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Hermeus Is Plugging An F-15 Engine Into its Hypersonic Test Aircraft

Eric Tegler Contributor

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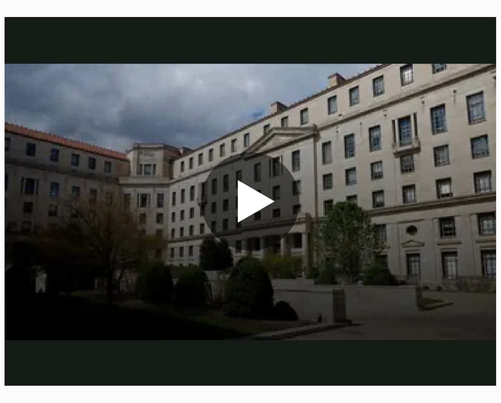

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Hermeus will use Pratt & Whitney's F100 as part of its TBCC propulsion system for the company's ... [+] HERMEUS

Atlanta-based hypersonics firm, Hermeus, has just taken delivery of an F100-229 engine from Pratt & Whitney. Best known for powering USAF F-15 Eagles and F-16s, the F100 will propel Heremeus' hypersonic Darkhorse aircraft to Mach 2.8 on the way to Mach 5.

Hermeus announced receipt of its first Pratt & Whitney engine early this month. "We always knew that we were going to larger and more modern gas turbine engines with better thrust than the J85," company CEO, AJ Piplica, told me.

The need for a more powerful conventional powerplant for Hermeus' turbine-based combined cycle engine (TBCC) falls into line with the company's march from a small, remotely-piloted Quarterhorse test aircraft to a larger reusable hypersonic UAS called Darkhorse and, at some point in the future, to a 20 passenger hypersonic aircraft called Halcyon.

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In simple terms, a TBCC is a hybrid between a turbine engine and a ramjet, allowing for both low-speed and high-speed operation, i.e takeoff, cruise and landing. Hermeus calls its TBCC propulsion system Chimera. The company is using Quarterhorse to validate Chimera - which employs the relatively small 5,000-pound thrust General Electric J85 in tandem with a ramjet - to reach Mach 4-plus speeds.

Darkhorse will be a versatile aircraft capable of acting as a payload-carrying hypersonic testbed as well as an operational unmanned aircraft for defense and intelligence customers. It will use a scaled-up Chimera II propulsion system which pairs Pratt & Whitney's 29,160-pound thrust F100 with an in-house developed ramjet (inlet, precooler, ram burner, and bypass system) to reach hypersonic cruise speeds.

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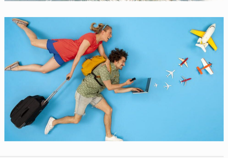

Darkhorse will rely on the F-15 engine for takeoff, climb to cruise altitude and acceleration to Mach 2.8 (approximately 2,131 mph). Once that speed is attained it will shut down as the ramjet takes over, accelerating Darkhorse to Mach 5-plus (approx. 3,806 mph) cruise. Once the cruise segment is completed, the aircraft decelerates and at the appropriate subsonic speed and altitude, the F100 is fired back up to bring Darkhorse back to land.

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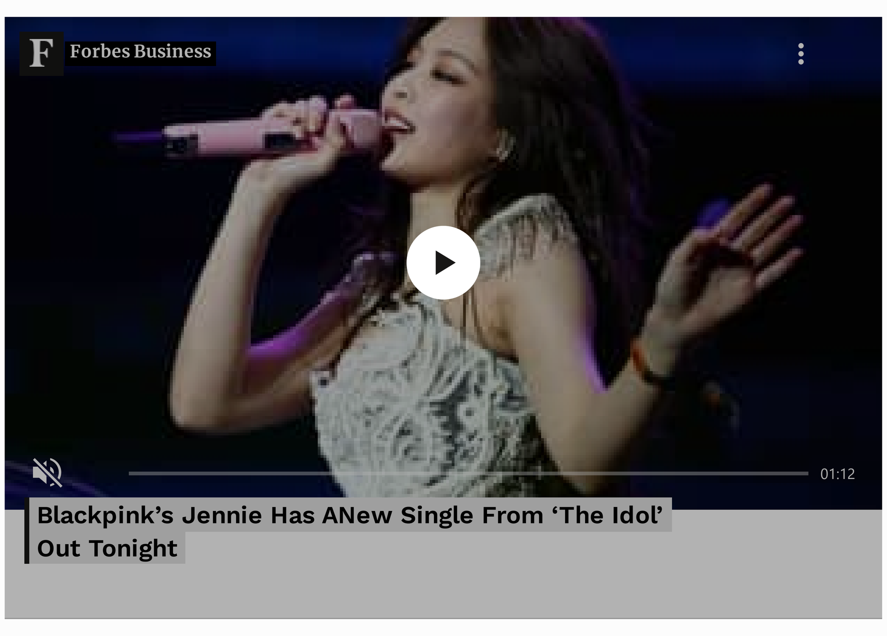
Piplica adds that Hermeus' plan was always to use an off-the-shelf engine as it has done for Quarterhorse. "We looked at a wide swath of military engines in the [relevant] class. We were happy to select the F100 given that it was developed for the F-15 and the top speed of that aircraft is around Mach 2.5. That aligns well with the way we plan to use the engine in Chimera II."



The F100's digital control system is a big step forward from the fully analog control system of the J85 (originally designed to propel a large decoy missile) which powers the Air Force's venerable T-38 Talon advanced trainers. Its software architecture should allow for smooth integration with the Hermeus ramjet and efficient transition between TBCC modes.

Given that the F100 will theoretically accelerate Darkhorse to nearly Mach 3 three on every flight, I asked Piplica about Hermeus' expectations for its fatigue-life. He acknowledged that the company won't have a solid answer until it begins engine testing (slated for 2024).

"That said," he continued, "we're not going to be operating this engine for long cruise periods. The engine will operate in max afterburner mode for a couple minutes at the beginning of the flight and once we get to about Mach 3 the engine will be fully bypassed so it will spool down and cool down."

While this bears some similarity to the way the F100 is used for high gross weight takeoffs and supersonic dashes in the F-15, the impact of max afterburner cycles on every flight may have implications for engine life and as a result, cost. Reusable hypersonic aircraft will surely have great potential utility but they won't likely come cheap.

The relative size of the F100 which will go into Darkhorse and the J85 which fits into Quarterhorse ... [+] HERMEUS

Piplica stresses that the iterative approach his company is taking with Quarterhorse and Darkhorse will inform them on F100 life cycles and cost well in advance of operational use of their aircraft. Given the hypersonic cruise flight segments that Darkhorse is expected to undertake, the reliability and fatigue life of the overall Chimera II TBCC system will have to be better understood.

The F100 will dictate the size, particularly the cross-sectional area, of Darkhorse. That, and the fuel necessary to allow it to climb-cruise to hypersonic speeds, likely means it will be "fighter jet-sized" Piplica says, comparable to the F-16 or T-7 Red Hawk for example. Ultimately, its performance and cost will dictate demand for Darkhorse and for F100 cores.

At present Piplica expects that Hermeus will use "a couple dozen" F100s in the Darkhorse test and development program. If it pans out as a valued platform for test payloads, ISR and potentially strike applications, it could represent a meaningful source of business for Pratt & Whitney.

With decreased demand for the engine given the Air Force's desire to retire older F-15s and F-16s, a different powerplant choice for the F-15EX (GE's F110), and new tactical aircraft designs requiring higher thrust/efficiency, it's ironic that the F100 could find continued life as a key hypersonic platform enabler.

Chris Johnson, vice president of Fighter and Mobility Programs at Pratt & Whitney recently reflected on the F100's 50 years of service, 30 million flight hours and its potential with Darkhorse. Decades ago, who would have imagined that plugging an engine developed in the early 1970s into a 21st century UAS could be the fastest route to a reusable hypersonic aircraft?

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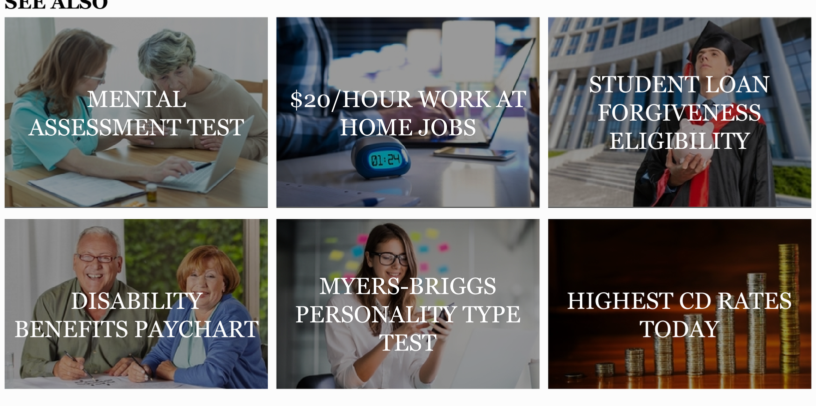

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