



REPLACING THE WORLD'S LARGEST JET ENGINE AT 40-BELOW

When a SWISS airliner was stranded in a northern Canadian territory in the dead of winter, engineers had to find a way to fix it.



By Eric Tegler Mar 9, 2017

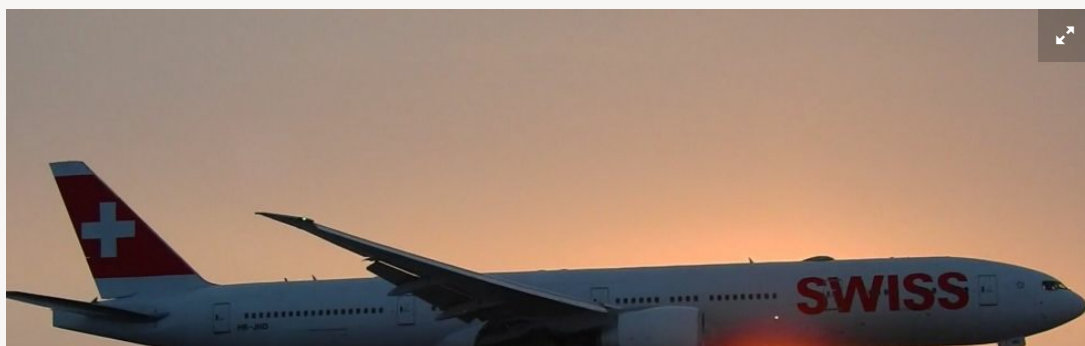
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In early February, the temperature meanders between -22 to -40 degrees. Add in 28-mph winds and it feels like a bone-shattering -76 degrees. Trees don't grow here; the summers are too short. Tarps rip like wax paper in freezing winds. One place stands out among the shrub-covered foothills, a lone 8,600-foot runway accompanied by one terminal with only two taxi gates.

This is Iqaluit Airport, and it's one of hell of a location for replacing a 18,000-pound jet engine.

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SWISS LX40 landing at Iqaluit airport.

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The Flight

Swiss International Airlines (SWISS) flight LX40 took off from Zürich, Switzerland, on Wednesday, February 1, at 4:20 p.m. Central European Time. The flight plan would have the plane cross the Atlantic, fly over the southern tip of Greenland, down across Canada, and then on toward its final destination in Los Angeles, spending a little more than 11 hours in the air. SWISS had been charting this daily 6,000-mile flight since 2016, thanks to the new Boeing 777-300ER powered by General Electric's GE90-115B—the world's largest jet engine.

It's a long, uneventful journey. But not this day.

Five hours into the flight, with the plane out over the ocean, Captain Roberto Battaglioni is napping in the crew-rest quarters in a small berth above the first class section while the co-pilot and relief pilot manage flight LX40. Suddenly, a flight attendant is pulling on Battaglioni's toe to jolt him out of sleep.

"Roberto, you have to go straight to the cockpit."

THIS 340-PASSENGER 777 HAS JUST BECOME A SINGLE ENGINE AIRPLANE.

As he steps through the reinforced cockpit door, the captain is told that that the left-side GE90 has automatically shut down after its self-monitoring system detected a problem. This 340-passenger 777 has just become a single engine airplane.

Boeing airliners have redundancies for this exact scenario, and a 777 can still fly comfortably on one engine. But if the second GE90 suffered a similar issue, the LX40 passengers and crew would be in a much more dire situation. When an engine fails over water, standard international aviation procedure calls for diverting to the nearest airport as soon as possible. In this case, that's a small airstrip on Baffin Island in the Canadian province of Nunavut called Iqaluit.



Baffin Island, a northern Canadian territory 180 miles away from Greenland at its narrowest point. It's the fifth largest island in the world.

Iqaluit is the capital of Nunavut, home to about 7,000 people of Inuit and European descent. Although it lies below the Arctic Circle, the city has a polar climate because of the frigid Labrador Current off Baffin Island. The average monthly temperature is below freezing eight months of the year.

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Iqaluit's airport was established as Frobisher Bay Air Base by the American Army Air Corps in 1942. With its 8,600 ft. runway, it served the U.S. military until the early 1960s and has been a divert field for trans-Atlantic airline flights ever since. It has scheduled airline service (aircraft are the main transport on and off Baffin Island) and also a terminal, but no large hangars.

"MY FIRST THOUGHT WAS WHERE IN THE WORLD IS IQALUIT?"

Once Captain Battaglioni was back in the cockpit, he apologized to the passengers and told the cabin they'd be landing at the nearest airport because of a "technical problem."

"I heard the announcement while half-asleep," passenger and RP Online reporter Judith Conrady [wrote in an article two days after LX40's diversion](#). Meanwhile, Battaglioni and his crew were making an engine-out approach to an airport they'd never seen in a simulator, let alone in real life. As the 777 touched down softly on the runway "everyone claps, even the snobs," Conrady says.



Aerial photo of Iqaluit.

Overflightstock

On the ground, the airplane could not turn itself 180 degrees with only one engine, so ramp tugs towed the 777 to the apron. Iqaluit's Mayor, Madeleine Redfern, offered passengers a tour of the city during their unplanned layover. But with current temperatures at -23 degrees, no hotel space to accommodate the 216 passengers and crew, and no enclosed jetway to connect passengers to the terminal, SWISS decided

to keep everyone on the airplane.

HiQPdf Evaluation 05/01/2017

After a long and cramped 14 hours, another SWISS Airbus A330 airliner finally came and took them to New York, where they would transfer to yet another plane to take them to L.A. For their former plane the work was just getting started.

And Now For the Hard Part

"My first thought was where in the world is Iqaluit?" Matthias Althammer told *Popular Mechanics*. The SWISS aircraft engineer got news of LX40 as he arrived for his morning shift on Thursday, Feb. 2. He immediately plugged Iqaluit into Google, showing a small town surrounded by lots of cold.

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Meanwhile, #LX40 was [already trending on Twitter](#) with pictures of the stranded 777 making its landing.



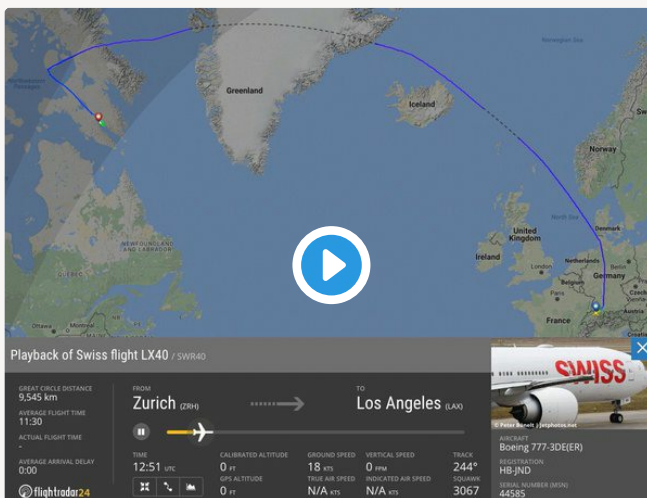
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#LX40 at Iqaluit Airport after landing with one engine.

2:59 PM - 1 Feb 2017

11 retweets 22 likes



Flightradar24
@flightradar24

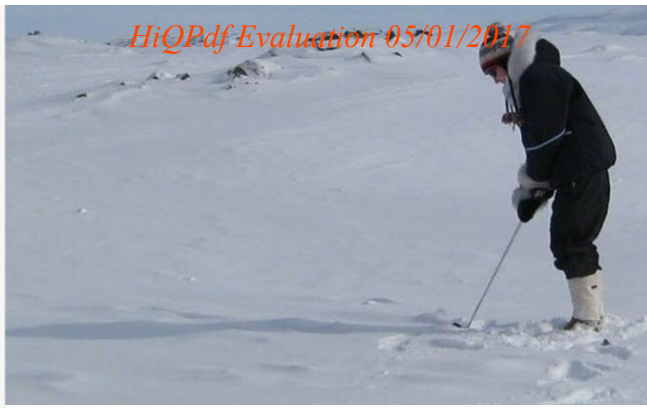
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#LX40 diverted to Iqaluit with an engine issue (via @tattuinee). Per NOTAM, runway at YFB is currently closed.

[flightradar24.com/data/flights/...](http://flightradar24.com/data/flights/)

12:49 PM - 1 Feb 2017

73 retweets 118 likes



Terrible Pilot
@terriblepilot

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If stuck in #Iqaluit I recommend a round of golf to pass the time.
Just saying...#ix40 #swissair #staywarm

1:58 PM - 1 Feb 2017

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Hours earlier, as the SWISS crew was still wrangling the solo-engine 777 while in flight, airline operations back in Zurich notified the local GE Field Service Engineer (FSE) of the engine shutdown. A GE team in Cincinnati got the word a few minutes later. With SWISS scrambling to get another airplane to Iqaluit, GE started exploring the problem and whether the 777 was still flyable. Most had no idea where Iqaluit was—except for one engineer from Winnipeg who knew well what to expect.

After engine data and photos were sent to the GE team, GE engineers determined that the turbofan wouldn't be running any time soon. They would need to replace the engine at the Iqaluit airport.



GE90-115B

Darren T. Brooks

But GE had no spare engine in the U.S. at the time, and the company's closest one was in London. However, SWISS did have a spare engine, but it had to somehow get from Zürich to Iqaluit. The GE90 is twelve feet long and weighs over 18,000 pounds. Its ducted fans measure 10-feet-8-inches in diameter. At full tilt, the GE90-115B creates up to 125,000 pounds of thrust—more power than the *RMS Titanic* and Alan Shepard's Mercury-Redstone 3 rocket combined.

Since this incredibly large and incredibly powerful cargo is much wider than an average fuselage, few planes can actually transport a GE90. But one such aircraft is the Antonov An-124, a huge military airlifter originally designed for the Soviet Air Force. SWISS contracted with a UK-based charter service to have an An-124 fly the engine and a batch of equipment to Iqaluit on Saturday, four days after the landing.



The Antonov An-124 that delivered the LX40's engine replacement.

CBC

With no hangar large enough to house the 777 and no GE90-specific tools on site, GE and SWISS hustled to gather what they'd need to get job done. SWISS technician Eric Rüttimann had done aircraft service in the field before but not in a place quite like Iqaluit. He told the [German newspaper *Blick im Abend*](#), "I took half an hour to write down everything that came to my mind, and then I began to pack."

The engine, a spare engine stand, cowl replacement stand, cowling slings, and other basic tools provided by SWISS were all finally packed inside the Antonov. GE placed its own Quick Engine Change package including an inflatable tent, materials, and consumables on the Russian freighter. After arriving on Feb. 4, five engineers from SWISS and 12 engineers from GE got to work.



The Deep Freeze Swap

The SWISS team handled the prep-work and readied systems for the engine swap, but GE performed the actual change. Both would rely on support from the local airline (First Air), the fixed base operator, and the Royal Canadian Mounted Police (RCMP), who made their hangar available. None of the groups had met previously, but they gelled immediately.

"I was astonished how fast the team was established," Althammer says. Althammer was one of a trio of SWISS technicians working directly on the aircraft. "You could feel each and every one's passion for aviation and that bound us together."

The combined team would need that passion in order to brave the elements. "There was a constant wind that made the whole thing feel even colder," Rüttimann told *Blick im Abend*. Without wind, -22 degrees is bearable but working unprotected in these conditions... was not worth thinking about."

The inflatable tent brought along by GE proved to be a lifesaver. Generators and lighting provided by the Iqaluit community raised the tent's inside temperature to a relatively balmy 50 degrees and permitted work during the 19-hour-long February nights. Anyone or anything that ventured outside had to be kept from freezing.



Removing the old GE90.

Darren T. Brooks

"It was hard to imagine how tough working under these conditions was," Althammer adds. "We had to make sure not to touch anything with our bare hands as we would have immediately stuck to it."

There are about 12 steps for changing the engine – from disconnecting all electrics, pneumatic, fuel, and hydraulic lines to reinstalling the fan cowls and pylon panels and performing a leak check. Once off its pylon, the GE90 was quickly ushered inside the RCMP hangar where the GE team undressed it and transferred necessary components to the replacement engine. Some things, like tending to the 777's auxiliary power unit, air conditioning system, and associated water tanks, had to be done outside.





Crews work to swap necessary components onto the new GE90.

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Weather stopped work several times when winds made moving large objects too dangerous and threatened frostbite. "The temperatures and winds made it too cold for even local people to be out working," says GE's Chris Chrissman, systems engineer for the GE90 program.

Strangely, these conditions might be dangerous for humans, but they closely replicate the kind of temperatures airplanes routinely battle—usually at much higher altitudes.



Installing the new GE90 engine.

Darren T. Brooks

Ready To Fly

Working continuously, weather interruptions aside, the crew had the new engine remounted and ready for leak checks, systems checks, and a ground run. As they labored, media outlets in [Switzerland](#), the [rest of Europe](#), and [North America](#) began reporting the story.

Finally on Feb. 9 at 6:00pm local time, and the airliner taxied to the runway under its own power for the first time in a week. LX40 ended its "halfway to LA" flight the following morning, touching down at Zürich Airport at 8:00am.



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Changing an engine—even one as mammoth as the GE90—in five days time is not a remarkable feat. The engine maker and its airline customers practice "stress tests" regularly, working through various maintenance/recovery scenarios. But none of these scenarios factor in Iqaluit's extreme weather. "GE has faced other challenging conditions in the past," Chrissman says. "But we consider this engine change to be one of the most extreme."

But Iqaluit's strange conditions were made much more tolerable because of the thoughtfulness of the Iqaluit community.

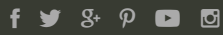
"I'm almost sure I'll be back to Iqaluit again," Rüttimann says, "but only in the summer."



LX40 prepares for its return flight to Zürich.

Darren T. Brooks

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