Mach 30 ‘Tunnel’ Will Put China Decades Ahead

By Dave Makichuk
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“There is a Chinese saying, it takes 10 years to sharpen a sword. We have spent 60 years sharpening two swords … and they are the best.” — Chinese researcher Han Guilai

Imagine a wind tunnel, capable of simulating flights at Mach 30 — that’s 23,000 mph, or, 30 times the speed of sound.

It may sound like science fiction, but in fact, China has built a hypersonic wind tunnel in Beijing which could put the superpower decades ahead of the West, according to a report in UK’s The Sun.

Researcher Han Guilai, of the Chinese Academy of Sciences, said that together with another facility, also in Beijing, China will be about 20 to 30 years ahead of other powers.

Such futuristic aerospace technology could make it possible for super-fast jets to fly anywhere in the world in two hours or less.

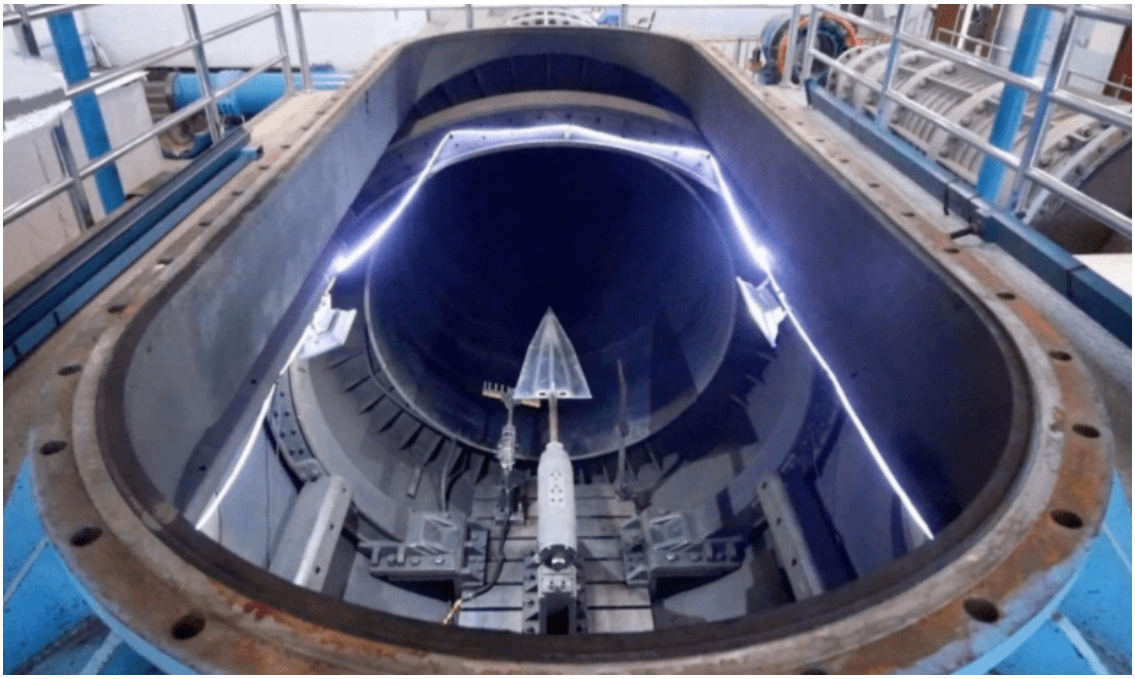
It could also make space travel accessible to ordinary people as the hypersonic aircraft could cut costs by more than 90%, reports say.

Of course, the technology is also hugely important when it comes to weapons.

President Xi Jinping has made modernizing the armed forces a key priority and wants to have a “world class military” by 2050 capable of matching the US, the report said.

China has invested a huge amount of time and money developing hypersonic missiles.

The lethal DF-17 “carrier killer” can perform extreme manoeuvers as it hurtles at Mach 10 — some 7,600 mph — towards a target, with any warship unlikely to survive a direct hit.



The older J-12 hypersonic wind tunnel in Beijing is working with the new facility to develop hypersonic aircraft. The JF-22 tunnel is capable of simulating flights at Mach 30 or 23,000 mph – 30 times the speed of sound. Credit: Handout

Even without a warhead, the DF-17 could tear through a big ship like the US Navy's latest carrier, the *USS Gerald R. Ford* — putting it out of action.

While no launch date has been set for China's hypersonic aircraft, scientists at JF-22 will work together with experts at JF-12 — another wind tunnel in Beijing which has about fifth of the new facility's power output, the report said.

Instead of using mechanical compressors, Beijing uses chemical explosions to generate high speed air flow.

Fuel burns in the JF-22 at speeds 100 million times faster than a regular gas stove creating shock waves similar to those experienced by jets at hypervelocity.

At America's most advanced wind tunnel, named the LENS II (Large Energy National Shock tunnels), simulated flights last 30 milliseconds, running between Mach 3 and 9.

In comparison, JF-22's average flight simulation can reach 130 milliseconds, Guilai said.

"Our experiment time is much longer than theirs, so the aircraft model can be larger than theirs, and the experiments can be more advanced than theirs.

"This determines our leading position in the world."

A surface-to-air missile is fired from a missile launcher by the air force under the PLA Southern Theater Command during a round-the-clock air defense training exercise. (eng.chinamil.com.cn/Photo by Zhang Hengping and Yuan Hai)

Guilai, who works with China's hypersonic agency the Institute of Mechanics, said a jet travelling at such high speeds could reach 10,000 degrees celsius and break air molecules into atoms — even giving some an electric charge.

He said: "This air is no longer the air we breathe in. The flying vehicle we study is like swimming in mud."

Qian Xuesen, considered "the father of China's rocket program," coined the term "hypersonic" in 1946 after he found that the behaviour of air flow was completely different at five times faster than sound.

The term was used in his research article "Similarity laws of hypersonic flows" to distinguish the flows at speeds much higher than the local speed of sound from supersonic flows where thermal and chemical reaction effects on flow motion can be ignored.

The hypersonic and high-enthalpy flow is referred to as a gas flow with high kinetic energy, in which there may exist thermal and chemical reactions behind the bow shock or within the boundary layer.

After more than sixty years' research work, hypersonic ground test facilities suitable for exploring aero-thermochemistry still rely on high-enthalpy shock tunnels.

Many shock tunnels have been built around the world.

For example, LENS I and II in the US, the High-Enthalpy Shock Tunnel (HIEST) in Japan, the High-Enthalpy Shock Tunnel (HEG) in Germany and the JF-12 and JF-22 tunnels in China.

The key aerodynamic phenomena and their effects on aircraft performance were first discovered during the atmospheric reentry of the space vehicles such as space capsules or space shuttles.

Such vehicles encounter extremely strong nose shock waves and viscous friction along the surfaces that can heat the surrounding air to a temperature up to thousands or even ten thousand degrees.

Molecule vibration excitation, gas dissociation and atom ionization may occur successively as the gas temperature increases. In such a situation, air will no longer be an ideal gaseous mixture, but a chemically reacting media varying with the flow temperature.

The substantial change in the flow media results in changes to the constitutive relation of the high-enthalpy flows in which the energy transition takes place within chemically reacting gases and flow motions.

This is the fundamental issue of hypersonic and high-enthalpy flows and boosts study on the chemical physics of gas dynamics.

As well as his work on hypersonics, it was Qian who single-handedly led China's space and military rocketry efforts after he was drummed out of the United States during the red-baiting of the McCarthy era.

A former US Secretary of the Navy, Dan Kimball — later head of the rocket propulsion company, Aerojet — would later say it was "the stupidest thing this country ever did."

But in the US of the 1930s and 1940s, Qian was no less valuable, if not so publicly celebrated, as a pioneer in American jet and rocket technology.

As a student at the Massachusetts Institute of Technology, and later as a scientist and teacher at the California Institute of Technology, Qian, also known as Tsien Hsue-shen, played a central role in early US efforts to exploit jet and rocket propulsion.

On the war front in Germany, he advised the US Army on ballistic-missile guidance technology.

At the war's end, holding the temporary rank of lieutenant colonel, he debriefed Nazi scientists, including Werner von Braun, and was sent to analyze Hitler's V-2 rocket facilities.

In 1955, Qian was sent back to China, where he was proclaimed a hero and immediately put to work developing Chinese rocketry.

Under his leadership, China developed its first generation of "Long March" missiles and, in 1970, launched its first satellite.

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Sources

The Sun, BBC News, Wikipedia, The New York Times, *ScienceDirect.com*

Featured image: A formation of Dongfeng-17 missiles takes part in a military parade during the celebrations marking the 70th anniversary of the founding of the People's Republic of China at

Tian'anmen Square in Beijing. (Xinhua/Mao Siqian)

Articles by: **Dave Makichuk**