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Grownups
at Play
BERK

"METHODICAL RISK TAKER"

Chuck Aaron and the Red Bull Helicopter(s)

BY DAVE HIRSCHMAN

Like other confirmed fixed-wing pilots, I've always regarded helicopters with deep suspicion. Their method of flight seems unnatural, unintuitive, and exceedingly fragile. It relies on maintaining an exquisite balance between complex, competing forces that seem predisposed toward violent mayhem.

So it was with some trepidation that I recently found myself in the left seat of the Red Bull helicopter with pilot Chuck Aaron as he demonstrated a series of aerobatic maneuvers that, frankly, seemed impossible for a craft in which flight itself appears improbable.

Plus— View the video.

"We'll start out with a roll," said Aaron, 62, who has delved deeply into all aspects of helicopters during 18,000 hours of varied rotary-wing flight over the past four decades. "It's probably going to be a bit different than what you're used to in airplanes."

That's an understatement.

At 120 KIAS over South Carolina's marshy coastline, he raised the nose and then pushed the cyclic full left. Unlike an aerobatic airplane in which the occupants are generally seated on or very near the thrust line, the helicopter rolls around its main rotor disk about four feet above the occupants. The sensation of rolling in the helicopter feels more akin to a curlicue roller coaster than a frozen-rope aileron roll.

Also, the helicopter's field of view is so expansive that I found it impossible to judge either the aircraft's pitch attitude or yaw with accuracy. There's no wing, cowl, or other fixed portion of the airframe to view against the horizon.

Aaron's feet were active on the antitorque pedals throughout each roll. Just as in a fixed-wing airplane, each tap was meant to compensate for the gyroscopic forces of the spinning disk. But since the disk is on top of the aircraft and aft of the pilot, the timing was far different from the nearly universal "step-on-the-sky" addition of top rudder that pilots perform while rolling fixed-wing airplanes.

Aaron executed a series of rolls with absolute consistency: An entry speed of 120 KIAS, a two-G pull to a nose-up attitude of about five degrees, and a full-deflection roll at a rate of about 70 degrees per second (or just under five seconds from beginning to end).

"It took me forever to figure out how to roll without losing altitude," said Aaron, who typically rolls at 500 feet agl during airshow performances. "You've

SPECSHEET

Messerschmitt MBB Bo105 CBS

Specifications

Seats	5
Length	38 feet 11 inches
Rotor diameter	32 feet 3 inches
Empty weight	2,813 pounds
Max takeoff weight	5,511 pounds
Power	Two Allison 250-C20B turboshaft engines (420 shp each)

Performance

Never exceed speed	145 knots
Max cruise speed	131 knots
Normal cruise	110 knots
Range	310 nm
Service ceiling	17,000 feet
Rate of climb	1,575 fpm

Aaron practices aerobatic maneuvers near Santa Paula, California (below), the same location where Lockheed test pilot Sammy Mason first rolled a helicopter in the 1960s.

TOP: BRIAN NEVINS/RED BULL; TOM PATTON/RED BULL

Chuck Aaron (left) has done everything from ag flying to movies in helicopters, but developing an aerobatic routine for airshows sets him apart. The German-built Bo105 with its rigid rotor system provides the capability for what seems like a contradiction in terms: rotary-wing aerobatic flight.

The maneuver was so small in diameter that it seemed more like a back flip off a diving board than a traditional loop.

got to think about it in terms of flying the disk, not flying the fuselage."

Next, Aaron demonstrated a series of loops. Each of them began at exactly 100 KIAS, a number that seems absurdly low to fixed-wing aerobats. Aaron pulled steadily on the cyclic at about two Gs and the nose obediently rose far beyond the horizon. He brought the cyclic to its full aft limit as the helicopter came over the top and began a rapid descent.

The Gs were comfortably positive throughout each loop, even the inverted portion, and the aircraft seemed to pivot—not fly—over the top. The maneuver was so small in diameter that it seemed more like a back flip off a diving board than a traditional loop. And the view through the skylights atop the fuselage was extraordinary.

The four-blade, fiberglass rotors buffeted sharply during each pullout as the flexing blades encountered their own disturbed air. "That's totally normal," Aaron said dismissively of the rumbling buffet. "Happens every time."

The vast majority of helicopters are equipped with articulating or semi-rigid rotor systems that allow the main rotor blades to bend, flex, and twist in ways that absolutely prohibit zero- or negative-G flight. In fact, a rash of military helicopters crashed during terrain-following, nap-of-the-earth flights when they crested hills and pilots quickly forced them back down. The negative Gs allowed the rotor mast to tilt, and the highly flexible blades struck tail booms or tail rotors with catastrophic results.

AOPA Aviation Summit
Meet Chuck Aaron at AOPA Aviation Summit, September 22 through 24 in Hartford, Connecticut
www.aopa.org/summit

The expansive view from the Bo105 cockpit (above) can be troublesome during aerobatic flight because it's difficult to accurarate judge the helicopter's attitude. Red Bull has two nearly identical aerobatic helicopters, and Aaron shuttles between them during airshow season so that he can perform at events across the country, such as in Atlantic City, New Jersey (right).

But the Red Bull helicopter, a 1982 Messerschmitt-Bolkow-Blohm Bo105 CBS, is equipped with a highly modified, rigid rotor system that keeps the mast firmly in place and allows as much as one negative G. (That's the same sensation you'd feel doing a headstand on level ground.)

Aaron describes himself as a "methodical risk taker" and says he avoids negative-G maneuvers in his airshow routine, even though he's shown that they are possible. Other maneuvers of his own invention include the "Chuckevak," a variation on the tumbling lomcevak; a back flip from a hover; and a split-S.

He performs several zero-G maneuvers including a bizarre pushover that, like the loop, begins with firm backpressure on the cyclic and a vertical climb. Then, with the helicopter traveling straight up and about 20 knots forward speed, Aaron pushes forward briskly on the cyclic and the nose of the

helicopter abruptly tilts straight down. With the helicopter suspended motionless in midair, Aaron pushes down on the collective in his left hand, causing the helicopter to back up for several seconds. Gravity then takes hold and the helicopter accelerates quickly earthward, and Aaron makes a 180-degree heading change in the dive just for good measure.

With no airframe references relative to the horizon, Aaron said it takes a great deal of practice to make his climbs precisely and consistently vertical. And the Red Bull helicopter is the only one he's flown that is capable of such maneuvers.

"What's the point of a parachute? Even if you got out, you'd go through the rotor system. I decided a long time ago that, whatever happens, I'm staying with the helicopter all the way."

TOP: BRIAN NEVINS/RED BULL ; ADAM KOCH/RED BULL

"I'd think about each maneuver, dream about it, and write it all out long before I'd ever attempt it. Going upside down goes against everything in a helicopter pilot's training and experience."

"If you tried a zero-G pushover in a normal helicopter," he said, "there'd be no way you'd survive it."

An exit strategy

Aaron is the son of a career U.S. Air Force pilot and grew up at military bases around the world, including Libya, which he says is blessed with many fine beaches.

He was learning to fly fixed-wing aircraft when a chance 30-minute helicopter ride provided the focus for his professional life. His first paying helicopter flying gig came in 1972 when he convinced a South Carolina crop duster to allow him to spray cotton crops. Later, he started his own helicopter firm in Orlando, bought and sold helicopters, repaired and rebuilt them, instructed, and even provided golf legend (and seasoned general aviation pilot) Arnold Palmer his first helicopter flight.

Aaron has lived in Southern California for many years and is based at Camarillo Airport, where he has flown helicopters in support of numerous TV and movie productions. He also rebuilt several former military Cobra helicopters from assortments of spare parts—and that's what led him to aerobatic rotary wing flight and Red Bull. The Cobra—a two-seat American ground-attack helicopter—also has a rigid rotor system. With a great deal of research, experimentation, and nerve, Aaron found that it was possible to roll the powerful Cobra.

"The maneuver is really a very big, ugly barrel roll," he said. "The Cobra is quite limited in what it can do in terms of aerobatic maneuvers."

Aaron sold a Cobra to Red Bull for the company's aircraft collection, and company officials then asked him an intriguing question: Was there anything Aaron could do in a helicopter that would make a high-energy airshow routine suitable for promoting Red Bull?

Aaron thought about it and decided a twin-engine Bolkow with a customized rotor system would be the right platform for a unique and unforgettable aerobatic flight demonstration. In the next year and a half, Aaron found the right helicopter, modified it to his specifications, and designed and practiced an aerobatic routine. Then, in 2005, he became the first (and, so far, only) pilot ever to obtain FAA approval to perform low-level aerobatic demonstrations in helicopters.

This year he's scheduled to perform at 20 events from California to Rhode

Island, and Texas to Wisconsin. Red Bull operates two identically painted and equipped Bo105 CBS helicopters. One is kept on the East Coast during the airshow season, and the other at Aaron's home airport in California.

Other helicopter pilots, starting with Lockheed test pilot Sammy Mason in the 1960s, have successfully rolled specialized rotary-wing aircraft. But Aaron was the first to gain approval to perform such maneuvers at low altitudes for airshow displays.

Coincidentally, both Mason and Aaron made their pioneering upside-down flights in the same coastal valley lined with orange and avocado orchards near Santa Paula, California.

Unlike in fixed-wing aerobatics, however, Aaron and his passengers aren't required to wear parachutes in the Red Bull helicopter.

"What's the point of a parachute?" the laconic Aaron asks rhetorically. "Even if you got out, you'd go through the rotor system. I decided a long time ago that, whatever happens, I'm staying with the helicopter all the way. Stick with it, keep fighting, and never, ever give up."

Aaron has more than 1,200 fixed-wing flight hours but never had any formal aerobatic training before inventing his helicopter maneuvers. He didn't regard his lack of fixed-wing aerobatic experience as a liability, however, because helicopter maneuvers are so different that a lack of ingrained habits worked for him by preventing negative transfer.

Aaron took the time to carefully consider each maneuver and the stresses they would place on the airframe. He rigged his helicopter with video cameras on the instrument panel and tail boom so that he could review the speeds, altitudes, and G-loading and match that information to in-flight images that showed the ways the airframe and rotor blades responded to the unusual forces.

He also removed all the helicopter's interior panels and inspected the airframe at regular intervals. So far, he said he's found no extraordinary wear.

"I'd think about each maneuver, dream about it, and write it all out long before I'd ever attempt it," he said. "Going upside down goes against everything in a helicopter pilot's training and experience.

"I have an exit strategy for every maneuver I perform," he said. "I know how I'm going to get out of each maneuver before I get into it. That's the key."

Aaron's son, Charles, also a helicopter pilot, often accompanies him at airshows and ferries helicopters between locations.

Aaron said he's considered passing on his hard-won aerobatic helicopter knowledge to his son or other aspiring performers, but he's deeply conflicted about whether to do so. He's acutely aware of how dangerous this type of flying is, and he doesn't know if he could live with himself if a protégé were ever hurt or killed.

"Red Bull has given me a magic carpet—and they've been 100-percent supportive," Aaron said. "At some point I'll hang it up. But I really haven't decided whether to pass on what I've learned through this whole process or not. That's going to be an extremely difficult decision, and one that I won't make lightly." AOPA

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