CENTRE FOR JOINT WARFARE STUDIES

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SCRAMJETS: DEVELOPMENTS IN CHINA

Chinese Scientists Carry out Another Scramjet Ground Test.

1. A scramjet engine built for China's hypersonic strike weapon was ground tested in Beijing to run at maximum boost for at least 10 minutes, the longest in the world. The scientists from Institute of Mechanics fed extremely fast, super-hot air into the engine and took the burn process to the maximum for 600 seconds, sometime last month. A scramjet is an air-breathing engine for flight that becomes operational at Mach 5 or above. Traditional jet engines can melt at hyper-velocity. The scramjet has no moving parts, like a turbofan, but instead uses the forward motion of the vehicle to compress air and mix it with high-energy fuel to generate explosive thrust. Unlike a ramjet, the air in the scramjet moves faster than sound, even after compression.

2. In a related development, the world's most powerful wind tunnel JF-22, is expected to be ready in China by end 2020. This facility in a mountainous district in Beijing, will facilitate the development of new generation of hypersonic weapons capable of flying till Mach 20 or beyond.

3. **Comments.** Hypersonic weapons can travel up to Mach 20. A 10- minute scramjet boost to a weapon could give it a range of more than 4,000 km (2,500 miles) at top speed. Even the most advanced missile defence system would struggle to intercept a weapon maneuvering at such high speed. The ground tests however, cannot simulate all the elements of an actual flight at high altitude, as some components that work on the ground might behave less reliably in the air.

4. Supersonic air stream could raise the temperature of the engine to over 4,000 degrees Celsius – twice that of ordinary jet engines – and if the heat continues to build up, the scramjet could explode. This problem is somewhat mitigated by directing fuel to

the surface of the most heated components, such as the combustion chamber. With precise injection control, the fuel absorbs and dissipates the heat; which in turn, vapourises the fuel into a gas of carbon and hydrogen molecules, ready to meet the incoming oxygen in thecompressed air, and burn.

5. Since 2013, the US Air Force X-51A Wave-rider has held the duration record with 210-second burn process that accelerated the plane to Mach 5. The US defence department also tested a prototype to validate the design of a hypersonic weapon that could be available for deployment by 2023. Russia deployed Avangard, a nuclear-capable hypersonic glide vehicle that was reportedly capable of reaching a top speed of Mach 27 in Dec 2019. In 2016, an Indian test vehicle reportedly reached Mach 6 with the engine running for just five seconds.

6. China also sees a great opportunity for using scramjet technology to produce engines for future space vehicles. Current space flights are conducted using rocket engines. The scramjet could, in theory, reduce the cost of space launch to just a fraction of present expense. To research this possibility, Chinese government has established a company in Hefei, Anhui province, with nearly 200 million yuan (US$28 million) initial investment.

Source: https://www.scmp.com/news/china/science/article/3086804/report-chinese-scramjet-test-challenge-most-advanced-missile