Teledyne J402

Outlook

- The J402 is a small, lightweight turbojet used in missiles
- Teledyne announced in 2021 that it had exited the small turbine engine market
- Engines used in U.S. missile programs are likely now drawn from stocks of refurbished engines already in inventory

Orientation

Description. Small, axial-centrifugal-flow, single-shaft turbojet engine.

Sponsor. The J402 was sponsored and funded by the U.S. Department of Defense, with initial program management provided by the U.S. Navy.

Power Class. The J402 series is rated at 640-960 lbst (2.84-4.27 kN). Other engine models under the overall J402 umbrella are maximum-rated at 1,120 lbst (4.98 kN).

Status. Production suspended

Application. Cruise missiles, drones, remotely piloted vehicles (RPVs), and other unmanned air vehicles (UAVs).

Price Range. Estimated at $116,700.

Contractors

Prime

Teledyne Turbine Engines	http://www.tbe.com, 1330 W Laskey Rd, Toledo, OH 43612-0971 United States, Tel: + 1 (419) 470-3000, Fax: + 1 (419) 470-3052, Prime Defunct

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 75 Glen Road, Suite 302, Sandy Hook, CT 06482, USA; rich.pettibone@forecast1.com

Teledyne J402

Technical Data

Design Features

Intake. Annular intake with bulletdome that acts as a bearing housing for the compressor shaft. Air inlet housing is of C355 material.

Compressor. The single-stage, transonic axial-flow compressor, followed by a single-stage centrifugal compressor, provides a pressure ratio of 5.6:1 at a compressor air mass flow of nearly 9.6 lb/sec (4.35 kg/s) for the J402-CA-400. The compressor ratio for the J402-CA-701 is 6.2:1; for the J402-CA-702, it is 8.5:1. Both stages are integrally cast of 17-4 PH. Rotor speed is 41,200 rpm. Radial diffuser and axial diffuser are of N-155 and IN718, respectively.

Combustor. An annular combustor housing of IN718 with a shell of N-155 is fed by a centrifugal fuel slinger of 17-4 PH. A pyrotechnic starter and igniter are used for ignition.

Turbine. A single-stage axial-flow turbine, integrally cast of IN100. The nozzle is also integrally cast but utilizes N-155, as does the exhaust duct.

Fuel Control. Electronic fuel control automatically sequences and regulates flow to meet mission requirements. The fuel pump is of centrifugal design and is located in the exhaust tail cone as part of the integrated fuel control hydraulic package.

Applications. Current or proposed applications include the following:

Engine Variant	Power or Thrust Rating	Application	Engines per Airframe
J402-CA-100-2		Lockheed Martin JASSM Block 1 (early production)	1
J402-CA-100-9B		Lockheed Martin JASSM Block 1 (later production)	1
J402-CA-400	660 lbst (2.9 kN)	Boeing AGM/RGM/UGM-84 Harpoon/SLAM/SLAM-ER	1

Variants/Upgrades

J402-CA-100. Despite the lower suffix number, this is a more recent variation of the J402. It was developed to power the Tactical Tomahawk cruise missile at the same thrust equivalent as the -700, from which it is derived. The first axial compressor stage and the turbine section are both aerodynamically refined. In December 1999, Raytheon dropped this engine from the Tactical Tomahawk after citing its inability to meet the required combination of fuel efficiency and maximum thrust. It now powers the JASSM Block 1 missile.

J402-CA-400 (Model 370). The J402-CA-400 is a low-cost engine for Harpoon missiles. The power rating is 660 lbst (maximum) at 41,200 rpm, and the engine life is slightly greater than one hour. The system's approximate weight is 102 pounds (46.3 kg).

J402-CA-401 (Model 370-1). The J402-CA-401 is a derivative of the J402-CA-400 that features a longer-life turbine, an external oil supply, and a coated combustor with provision for a 3.2-kW alternator.

J402-CA-700 (Model 372-2). The J402-CA-700 is another low-cost engine variant that is used by the Beech MQM-107A Streaker target. It is essentially the same as the J402-CA-400, but differs in respect to its engineering and equipment and has an engine life of 15 hours. The engine is maximum-rated at 640 lbst at 40,400 rpm. The system's approximate weight is 113 pounds (51.3 kg).

J402-CA-701 (Model 372-11A). The J402-CA-701 is a slightly uprated variant of the J402-CA-700 that has provision for a 4-kW DC generator, which is regulated through a power conditioning unit. The engine is maximum-rated at 725 lbst at 42,000 rpm. The system's approximate weight is 113 pounds.

J402-CA-702 (Model 373-8). The J402-CA-702 develops 960 lbst (maximum) at 41,500 rpm. Airflow is 13.7 lb/sec (6.21 kg/s), and EGT is 1,400°F (760°C). The engine weight is 138 pounds (62.5 kg). It powers the MQM-107D Streaker and the NV-144/NV-151.

Program Review

Background. The Teledyne J402 is a low-cost, expendable turbojet based on the company's J69 turbojet, which is itself a derivative of the Turbomeca Marbore. The J402 is actually a modified J69 that is designed for a wide range of missiles, target drones, and remotely piloted vehicles. Its chief application was originally the U.S. Navy's Harpoon cruise missile. By winning a spirited competition with (then) Garrett AiResearch in 1972, Teledyne climbed aboard one of the fastest paced military programs of all time.

Design and development of the J402 began with the modification of the supersonic J69-T-406 powerplant of the BQM-34 Firebee I/II system. By using an extensive computer design, the J69 was ultimately reduced to 32 percent of the original J69 envelope, but improved upon the former's low thrust-to-weight ratio through the use of investment castings. As a result, the J402 rotor has only 16 parts, as opposed to 149 parts in the J69. Another example of the simplicity inherent in the design is the use of a pot-lubricated bearing and a grease-packed rear roller bearing instead of a circulating lubrication system, which adds weight, complexity, and, most importantly, cost to the system. Teledyne has also improved the engine's life by adding fuel-mist lubrication to the rear bearing.

The J402's prime features are a very small frontal area, ease of maintenance of accessories, and high reliability, notwithstanding the 15-hour design life.

Current Applications

Boeing Harpoon Missile. The Boeing Harpoon all-weather, anti-ship cruise missiles are turbine-powered, low-flying missile systems that are used worldwide. The missiles weigh 1,145-1,503 pounds (520-683 kg) and have a range of approximately 54 nautical miles (100 km).

Since the early 1970s, when Harpoon missile system development began, the missile series has spawned many variants and several modes of firing. The current production model is known as the Harpoon II. The Navy launched a Block III enhancement package in 2008 but later abandoned the effort.

Lockheed Martin JASSM. The Lockheed Martin AGM-158A Joint Air-to-Surface Stand-off Missile (JASSM), powered by a single J402 engine, is 14 feet (4.27 m) long and weighs approximately 2,250 pounds (1,022 kg). The subsonic missile uses body shaping for low observability, and features folding wings and fins. Midcourse guidance is provided by an internal navigation system, with GPS assistance, using a zero-steering antenna for jamming protection.

On the AGM-158B JASSM-ER variant, also known as the Block 2 JASSM, the J402 engine is replaced with a Williams International F107-WR-105 turbofan.

Forecast Rationale

Teledyne announced in 2021 that it had exited the small turbine engine segment.

The J402 turbojet program had two applications: Lockheed Martin's JASSM Block 1 cruise missile and Boeing's Harpoon anti-ship missile.

The U.S. Air Force has altered its procurement plan for the JASSM, and it now plans to buy only the extended-range JASSM-ER. This model is powered by a Williams F107 turbofan in place of the J402, so the JASSM program no longer needs a large number of new J402 engines.

The Harpoon is currently the standard anti-ship missile of the U.S. Navy, and it remains popular with export customers. While it could furnish demand for new engines down the road, we believe that the program is currently using refurbished engines taken from existing inventory rather than buying new-build engines. For the time being, we are not forecasting production of new J402 engines.

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