

Speeding into the future

In a history-making flight, the X-51A showed the possibilities of hypersonic travel

By Christina Kelly

For Boeing engineer Mark Nugent and many other employees, nearly a decade of hard work and preparation all came down to a nail-biting 200 seconds.

That's how long it took the X-51A WaveRider to successfully complete the longest supersonic combustion (scramjet) powered flight in aviation history on May 26, reaching a speed of about Mach 5, or five times the speed of sound.

"It happened so fast," Nugent said. "The closer we got to first flight, we began counting down. First days, then hours, then tenths of seconds. It is still sinking in that we did it. We made history!"

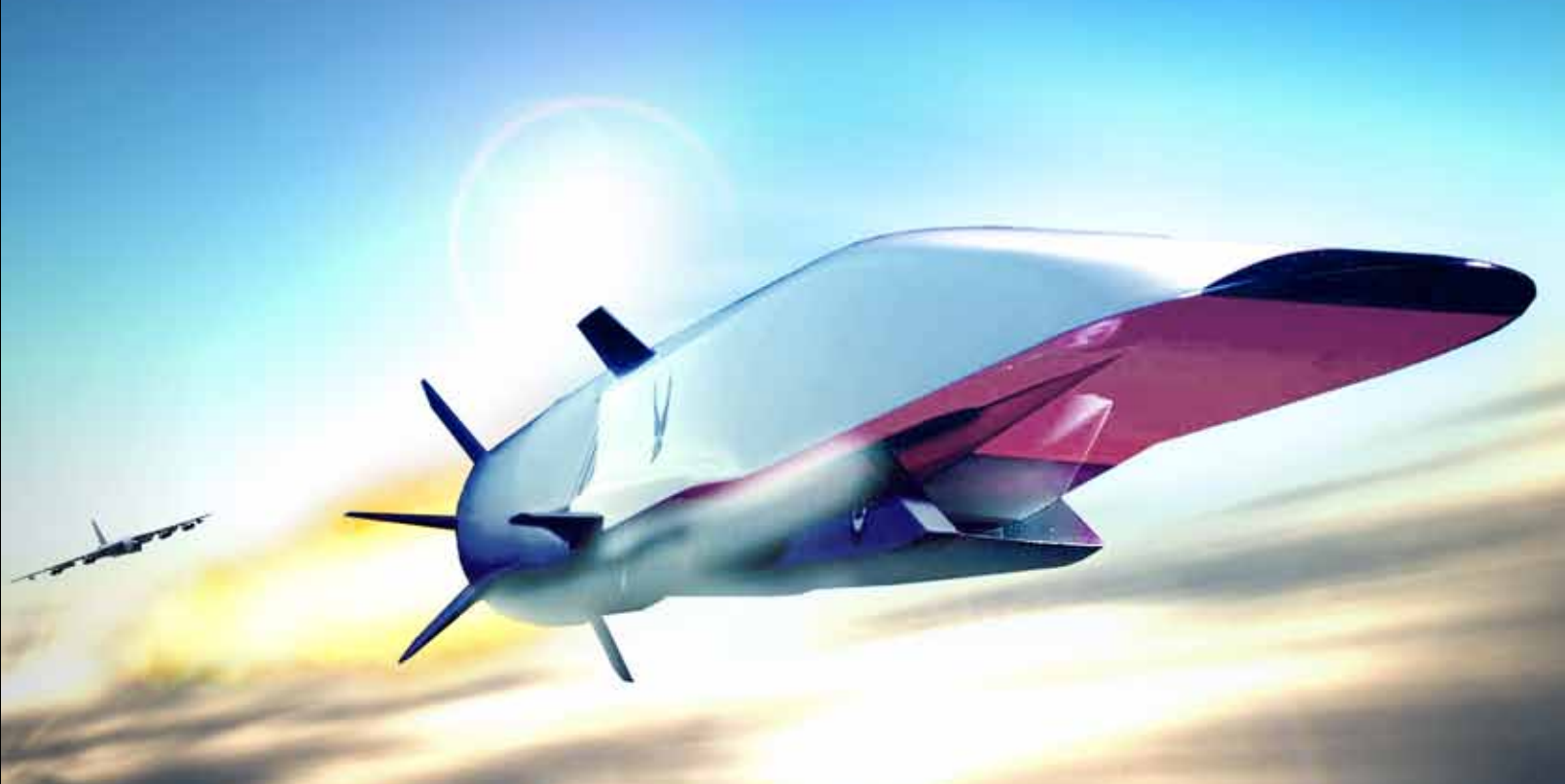
The journey from concept and design to the actual flight was a roller-coaster ride filled with delays and obstacles that often had little to do with the

test vehicle and more to do with other equipment and scheduling.

"It's been quite a ride," said Rick Marsh, Boeing's Integrated Product Team lead for the X-51A rocket booster. "In the aerospace industry you don't often get to see the project from design sketches to the actual flight. "There were a dozen times when I wondered if we'd ever get here."

So named because it is designed to ride its own hypersonic shock wave, WaveRider was built by Boeing Phantom Works for the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio. The scramjet motor was developed by Pratt & Whitney Rocketdyne.

On the day of the test, WaveRider was carried under the wing of a U.S. Air Force B-52H bomber to an altitude



'Lighting a match in a hurricane'

Hypersonic technology is the ability of air-breathing vehicles to fly at speeds between Mach 4 and Mach 14 using a supersonic combustion (scramjet) powerplant. Air-breathing hypersonic vehicles offer the hope of low-cost, on-demand access to space. The idea has been around since the 1950s, but the technology didn't exist until recently.

X-51 program officials have compared the challenge of scramjet propulsion to "lighting a match in a hurricane and keeping it burning."

Previously, the longest hypersonic scramjet test flight was by the X-43, an unmanned air-launched vehicle conceived by NASA in 2004. Boeing Phantom Works was part of that team, but the flight lasted only about 10 seconds and the X-43 used hydrogen fuel. The X-51A engine uses JP-7 jet fuel, which is less costly and more efficient.

PHOTO ILLUSTRATION: The X-51A WaveRider began its history-making hypersonic flight after being released by a Boeing B-52 bomber at 50,000 feet (15,240 meters).

WAVERIDER GRAPHIC BY U.S. AIR FORCE;
PHOTO ILLUSTRATION BY BRANDON LUONG/BOEING

of 50,000 feet (15,240 meters) off the Southern California Coast, over the Point Mugu Naval Air Warfare Center Sea Range.

Four seconds after WaveRider was released, a solid rocket booster accelerated it to about Mach 4.5 before it and a connecting interstage were jettisoned. For about 200 seconds WaveRider flew exactly as it was intended, reaching an altitude of about 70,000 feet (21,340 meters).

Somewhere in the span of those few minutes, Joe Vogel, Boeing's X-51A program manager, noticed the vehicle began to de-accelerate. In the control room, the buzz of excitement trailed off a bit. At about Mach 5, the control center lost telemetry, meaning no data

were being sent by WaveRider, and it was destroyed as planned.

"The vehicle did everything we wanted it to do, except go a little faster for a little longer," Vogel said. "Something occurred that we don't fully understand yet, but we have plenty of data to review. I have no doubt it is something we will be able to fix and that the next vehicle will go even faster."

Three more test vehicles were built, but no decision has been made about when WaveRider will fly again.

Even though WaveRider did not fly for 500 seconds as planned or reach a speed of Mach 6, the U.S. Air Force hailed the flight a success.

"We're ecstatic to have accomplished many of the X-51A test points during its

first hypersonic mission," said Charlie Brink, Air Force X-51A program manager with the Wright-Patterson research lab. "This gives us huge confidence."

Boeing's Vogel said the flight helped prepare the way for future applications of hypersonic technology.

"This is a new world record and sets the foundation for several hypersonic applications," Vogel said, "including access to space, reconnaissance, strike, global reach and commercial transportation." ■

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WaveRider flight brings moonwalk memories

On July 20, 1969, Joe Vogel watched as astronaut Neil Armstrong climbed down a ladder from the lunar lander Eagle and planted the first human footprints on the moon. The youngster turned to his dad and asked what kind of job would get him to the moon.

"My dad said, 'son, engineers made that happen,' and I knew from that

time on, I was going to be an engineer," recalled Vogel, who worked on the Space Shuttle *Endeavour* for NASA at the Johnson Space Center in Houston before coming to Boeing.

"I wanted to work on something that had never been done before," Vogel said, explaining why he joined Boeing.

Vogel got his wish with the X-51A WaveRider program, which he's managed since 2006.

Following the X-51A flight, a video from the F-18 chase plane was downloaded on the YouTube Internet videoclip sharing site. Within 48 hours, the video had nearly 200,000 visits.

After Vogel left Edwards Air Force Base, he took the YouTube video to his son Jeremy's third-grade classroom. In the

back of his mind was the childhood awe he felt after seeing men walk on the moon.

"The reaction from the kids was unbelievable," Vogel said. "They could not stop talking about it. Who knows? Perhaps 15 or 20 years down the road, we will see the next crop of engineers who will say it was the X-51A test flight in 2010 that jump-started their interest in aerospace."

— Christina Kelly

PHOTO: Skies call—the X-51A WaveRider vehicle and its B-52H launch aircraft are readied for the record-setting test flight.
U.S. AIR FORCE PHOTO