

PBS TJ100 Jet Engine for UAVs and Target Drones

První brněnská strojírna Velká Bíteš, a.s. (PBS) has been a leading manufacturer of products and equipment for the international aerospace industry for almost 50 years. The unique ability of PBS to carry out in-house development, manufacture and testing of aircraft products in accordance with global aerospace standards have greatly contributed to its enduring success on the global market. A Quality and Environmental Management System that complies with ISO 9001, AS 9100 and ISO 14 001 manages its modern manufacturing processes. Moreover, it holds Design Organisation Approval (DOA) and Production Organization Approval (POA) for aerospace products according to Part 21, Section A, Subpart J, G.

A long history in aerospace manufacturing

The aerospace programme at PBS began with the manufacture of Auxiliary Power Units (APU) and environmental control systems (ECS) for aeroplane and helicopter manufacturers around the world. After gaining valuable experience in these areas, it expanded its product range to include main power units – turbojet and turboshaft engines for small, manned / unmanned aeroplanes and helicopters.

Designing a unique, job-specific turbojet engine

Following on the heels of its main power unit production program was development of the TJ100 turbojet engine. The TJ100 is a single-shaft engine that features a starter generator integrated in the radial compressor impeller, one axial turbine, autonomous fully aerobatic oil system and digital control system. Apart from the ignition device and stop valve, all accessories are integrated in the engine for easy and convenient build-up. Key features of the engine are its compact size, lightness, reliability, wide starting envelope and low consumption of fuel and oil. Development of the TJ100 to achieve 1,000N of thrust began in 2001 and its first serial production engine was bought by INTA in 2004.

Increased thrust and modifications for worldwide UAV and Target Drone use

Subsequent development and new innovations to the TJ100 increased thrust to 1,100N. Modifications were also carried out according to the needs of individual customers and UAV applications. To date, 611 engines have been delivered for various applications (especially target drones) to customers in Spain, China, United Arab Emirates, Russia, Pakistan, Germany, Saudi Arabia, and the USA.


Further performance upgrades and refinement

To expand its potential applications, engine thrust and end-use properties required further development:

- Increase thrust to 1,300 N
- Extend service life from 50 to 300 hours
- Reduce specific fuel consumption
- Expand flight envelope from 8 to 10 km
- Increase maximum airspeed from 0.8 M to 0.9 M

Key advantages of the TJ100 turbojet engine:

- Excellent thrust-to-weight ratio
- Performance parameters confirmed with altitude chamber testing at CIAM (Central Institute of Aviation Motors) in Moscow

MAIN PARAMETERS		JET ENGINE TJ100
Thrust: take - off (max. 5 min.)	1,300 N	
Power supply	24 V DC	
Electrical power output	750 W	
Specific fuel consumption (at max. thrust)	≤ 0.112 kg/N/h	
Dimensions and weight		
Outside diameter	272 mm	
Engine length	625 mm	
Engine weight	19.5 kg	
Operating range		
Max. operating altitude	10,000 m	
Max. starting altitude	8,000 m	
Flight speed range	< Mach 0.8	
Speed range for start-up	< Mach 0.6	
Temperature operating range	-40°C to + 50°C	

A limiting factor was the requirement to keep the engine's external dimensions the same. Therefore, a new development project was launched in 2012 with the objective of reaching the above stated parameters. Above all, it was necessary to design new flow parts. Proven PBS design methods were utilized to carry out thermodynamic calculations and design rotor and stator parts of the compressor and the turbine stage. Other key modifications included a new version of the combustion chamber and a more powerful fuel pump and fuel nozzles. Out-of-pack aluminizing technology was applied to stator and rotor turbine wheels.

Fully tested and verified

After producing and testing all individual components, an operational prototype was assembled. The prototype was subjected to ground bench tests on the PBS test bench and achieved the target values for thrust, fuel consumption and service life. Verification of the starting and flight envelopes proved to be very challenging, both from organizational and financial points of view. It was originally intended for the engine to be tested in a special container mounted to an L-159 jet. These tests, however, proved to be impractical in Czech Republic airspace. Therefore, the company contacted the Central Institute of Aviation Motors (CIAM) in Moscow, which has a thermo-baro-chamber for testing aircraft engines. This system simulates environmental conditions – temperature, pressure and airspeed - for the specified flight level. The engine achieved the required values within the entire flight envelope, limited by a height of 0 to 10,000 m and airspeed of 0 to 0.88 M. Starting ability was verified up to the height of 8,000 m and airspeed of 0.6 M. Valuable operational data were acquired thanks to the tests in the thermo-baro-chamber. These data have been used not only for the internal verification of the engine's characteristics, but also to inform customers about the flying qualities of the TJ100.

Optimized and performance enhanced for UAV and Target Drone use

Today's TJ100 Turbojet Engine from PBS has been purpose-designed, refined and optimized for use in UAVs and Target Drones. It is a high performance engine with an excellent weight/thrust ratio, extended service life and low fuel consumption. Currently ranked as one of the best small turbojet engines in the world, it is an intelligent choice for lightweight air vehicles around the world.

