

# The Status and Future Prospects of Civil Supersonic Aircraft Development

Yoshihiro Fujimaki, Japan International Transport and Tourism Institute, USA

## 1. Civil Supersonic Aircraft in the Past and Their Problems

Aircraft that fly at supersonic speeds were first utilized as fighter planes in the 1950s. After that, research and development of supersonic aircraft for civil use progressed. The Concorde developed in Europe and the Tu-144 developed in Russia (formerly the Soviet Union at that time) began commercial operations in the 1970s. Since these two types of aircraft were commercialized, although there are projects of civil supersonic aircraft in development, nothing yet has advanced to the point of practical use.

Like the Concorde, the Lockheed L-1011 TriStar is a civil aircraft flying at subsonic speed that started commercial operations in the 1970s. If we compare these two models of aircraft, (TriStar is a type of L-1011-200) there is not a big difference in cruising distance, but the Concorde has over 10% more fuel on board<sup>1),2)</sup>. Furthermore, the Concorde has less than half the fuel economy (based on a passenger kilometers per fuel consumption rate) comparatively, considering that Tristar's passenger capacity is two or more times greater. In addition, because of the oil shock in the 1970s, only Air France and British Airways continued to operate the Concorde, which had bad fuel efficiency.

Although the cruising speed of the Concorde is Mach 2, and two or more times faster than subsonic aircraft, problems related to supersonic cruising were not limited to the fuel consumption mentioned above. In particular, shock waves naturally arising from supersonic cruising caused a sonic boom, resulting in an expanded area along flight routes with noise issues, which used to be limited to takeoffs and landings at airports. Because of this, supersonic flights

were banned in principle on U.S. soil in 1973 by order of Federal Aviation Regulations (FAR) 91.817, which is still in effect. This measure also led to the decline of the Concorde, as significant regulations were imposed on routes and the abilities of the supersonic aircraft to perform.

In terms of new development of civil supersonic aircraft, it will be necessary to contain problems with noise and fuel economy within an acceptable level. With increases in engine bypass ratios, etc., civil subsonic aircraft have improved both fuel efficiency and noise, and acceptable standards have become stricter since the 1970s. Under these circumstances, multiple development projects of civil supersonic aircraft are ongoing in the U.S., and are aiming for commercialization by the mid-2020s. This report will introduce the status and future prospects of these projects, and will include the handling of noise and fuel consumption issues.

## 2. Development Projects of Civil Supersonic Aircraft in the U.S.

### 2.1 Aerion Supersonic (Aerion)

Aerion, headquartered in Reno, Nevada, is a start-up company that develops supersonic aircraft, including the "AS2," a business jet with Mach 1.4 cruising speed.<sup>3)</sup> According to the plan that the Aerion CEO shared in January 2020, they are targeting for the first flight of the AS2 to occur in 2024 and to start commercial operations in 2026.<sup>4)</sup>

Cruising speed of the "AS2" is slower than it is for the Concorde. This is related to the technology that they have trademarked the "BOOMLESS CRUISE". The strength of

shock waves arising from supersonic flight weaken as speeds go down. When aircraft fly at high altitudes at relatively slow supersonic speeds, the shock waves generated in the air do not reach ground level, realizing a state of “Mach cutoff” where there is no sonic boom. Attaining “Mach cutoff” is dependent on speed and air temperature. This status is utilized in “AS2’s” “BOOMLESS CRUISE,” and targets for aircraft to fly at supersonic speeds of up to around Mach 1.2 even on land without having the issue of a sonic boom.

Regarding the matter of fuel consumption, while the afterburner installed on the Concorde’s engines for supersonic flight was the cause of worsening energy efficiency, the “AS2” flies at supersonic speeds without the installation of an afterburner on its engine. For use as “AS2’s” engine, General Electric (GE) announced in October 2018 that they were going to develop a turbofan engine called “Affinity.”<sup>5)</sup> This engine satisfies the existing criteria for gas emission and the latest standard for noise (Stage 5) in the U.S. It will also be designed to support 100% biofuel (not mixed with regular jet fuel).

In February 2019, Aerion announced their partnership with Boeing on production, technology, and financial resources.<sup>6)</sup> Due to this cooperation, 2 of the 5 members on Aerion’s Board of Directors became outside board members from Boeing. Furthermore, Governor of Florida Ron DeSantis announced in April 2020 that Aerion will invest 300 million dollars to the city of Melbourne to build their global headquarters and establish a hub for design, production and maintenance by 2026.<sup>7)</sup> Because of this, production aircraft for “AS2” will be manufactured in Melbourne, Florida.

## 2.2 Spike Aerospace (Spike)

Spike is a start-up company developing supersonic jets headquartered in Boston, Massachusetts. They develop the “S-512,” which is a business jet with a cruising speed of Mach 1.6.<sup>8)</sup> According to the plan the CEO of Spike published in April 2019, they have been aiming to start the business operations of the “S-512” in 2025.<sup>9)</sup>

The cruising speed of the “S-512” is slower than that of the Concorde’s. As mentioned earlier, this trait is to weaken the

strength of shock waves and contain the noise problem of sonic boom on land.

While the “AS2” of Aerion aspires for shock waves that arise in the air to not to reach ground level, shock waves of “S-512” do reach the ground. However, by limiting sonic boom at the ground level to 75 PLdb (equating to a weak hand clapping sound) using their patent-pending “Quiet Supersonic Flight Technology,” Spike hopes to achieve supersonic flight at both sea and land.

The “S-512” installs big screens in the cabin to replace windows using a technology called “Multiplex Digital Cabin,” which is also pending patent for Spike. These screens can show entertainment, such as movies and panoramic views from an outside camera. They also are meant to significantly reduce noise inside of the cabin with the absence of windows in the fuselage structure.

As of June 2020, information about the actual engine to be installed on the “S-512” has not yet been published, nor a detailed plan for manufacturing of production aircraft. Thus it seems very difficult to achieve the goal of starting commercial operations in 2025.

## 2.3 Boom Technology (Boom)

Boom is a start-up company developing supersonic passenger aircraft headquartered in Denver, Colorado. The passenger transport “Overture,” which they develop, has a cruising speed of Mach 2.2 with 55~75-passengers.<sup>10)</sup> As of June 2020, they have been working on producing the “XB-1,” which has a reduced aircraft size from the “Overture,” for engineering testing. They are targeting a Summer 2020 rollout for the “XB-1”, and the start of flight tests in the mid-2020s for the “Overture”.<sup>11)</sup>

Because the cruising speed of the “Overture” is faster than it is for the Concorde, sonic booms on the ground level due to the shock waves arising in the air will be a problem. Therefore, like the Concorde, “Overture” is expected to fly at supersonic speeds only when at sea and at subsonic speeds on land. Regarding the issue of fuel consumption, the “Overture” is expected to fly at supersonic speeds without the installation of an afterburner on its engine, just like the “AS2” from Aerion. However, as the “XB-1” is a plane built for technical demonstrations, an afterburner

will be installed since its GE engine is diverted from a military plane. The actual engine to be installed on the “Overture” has not yet published as of June 2020.

Boom has announced that they will be the first aircraft manufacturer in the world to achieve carbon neutrality by utilizing carbon offset and Sustainable Aviation Fuel (SAF) in its pilot program for the “XB-1.”<sup>12)</sup> In June 2019, Boom also published that they will cooperate with Prometheus Fuels, a SAF start-up company in California for ground tests and flight tests of the “XB-1.” They will develop fuel with zero additional CO<sub>2</sub> emissions by employing technology to directly absorb CO<sub>2</sub> from the air (called Direct Air Capture) and using renewable energy, such as generated solar and wind power.

Regarding the status of production of the “XB-1”, it was posted on Boom’s website in April 2020 that the main wing and body have been joined. Flight tests for the “XB-1” are planned to be held at the Mojave Air & Space Port in California after rollout, and the results will be reflected in the development of the “Overture.”

### 3. Conclusion

These 3 development projects of civil supersonic aircraft, mentioned in Section 2, have been targeting to commence commercial operations in the middle or later part of the 2020s.

The 3 companies have different approaches to handling the problem of sonic boom, which had been an issue for the Concorde. Like the Concorde, Boom’s “Overture” flies at supersonic speeds only at sea, and thus it is not affected by the prohibition of supersonic flight by FAR. This regulation needs to be mitigated in some way for Aerion’s “AS2” and Spike’s “S-512.”

Regarding the issue of fuel consumption, which had also been a problem for the Concorde, these projects take technological measures to fly at supersonic speeds without installing afterburners on their engines. In addition to this, they have been focusing on trying to remove the stereotype that “supersonic aircraft is not environmentally friendly.”

The Federal Aviation Administration (FAA), the U.S.’s aviation safety authority, published a proposed rule for

the revision of FAR in June 2019 in response to the development projects of civil supersonic aircraft,<sup>13)</sup> which I will write about in greater detail in a separate report.

### References

- 1) FAA, Type Certificate Data Sheet No. A45EU  
[https://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgMakeModel.nsf/0/B1C629AE866297538625768000667AF2?OpenDocument](https://rgl.faa.gov/Regulatory_and_Guidance_Library/rgMakeModel.nsf/0/B1C629AE866297538625768000667AF2?OpenDocument)
- 2) FAA, Type Certificate Data Sheet No. A23WE  
[https://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgMakeModel.nsf/0/5342E492984E8616862576AC0055FEB3?OpenDocument&HighLight=1-1011](https://rgl.faa.gov/Regulatory_and_Guidance_Library/rgMakeModel.nsf/0/5342E492984E8616862576AC0055FEB3?OpenDocument&HighLight=1-1011)
- 3) Aerion Supersonic  
<https://www.aerionsupersonic.com/>
- 4) Consumer News and Business Channel (CNBC), “Jet builder Aerion expects to fly silent supersonic planes by 2024, unlocking a \$40 billion market”  
<https://www.cnbc.com/2020/01/16/aerions-as2-silent-supersonic-jet-aims-to-fly-by-2024.html>
- 5) Aerion Supersonic, “GE’s Affinity: The first civil supersonic engine in 55 years - launching a new era of efficient supersonic flight”  
<https://www.aerionsupersonic.com/news-media/press-release/ge-affinity-the-first-civil-supersonic-engine-in-55-years-launching-a-new-era-of-efficient-supersonic-flight/>
- 6) Aerion Supersonic, “Boeing Partners with Aerion to Accelerate Supersonic Travel”  
<https://www.aerionsupersonic.com/news-media/press-release/boeing-partners-with-aerion-to-accelerate-supersonic-travel/>
- 7) Aerion Supersonic, “Governor Ron Desantis announces Aerion Supersonic will move global headquarters to Florida”  
<https://www.aerionsupersonic.com/news-media/press-release/governor-ron-desantis-announces-aerion-supersonic-will-move-global-headquarters-to-florida/>
- 8) Spike Aerospace  
<https://www.spikeaerospace.com/>
- 9) Spike Aerospace, “Supersonic Flights: Sustainable, responsible and Game Changing Transportation”  
<https://www.spikeaerospace.com/supersonic-flights-sustainable-responsible-and-game-changing-transportation/>
- 10) Boom Technology

<https://boomsupersonic.com/>

11) Boom Technology, “Frequently asked questions”

<https://boomsupersonic.com/contact#faq-section>

12) Boom Technology, “Boom Supersonic Announces First Fully Carbon-Neutral Aircraft Program, XB-1”

<https://boomsupersonic.com/news/show/carbon-neutral-aircraft>

13) FAA, “Fact Sheet - Supersonic Flight”

[https://www.faa.gov/news/fact\\_sheets/news\\_story.cfm?newsId=22754](https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=22754)