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Nation nails reusable rocket landing in stunning sea catch

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China achieved a milestone in its space program on Friday by successfully recovering the main body of a carrier rocket for the first time, recording a breakthrough for the nation on the path to rocket reusability.

The feat also marks the world's first recovery of an orbital-class rocket using a wire arrestment system that involves a net made of pretensioned cables for high stability and flexibility.

The recovery was achieved during the debut flight of the Long March 10B, a large liquid-fueled rocket model designed and built by the China Academy of Launch Vehicle Technology, a Beijing-based subsidiary of China Aerospace Science and Technology Corp.

With this mission, the Long March 10B has become the nation's first — and the world's third — rocket to complete all key steps of a full recovery profile, namely controlled return flight, vertical terminal descent and intact retrieval.

At 12:15 pm, seven powerful

engines on the Long March 10B's first-stage booster roared into life, burning liquid oxygen and kerosene, and lifting the 63.6-meter-tall rocket off a service tower at the Hainan International Commercial Aerospace Launch Center in Wenchang, a coastal city in Hainan province.

After two-and-a-half minutes, the launch vehicle reached the separation point several kilometers above the Karman Line, the globally recognized boundary between Earth's atmosphere and the edge of outer space, where its first- and second-stage boosters separated and the engines of the first stage temporarily turned off.

A single liquid oxygen-methane engine on the second stage ignited to propel the payload-carrying upper stage toward its target orbit. Later, the upper stage deployed a satellite into its preset orbit hundreds of kilometers above Earth.

Controlled descent

Meanwhile, the rocket's first stage continued coasting upward by inertia. Its grid fins unfolded and the reaction control system activated to adjust attitude and fine-tune its trajectory, before it began descend-



A video grab shows a platform mounted on the recovery ship *Linghangzhe* successfully capturing the first-stage booster of the Long March 10B carrier rocket on Friday. CCTV

ing back into Earth's atmosphere in a controlled manner.

During the descent, select engines on the first stage reignited twice in sequence. Working in tandem with the grid fins and the reaction control system, the engine ignitions slowed down the descent, maintaining the first-stage booster's intended flight path as it neared the sea surface. Between the engine ignitions, the booster relied on a carefully calculated falling position to use air resistance to bleed off speed.

return maneuver, all engines on the first stage turned off, and a set of specialized metal hooks deployed to engage with the pretensioned cables.

After the net captured the booster, auxiliary cables deployed to provide initial stabilization. An automatic clamping platform then moved into position beneath the booster to clamp, lock and support it. These steps fully secured the recovery of the rocket booster.

In the mission control room at the Wenchang commercial spaceport, designers, engineers and ground controllers cheered loudly when the first-stage booster came into the view of cameras on support vessels and monitor drones near the recovery ship, and as the booster was secured by the net, they erupted into celebration.

The entire recovery process, which started at the point when the two stages of the rocket separated, took about six minutes.

A recovery ship, named the *Linghangzhe*, waited at a predetermined site hundreds of kilometers southeast of Wenchang, continuously tracking the return path and adjusting its position to maintain optimal alignment.

At the ship's center, pretensioned cables were carried by rail-mounted sliders, which automatically positioned themselves to maximize the likelihood of the booster making a successful landing in the net. In the final seconds of the intricate

Mission: Booster likely to be reused before end of the year

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The Long March 10B model weighs about 760 metric tons when fully fueled. It has a diameter of 5 meters and a liftoff thrust of more than 890 tons. It is now the second-most powerful space launch vehicle in China, following the Long March 5, which boasts a liftoff weight of around 870 tons and a thrust of nearly 1,100 tons.

The Long March 10B is capable of transporting payloads with a combined weight of 16 tons to a typical low-Earth orbit at an altitude of 200 kilometers, or 11 tons to a 50-degree inclined orbit at an altitude of 900 km.

Prior to Friday's mission, two types of Chinese rockets — the ZQ3 of commercial company LandSpace and the Long March 12A from the Shanghai Academy of Spaceflight Technology — had attempted the extremely sophisticated recovery, but they faced last-minute failures.

In February, the Long March 10A model performed its maiden flight

from the Wenchang Space Launch Site, another spaceport in the city. Its first-stage booster successfully returned to Earth and completed a controlled splashdown in designated waters in the South China Sea, as part of a deliberately designed technical trial.

Chen Muye, a structural designer of the Long March 10B, said the rocket used on Friday was manufactured at a production complex in Tianjin and was transported by ship to Wenchang in February. It underwent a host of technical and functional tests and launch-sequence rehearsals at the Wenchang commercial spaceport before being moved to the service tower, he said.

Using the wire arrestment recovery system to catch the booster helped simplify the rocket's onboard structure, Chen noted. "It removed the need for complex landing legs, which helped reduce the rocket's structural weight and, in turn, boosted its payload capacity and cost-effectiveness," he said.

"In addition, this recovery method is highly tolerant of landing position deviations. Through coordinated adjustments, the cable-net system can effectively widen the capture window," Chen said, adding that the system can also meet the recovery needs of rockets of different sizes and configurations.

Major leap

Wang Wei, a project manager of the Long March 10 series, said the new rocket is of great significance to China's commercial space development.

"It represents a breakthrough in low-cost, high-payload reusable launch vehicle technology, fills the domestic gap in this field, and it will drastically reduce commercial launch costs and enhance our commercial launch service's competitiveness in the global arena," he said.

"This maiden flight has successfully verified a series of core technologies, including system-level optimization design for combined configurations, high-thrust tank-bot-

tom load transfer, and methane self-pressurization," he said.

Wang highlighted that the rocket will mainly facilitate satellite constellation deployment in low-Earth orbit, and will support the construction of massive internet networks and communication satellite systems. He added that the recovered booster was expected to be reused before the end of this year.

Wang Yanan, chief editor of Aerospace Knowledge magazine, said that reusable rockets have been regarded by the Chinese space community as a kind of strategically significant asset because they can largely lower the cost and preparation time of launches.

"That has proved to be a distinct advantage when it comes to developing vast internet satellite networks with global coverage and tapping the lucrative space tourism market. It is virtually impossible for companies to use conventional expendable rockets to compete with those that have reusable products," he said.