instead of the normal docking mechanism Dragon needs for its trips to the International Space Station.

For this mission, Resilience received new hardware, a hatch with an array of hand and footholds that will be used when he and Gillis make the trip outside the Dragon.

Poteet and Menon will stay inside, but because Resilience has no airlock, will be subject to the vacuum of space as well. The space walk is

scheduled for day three of the five-day mission, when the spacecraft is on an elliptical orbit at around 435 miles altitude. The whole event, which will be livestreamed, should take less than two hours.

"When we are out there, we're going to make use of various mobility aids the SpaceX team has engineered, and it'll look like we're doing a little bit of a dance," Isaacman said. "What that is, is we're going through a series of test matrix on the suit, and the idea is to learn as much as we possibly can about this suit and get it back to the engineers to inform future suit design evolutions."

The mobility aid structure he's referencing is called the Skywalker, something outside the hatch that the duo will use to complete their maneuvers safely without free floating.

When asked why not do that full float away like the famous photo of the first American space walk, astronaut Ed White on June 3, 1964, on Gemini 4, Isaacman said safety trumps such a notion, and either hands or feet will be engaged with the Skywalker at all times. That follows safer parameters such as those performed by Buzz Aldrin on the Gemini 12 mission from Nov. 12–14, 1966.

"Looks cool, inspirational, which is always part of every one of these missions, but I think we want to learn from history on this one, and try and always maintain at least one point of contact with the mobility aid," he said.

SpaceX's ultimate goal is the colonization of Mars, and this first version of the EVA suit design features a heads-up display, helmet camera, as well as new architecture for joint mobility and thermal insulation.

"It's not lost on us that you know, it might be 10 iterations from now and a bunch of evolutions of the suit, but that someday, someone could be

wearing a version of which that they might be walking on Mars," Isaacman said. "It feels like a huge honor to have that opportunity to test it out on this flight."

The plan is for Isaacman and Gillis to each spend about 15–20 minutes outside the Dragon with two oxygen lines each fed to their suits through tethers that run about 12 feet long.

"Long enough to get the job done, not long enough to do the original depiction of us floating in space," Isaacman said referencing the original rendering the Polaris Program released when the mission was announced.

Once done with a series of maneuvers, the spacecraft is designed to repressurize with a breathable atmosphere. If anything goes wrong with repressurization, the EVA suits would be the quartets' lifeboats on the trip back home.

SpaceX has gone through as many emergency response plans as they could dream up, Gillis said.

"That's really where we started. What are the contingencies we need to plan for, and how do we ensure crew can get home safely? So there's some really interesting operations that have been developed that ensure we have a good landing site that's within reachable target at the start of a space walk, for instance," she said.

"But we have spent so much time drilling contingency responses, drilling all different flavors of responses we might need to have on the space walk. As a framer, I actually think we have used up all the ideas I had at the start of this for what I might want to drill."

One of the safety plans is to orient the spacecraft in a way that would

protect the astronauts from potential micrometeorites, as well as away from the sun, although the suits and visors are designed for use whether the sun was in view or not.

"It's kind of a really clever way of both providing shade to the nose cone and then also additional protection of spacecraft," Gillis said.

Isaacman said he was almost concerned the attention to detail on the EVA was taking away from the other mission objectives, but SpaceX's team helped assuage those concerns.

"That's where in the handful of months approaching your certification for flight, SpaceX begins all of their paranoia reviews, as you would call it, where they look at everything. I mean, start essentially all over again," he said.

He said the four crew members have been involved in every risk briefing, including a sobering discovery SpaceX made during development about a potential fire hazard, the details of which were addressed during the press conference by Bill Gerstenmaier, SpaceX vice president of build and flight reliability.

"When we're in the vacuum with 100% oxygen into the space suits, we want to eliminate as many flammability risks as possible," Gerstenmaier said.

"We discovered that in the dry environment there can be static electric discharge, and that could potentially lead to a flammability concern. The teams went in to mitigate that. They've changed procedures, they've changed processes, they've added conductive material, and we are truly ready to go fly."

It's one example of a bevy of risks in the maneuver as SpaceX and the

Polaris Program partner to push the boundaries for commercial spaceflight, but Isaacman has put his faith in SpaceX's attention to safety.

"The communication, the transparency with SpaceX from the beginning all the way through the end, especially when I said, they literally start all over again to look at every piece of the mission, not just the EVA, is what inspires so much confidence," he said.

Even on day one, when the crew attempts to fly to a new low-Earth orbit altitude record, they will begin to shift the composition of the air in the cabin so they don't suffer from decompression sickness when eventually switching to 100% oxygen.

"Over the course of about 45 hours, we'll actually slowly drop cabin pressure and raise oxygen concentration to help mitigate the risk," said Gillis. "On flight day two, we'll get pressurized in the suits and actually go through a mobility demo where we step through the sequence and movements inside the spacecraft and really make sure there was nothing missed in our training (so) that we're confident before we step outside."

The crew simulated the atmosphere on Earth during training.

"We actually spent two whole days in a vacuum chamber at NASA Johnson Space Center and went through the entire protocol, stepping down the pressure and then ultimately performing a simulated EVA on breathing masks of 100% oxygen, stepping through the full operation," Gillis said.

The spacecraft itself went through a spate of modifications to support the space walk, adding more oxygen to support all four passengers, a nitrogen refresh system needed for repressurization, and more environmental sensors so SpaceX can get a good idea of what the interior

is like before, during and after the event.

"With all of these life support system upgrades, obviously, there's a ton of testing that needs to go into this, and that's both at a component level, but then also at a full-scale system level," Gillis said.

To that end, SpaceX put the entire spacecraft into a thermal vacuum chamber running an end-to-end sequence depressurizing the capsule, remaining in vacuum and repressurizing with all of the software and hardware expected to be used on the flight. That included exposing the interior to vacuum, which bakes out some of the material including chemicals that would be stripped away because of the exposure to space.

"You are taking on a lot of risk at that point," Isaacman said. "I think it just goes into the preparations for that risk that I believe have been well mitigated."

He said there are manual ways to open the hatch, a hatch motor to open or close it, redundant seals and more sealant than on a normal Dragon; two different systems to get the ship back to habitable atmosphere after the spacewalk; and redundant oxygen supplies for the EVAs.

"At some point in time or another, if we are to unlock this last great frontier, and people are going to venture out into space—which, by the way, whatever risks associated with it there is, it is worth it—we have no idea what it could do to really change the trajectory of humankind. … There has to be some first steps in this direction, but they are really well thought out, well mitigated, for the benefit of those that will follow that will inevitably be doing space walks to build, construct, repair, discover.

"So, yeah, I think definitely would be the riskiest as part of the mission. It's also the one that's received rightfully, probably the majority of the last 2.5 years of attention."

The EVA isn't the only risky maneuver on the flight.

Another is the mission's initial goal on day one of flying to a higher orbit of 870 miles altitude that would beat the low-Earth orbit record set for a crewed mission in 1966, when NASA astronauts Pete Conrad and Richard Gordon flew on the Gemini 11 mission to 853 miles.

"When you go higher into space, that comes with all sorts of potential challenges," Isaacman said, "You're putting a lot of energy in the vehicle, then you take it out. But there's other realities when you're up there too, which is a completely different micrometeorite, orbital debris environment, obviously different radiation environment."

He said the goal was to expose the spacecraft to conditions that will be the norm for deep space and Mars initiatives. The spacecraft will be passing through the inner regions of Earth's Van Allen radiation belt, which traps charged particles as part of the planet's magnetosphere.

"We stand to learn quite a bit from that in terms of human health science and research," he said. "If we get to Mars someday, we'd love to be able to come back and be healthy enough to tell people about it. So I think that's worthwhile."

But it won't be a long time spent at that more dangerous altitude.

"To get some exposure in that environment also informs vehicle architecture, because, generally speaking, vehicles don't like radiation, so that's why we're going to stay there for the shortest amount of time that's necessary to gather the data we want, and then we'll come back down," Isaacman said.

For SpaceX's part, Gerstenmaier lauds Isaacman's willingness to perform risky missions that help push the envelope for SpaceX as it pursues lofty

end goals, but safety is still paramount.

"We take the responsibility that we've been entrusted to us to fly the crew and return them safely home," he said. "Spaceflight is not easy. Our mission right now is to safely launch Polaris, support their multiday mission and return them home to their families and friends."

But he said due diligence has been paid and he expects success.

"EVA is a risky adventure, but again, we've done all the preparation. We did the capsule testing, we did the suit testing, we did hyperbaric chambers, we did all the work to really get ready for this," he said.

He said SpaceX has built off of NASA's heritage, but extended it further.

"I think it's a really a tribute to this team, that they advance the state of the art," Gerstenmaier said. "We're going to do it as safely as we can, and we've got the right protocols and we've done the right testing to get ready to go do it."

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