



# PBS JOURNAL





**Ing. Petr Motýl Ph.D.**  
PBS INDIA

## PBS STRENGTHENS ITS POSITION IN THE INDIAN MARKET

PBS is a major European manufacturer in the aerospace, power, energy and machinery industries.

At PBS we are very aware that India will soon become the most populated country in the world and we recognise the importance of its role in the world economy.

The rate of growth of GDP in the Republic of India is one of the fastest in the world while the country's economic growth remains stable. PBS are delighted to witness the relationship between India and the Czech Republic develop in a very positive fashion and can confirm that our company has received a tremendous welcome from our Indian customers who have been very cordial and welcoming. PBS has many customers in India whom we value very highly. We have established good relationships with the Government bodies and also with many of the major Indian companies, especially in the field of aircraft devices. Our aim is to develop these relationships further and it is for this reason, we have decided to develop and strengthen our local position.

Potential Indian customers and representatives from the defense forces are visiting our production plant in the Czech Republic on a more frequent basis and our relationships continue to grow. This can be witnessed from our corporation with the Czech Ministry of Foreign Affairs when the President of India visited Prague and when we attended a meeting of the Czech-Indian Heavy Engineering Joint Working Group. We have had long-term support from the Czech Embassy in Delhi, the Czech Trade office and the Czech consulate offices in Bangalore and Mumbai.

In India and South-East Asia our aircraft devices are particularly suitable for the helicopters, which are used by the local air forces. As for our Safir auxiliary power units, we are ready to provide the Indian air forces with overhauls of their helicopters, support and other services. Big opportunities may also arise for the supplying of our jet engines in the field of UAV's, flying targets and missiles.

Simultaneously, PBS's products in the fields of precision casting and cryogenic technology are becoming more and more successful in the Indian market.

We intend to develop our business activities in India primarily in the fields of aerospace, precision casting and engineering and while our principal products are aircraft engines, auxiliary power units (APUs) and environmental control systems, including services and service activities, we also have a number of customers in the field of cryogenic technology. Our products can be used, for example, in Indian space exploration and science programmes. Our company has its own leading European precision casting foundry, and we are a reliable supplier of castings for power engineering, transportation, aviation and glass industries. PBS also provides galvanic surface treatments and high-precision machining including titanium alloys. Last but not least, especially in Europe, we supply steam backpressure and condensing turbines, expansion gas turbines and industrial boilers.

Our products and services are much sought after by customers from all over the world, notably from within the aviation, power engineering and transportation industries. We are an export company and understand the Make in India principles.

The potential of the Indian market is so important for PBS that we have decided to invest in activities which give even greater support to our permanent presence in this growing market. We are really looking forward to developing a mutually beneficial cooperation with our new Indian customers.

**Ing. Petr Motýl Ph.D.**  
**Member of the Board, PBS INDIA**

## ABOUT PBS

PBS INDIA is a member of PBS GROUP, a.s. - stable, high quality and innovative engineering company that has been active in the field of high precision engineering for over 200 years. The key area for PBS is aerospace engineering: in-house development, production, testing and certification of small turbojet, turboprop and turboshaft engines, auxiliary power units (APU's) and environmental control systems (ECS).

Thanks to the excellent thrust-to-weight ratio and a guaranteed thrust range of 400 – 1,500 Newtons, PBS turbojet engines, currently rank in their category among the best in the world. Auxiliary Power Units (APU) and Environmental Control Systems (ECS) are proven in thousands of aeroplanes and helicopters worldwide.

The PBS quality management system is certified in accordance with ISO 9001, AS 9100, ISO 14001 and Nadcap. In addition, PBS is a holder of Design Organisation Approval (DOA), Production Organisation Approval (POA) and Maintenance Organisation Approval (MOA) issued by the European Aviation Safety Agency (EASA).

The PBS manufacturing programme further includes precision casting, precision machining, surface treatment and cryogenic products.

# AEROSPACE PRODUCTS

PBS has designed and successfully launched a series of high-quality and reliable aerospace products:

## Small turbine engines

are designed for UAVs, target drones, missiles, experimental aircraft and ultralight helicopters.

## Auxiliary Power Units (APU)

are designed to deliver compressed air for starting the main engines and to supply electrical power to the aircraft's onboard systems.

## Environmental Control Systems (ECS)

are designed to maintain a comfortable thermal environment in the cockpit, passenger cabin and cargo holds of aircraft and helicopters during ground operations and all flight modes.

	ADVANTAGES	CIVIL & COMMERCIAL	MILITARY & DEFENCE
<b>TURBOJET ENGINES</b>  <b>1000+</b> flying worldwide	<ul style="list-style-type: none"> <li>→ Excellent weight/thrust ratio</li> <li>→ Compact design</li> <li>→ Low fuel consumption</li> <li>→ Electric starting system</li> <li>→ Ground or in-flight restart</li> <li>→ Short starting sequence</li> <li>→ High variability in starting positions/client requirements</li> </ul>	UAV → Micro-jets → Transport → Surveillance, Research	UAV → Target drones → Missiles → Tactical → Transport
<b>TURBOPROP TURBOSHIFT ENGINES</b> 	<ul style="list-style-type: none"> <li>→ Light &amp; compact design</li> <li>→ High static thrust</li> <li>→ High performance, low vibrations and low noise</li> <li>→ Both tractor/push configurations</li> <li>→ Stable operation in high altitudes and temperatures</li> <li>→ Ability to start in very cold conditions without preheating</li> </ul>	UAV <b>EXPERIMENTAL</b> → Small personal aircraft → Small helicopters	UAV <b>TRAINER &amp; COMBAT</b> → Small aircraft → Small helicopters
<b>AUXILIARY POWER UNITS (APU)</b>  <b>5500+</b> installed and operating	<ul style="list-style-type: none"> <li>→ Supplies power + compressed air</li> <li>→ Unlimited number of main engine starts</li> <li>→ Continuous operation for up to 6 hours</li> <li>→ Easy maintenance</li> </ul>	<b>Civil aircraft:</b> L-39 Albatros L-159 ALCA  <b>Helicopters:</b> Mi-8/17/171	<b>Trainer aircraft:</b> L-159 ALCA L-39 Albatros  <b>Military helicopters:</b> Mi-8/17/171
<b>ENVIRONMENTAL CONTROL SYSTEMS (ECS)</b>  <b>7000+</b> installed and operating	<ul style="list-style-type: none"> <li>→ All-in-one cooling and heating</li> <li>→ Low weight, compact design</li> <li>→ No electricity requirements</li> <li>→ Ecological - no refrigerant</li> <li>→ Variability according client needs</li> </ul>	<b>Civil aircraft:</b> L-39 Albatros L-159 ALCA L-39 NG  <b>Helicopters:</b> Mi-8/17/171	<b>Civil aircraft:</b> L-39 Albatros L-159 ALCA L-39NG  <b>Helicopters:</b> Mi-8/17/171

# PRECISION CASTING

We cooperate with the world's leading manufacturers of turbochargers, combustion turbines, aviation components and insulation materials based on glass wool.

We are one of the leading European foundries focusing predominantly on precision casting with more than 50 years of experience. Currently, the production program consists mainly of: blades and segments of stationary gas turbines, turbocharger wheels for automotive, impellers and guide wheels for aircraft engines and spinner discs for the glass industry. We also deliver femoral components for the health sector.

- Air or vacuum casting
- From carbon steels to nickel or cobalt superalloys
- Range of casts dimensions: 50.8–520.7 mm
- Weight range of casts: 0.15–80 kg
- Most technically advanced products with maximum durability

AEROSPACE & AUTOMOTIVE	POWER INDUSTRY	TRANSPORTATION	INSULATING MATERIALS MANUFACTURERS
Impellers and guide wheels for aircraft engines, APU and casting parts for ECS	Gas turbine buckets and nozzles	Turbocharger wheels and blades	Spinner disks
<b>Impellers diameter:</b> 60 - 260 mm  <b>Impellers weight:</b> max. 2.5 kg  <b>Material used:</b> IN 713LC, MAR M247, IN 792-5A	<b>Blades lengths:</b> 50 - 400 mm  <b>Blades weight:</b> 0.1 - 30 kg  <b>Material used:</b> EEQ 111, FSX 414, IN 939, IN 738LC, MAR M247	<b>Wheel diameter:</b> 50 - 400 mm  <b>Wheel weight:</b> 0.15 - 44 kg  <b>Material used:</b> IN 713C, IN 713LC, B1914, MAR M247	<b>Spinner disk diameter:</b> 300 - 520 mm  <b>Spinner disk weight:</b> 9 - 30 kg  <b>Material used:</b> Ni and Co based superalloys for the glass industry:  141I, 141J, 2.4879, Co Stellite
			

## EQUIPMENT

Thanks to the state-of-the-art machinery we are able to provide our clients with top quality castings for the production of their products.

Technology available in our foundry:

- 10 injection moulding machines
- 2 robotic coating lines
- 2 boilerclaves for smelting
- 4 carousel gas annealing furnaces
- 2 electronic resistance annealing furnaces
- 7 vacuum furnaces
- 9 blasting machines

## ADDITIONAL SERVICES

Special types of heat treatment:

- In a protective atmosphere of argon, nitrogen or vacuum
- Hot isostatic pressing (HIP)
- Machining and balancing
- Production of model equipment
- Manufacture of ceramic cores
- Leaching of ceramic cores
- 3D measurement
- Testing in our own or independent laboratories
- Non-destructive tests certified by NADCAP

# PBS - OTHER PRODUCTS AND SERVICES

In our production plant, which extends to 6,600 m<sup>2</sup>, we perform a wide range of production operations. We have a huge fleet of machines as well as up-to-date process equipment available. Thanks to the combination of specialized operations under “one roof” we are able to save our clients both time and logistic expenses.



## PRECISION MACHINING

We dispose of advanced modern technologies and experienced staff for engineering operations like turning, milling, balancing, grinding, sputtering, drilling, welding and assembly.



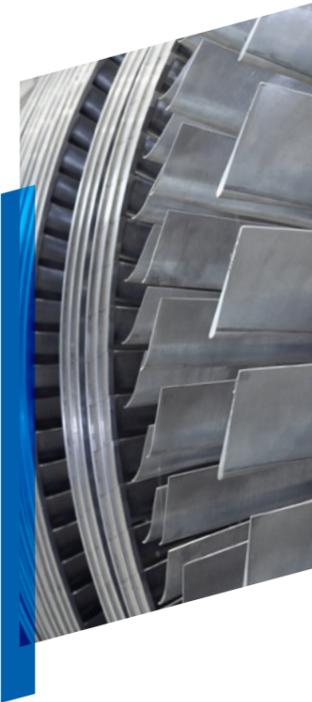
## SURFACE TREATMENTS

We are a leading supplier of galvanic surface finishes with a comprehensive range of services.



## CRYOGENIC TECHNOLOGY

We are a major supplier of cryogenic compressors and pumps for the world's leading manufacturers of cryogenic systems.



## POWER ENGINEERING

We develop, design and implement turbines and industrial boilers. We also provide a comprehensive range of services and equipment reconstruction.



PBS factory in Velka Bites, Czech Republic

# TRADITIONAL CZECH COMPANIES ARE WELL KNOWN IN INDIA, AND PBS IS AMONG THEM

Czech companies have a good reputation in India. Knowledge of traditional companies and awareness of the high quality of their products have had roots in the Indian market since the existence of Czechoslovakia in the first half of the 20th century. The Czech Republic, as a successor state of Czechoslovakia, celebrated its 100 year anniversary just over a year ago. However, the tradition of PBS is much longer. The company was founded more than 200 years ago and it has focused on the development of aircraft devices for more than half a century.

Many Czech companies have been well known in India for a long period. In the first half of the 20th century, when Czechoslovakia still existed, traditional Czech brands built a good reputation for the Czech industry there. It is interesting that some people in India believe that a shoe manufacturer and seller Bata is an Indian company. It is not surprising that a few years ago, one of the new underground stations in New Delhi was named after this giant of Czechoslovakian industrial history. Also other companies, such as Škoda, the Czech manufacturer of cars, have a good reputation in India. Radar systems from another Czech company, Eldis, protect almost 90 % of Indian airspace today.

## History of PBS

PBS is one of the traditional Czech companies. At the same time, its history is much longer than the existence of the Czech Republic or Czechoslovakia. It was founded in 1814. The main production programme progressively became the manufacturing of steam engines, boilers and turbines. PBS developed its own steam engine 10 years after its foundation

and became one of the biggest industrial companies in Austria-Hungary at the beginning of the 20th century. At first, the company mainly produced steam turbines on the basis of a Parsons licence, but later PBS came up with its own solutions, which allowed an increase in power output and efficiency.

PBS started to operate in the field of aircraft devices in the second half of the 20<sup>th</sup> century. The company commenced development of air generators and auxiliary power units (APUs) in the 1970s. Development of jet engines started in 2001, and 3 years later PBS dispatched the first serial PBS TJ100 engine to INTA, the Spanish manufacturer of training targets. Since then, PBS has extended the range of jet engines to 5 types, with a number of individual customised modifications in the power category from 230 to 1,500 N of thrust.

## PBS in the Indian market

Like other Czech brands, PBS is highly respected in the Indian market where there is a considerable level of interest from

Indian companies interested in business cooperation. The company has established good relationships not only with the state administration and defence forces of India, but also with significant Indian companies, above all with those operating in the field of aircraft devices. PBS is also increasingly found in the precision casting industry on the Indian market.

## Cooperation between India and the Czech Republic

India has stable economic growth and a predictable political situation and is among the most significant business partners of the Czech Republic in Asia. The Indian market is one of the most important for PBS. Strong levels of communication and contact exists between India and the Czech Republic, even on a governmental level. The Indian president, Mr. Rám Náth Kóvind, visited the Czech Republic in 2018. PBS has also welcomed a large number of potential customers from the Indian market to its premises recently. Representatives from the Indian Ministry of Defence visited the PBS booth at the 2019 International Engineering Trade Fair in the Czech Republic.



Visit of the Indian Ministry of Defence representatives to the PBS booth, IDET 2019



## PBS HAS BEEN SUPPLYING AUXILIARY POWER UNITS FOR MIL HELICOPTERS FOR MORE THAN 20 YEARS

PBS has been developing and supplying small turbine drive units for the aerospace industry for half a century. The company celebrated the 20th anniversary of cooperation with the manufacturers of Mil helicopters in 2019. PBS mainly supplies the Safir 5K/G MI auxiliary power unit (APU), which triggers the main engines of approximately 150 Russian Mi-17 helicopters. PBS continually works on modifications of existing products, but the company also develops other devices for new types of helicopters as well as jet aircraft.

PBS has been developing and producing aircraft devices since the end of the 1960s. Its products include auxiliary power units (APUs) and environmental control systems (ECS) for various types of aircraft and helicopters. In the new millennium, the company also expanded the portfolio of its products to jet engines, which it develops primarily for unmanned aerial vehicles.

### 20 years of cooperation with Mil

PBS has implemented almost 6,000 APUs in total. Last year, the company celebrated the 20th anniversary of cooperation with the manufacturers of Mil helicopters for which it developed the Safir 5K/G MI APU. This APU has been designed for Russian Mi-8, Mi-17 and Mi-171 helicopters, which are among the

most successful helicopters in the world in terms of both the number of units sold and the number of countries in which they fly. You can find the Mi-17 in more than 60 countries, including India. About 150 Mi-17 helicopters with Safir 5K/G MI APUs fly there at present.

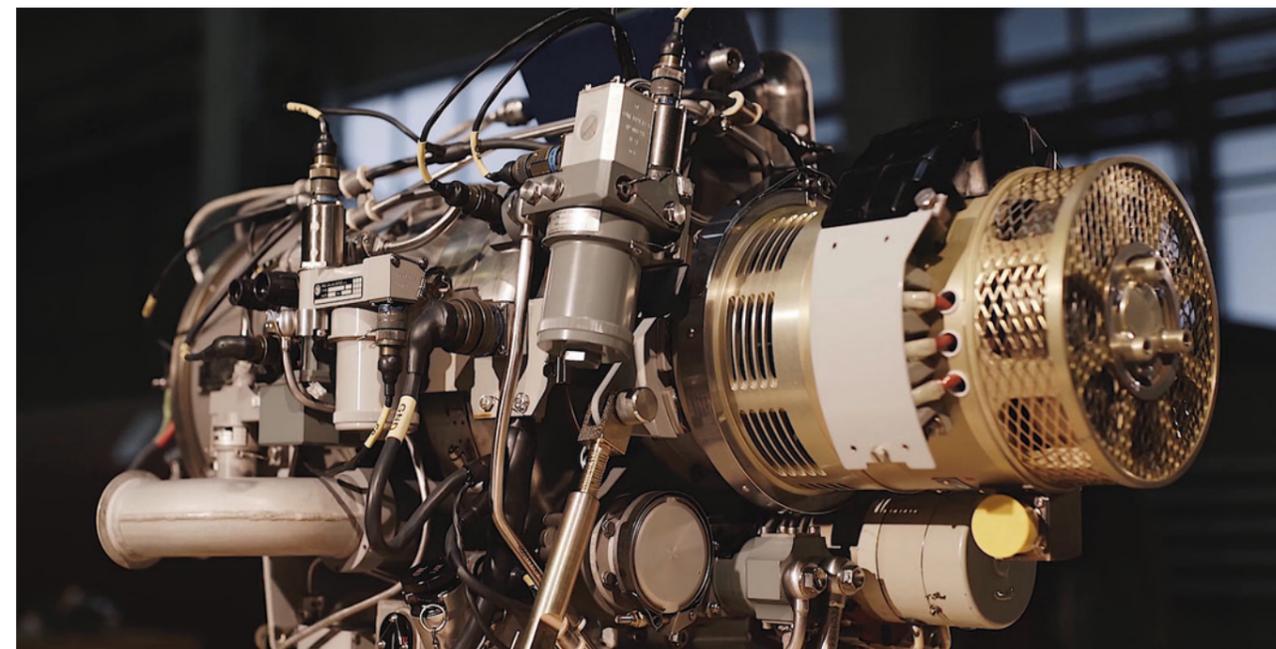
### History

The beginning of the development of the Safir 5K/G MI dates back to 1969, when PBS took over the development of the air generator for the L-39 Albatros aircraft. An APU with the designation Safir 5M resulted from the reconstruction of this generator. The Safir 5K unit for the newly designed L 610 aircraft and the Safir 5K/G for the L 610G aircraft were based on this APU. An APU with very good parameters was

created in this way. Representatives from the Mil design office and helicopter production plant from Kazan demonstrated their interest in this APU at the MAKS 1999 Aerospace Salon. They were looking for a substitution for the original APU in order to ensure a take-off ability in Mi-17 helicopters up to a height of 6,000 m. An APU with the new designation Safir 5K/G MI was tested successfully in the alpine environment of Tibet at an altitude of 6,300 m above sea level. The first supply of serial Safir 5K/G MI APUs took place in 2001.

### Devices for helicopters and jet aircraft

PBS APUs are especially suitable for civil and military helicopters, training and light combat planes, and business jet planes.



Applications in ground military forces or marine applications are also feasible. They are incorporated into various configurations not only in several types of helicopters, but also in training and light combat planes.

For example, the Czech L-159 ALCA plane is used among others, by Draken International for training American pilots. They were also found useful for another Czech plane, the L-39 Albatros, which is one of the most widespread training planes in the world. Currently, PBS is following up previous cooperation with the development and supply of several systems for the new generation of this aircraft, designated L-39NG. This includes, the environmental control system, some fuel system instruments, the EMG-200 starter generator, and other devices.

### World leader

The existing APU configurations from PBS production guarantee the possibility of continuous operation for up to 6 hours, and in the power category of up to 100 kW it is a world leader. This is documented by obtained and repeatedly defended DOA, POA and MOA certificates from the EASA. PBS is one of 4 companies worldwide in the APU segment which have obtained the aforementioned certificates.

### Development and innovations

PBS continuously invests in development and has high-quality technological support and development and testing capacities available. The company continually extends the time limits of overhauls for the Safir 5K/G MI, thus increasing its competitiveness. The company developed the relatively new EMG-200 starter generator for the Ansat helicopter, and sells

several dozen units a year at present. The CS-MIV environmental control system for the new type of Mi-171A2 helicopter is another example of successful development. This system is able to heat and cool

simultaneously, not only in the cockpit, but also in the cargo space of the helicopter. Modifications of this unit for other types of helicopter are planned in the future.



# MI-171A2 GAINS CERTIFICATION IN BOTH INDIA AND COLOMBIA

The Mil Mi-171A2 multi-purpose helicopter, which uses PBS's top selling APU Safir 5K/G MI and ECS-M1V air conditioning system has been certified for civilian use in both India and Colombia, setting the stage for the exportation of these systems for civilian use.

The certificates were issued by the Civil Aviation Authority of India and the Special Administrative Unit of Civil Aeronautics of Colombia, according to Russian Helicopters. The company has produced its first sample helicopter for Indian customers at its Ulan-Ude factory and is aiming to obtain additional certifications in China, South Korea, Brazil, Mexico, Peru and other countries.

Russian Helicopters commented that, "the helicopters have absolutely new capabilities for operation in high-mountain and

high-temperature areas. Also the cruising and maximum speed of the Mi-171A2 is 10 percent higher and the load capacity is 25 percent greater than those of serial Mi-8/17 helicopters".

PBS supplies the auxiliary power unit Safir 5K/G MI and air conditioning system ECS-M1V, for the Mi-171A2, which is pictured in the photograph alongside the Kazan Ansat helicopter, for which PBS provides the EMG-200 generator.

SEPANG, MALAYSIA - DECEMBER 03, 2018: Russian Helicopter, Ansat (up) and Mi-171A2



## LAUNCHING TWO JET ENGINES ONTO THE MARKET IN ONE YEAR

PBS has expanded its offer with a fifth type of jet engine covering a relatively wide power output spectrum from 200 to 1,500 Newtons of thrust.

In 2018, the company presented two second jet engines to the market, which is rather a curiosity in the aviation industry due to the difficulty of the process of design, manufacturing, assembly and testing of turbine aviation engines all of which, incidentally, the company accomplishes in-house.

The PBS TJ80 engine presented to the market in the first half of the year has a maximum thrust of 900 Newtons. The interesting thing about this type is that it doesn't have a separate oil system and is lubricated by an admixture of oil in the fuel. This design solution decreases the frontal diameter and weight of the engine and allows it to start in any position, including in flight.

### PBS TJ150 - our most powerful jet engine

In the end of the year, PBS presented another new jet engine to the world market, the PBS TJ150. The engine particularly excels with its excellent thrust to weight ratio and its outer diameter, which are the most notable parameters in this category of aircraft propulsions.

The launch of two new jet engines onto the market in one year shows that PBS is establishing itself as a leader in the category of small jet engines in this power output category.



### TURBOJET ENGINE PBS TJ150

technical parameters	
Maximum thrust	1,500 N
Maximum speed	0.9 M
External diameter of the engine	272 mm
Engine weight	19.6 kg
Maximum altitude	10,000 m
Electrical power output	600 W / 28 V
Ambient temperature range	-50 °C up to +45 °C
Fuel	JET A-1
	An integrated electronic control system

# HOW IS A JET ENGINE DEVELOPED AND MANUFACTURED?



PBS TJ150 is the fifth and the most powerful jet engine type that we supply to foreign markets. What preceded the launch onto the world market?

The PBS TJ150 mainly stands out with its excellent thrust-to-weight ratio as well as the engine's outer diameter, which are the most viewed parameters in this aircraft drive category. Other advantages include its compact design, an integrated starter generator, reliability when starting up the engine under harsh climate conditions, and the added possibility of starting in mid-flight at high speeds and high altitudes.

The project of developing a new engine was based on the upgrade of the current PBS TJ100 engine with a power output of 1,300 N. It was clear from the beginning that it would be necessary to make complex structural changes in order to be able to reach a higher thrust while maintaining the same diameter and engine weight.

At the beginning of 2017, the basic design sketch was made. The calculation department made the thermodynamic calculations, structural calculations and the design of the engine's through-flow parts. After verifying the calculations, it was necessary to create detailed drawing documentation for manufacturing the prototypes. We managed to accomplish this in mid-2017, which is an excellent result considering the complexity of the entire process. The engine required a range of innovations, among others a new turbine stage, a new concept of the bearing case and, most notably, an integral radial-axial diffuser, which optimises the flow of compressed air into the combustion chamber.

This new technical solution allowed the engine to reach the nominal parameters while keeping the outer diameter of the engine to 272 mm. It was so innovative that the company patented it.

The subject of the patent is used in the design of several other jet engines from PBS production.

## Production process

After creating the complete technological documentation, the individual parts entered production. During production, classic and modern technologies were used, among others, five-axis CNC machining, electrical discharge machining, the manufacturing of the combustion chamber with laser technology, and also the implementation of stamping technology instead of metal knocking, which increased the accuracy of the individual components in the combustion chamber. Modern technologies were also used for the grinding of gears or for surface treatments. All of these technologies are ensured by the ATD with its own production capacities. After the final assembly of the engine, only the electronic equipment is purchased, such as the engine control unit (ECU), cabling and a few other components.

## Assembly and testing of the first prototypes

After finalising the production of the components, assembly took place. Before the end of 2017, tests of the first prototype were able to begin. During the tests, it was verified that the engine was able to meet the required parameters, but the first results weren't entirely optimal. A planned optimisation mainly of the fuel and oil systems and the control system took place. During further tests, various variants of the through-flow parts were verified with the goal of reaching the best possible parameters.

Based on the specific measurements and their evaluations, the design department came

up with a fairly radical step in the turbine's design. Due to time constraints, 3D printing technology was selected for the development of the new turbine, although this technology is not ideal for the use of Inconel 718 material.

Several potential suppliers from home and abroad were pre-selected. Production completion took place at a Czech manufacturer. The new turbine manufactured with this technology was available within a relatively short time but it was not possible to reach the required strength of the material and an accurate enough geometry. Despite this, however, an improvement in the newly developed turbine's parameters was demonstrated.

## The final version of the engine's development

In the fourth quarter of 2018, the final configuration of the engine was defined. In this design, it was necessary to realise all the defined tests and inspections for validating the functionality of the engine during the desired operating conditions. After satisfactory testing was completed in August of 2018, the creation of the serial production documentation and its issuance into serial production followed. At the conclusion of the project, it was necessary to create operational regulations and documentation for customers. Development was concluded with the manufacturing of prototypes in the serial design, which meet the required technical parameters from the beginning of the development. And so, the company has another sophisticated product with which it can offer to an even wider spectrum of customers that are mainly recruited from the defence industry, mainly in Europe and Asia.



# PBS DEVELOPS NEW ALLOYS AND PRECISION CASTING TECHNOLOGIES. THE COMPANY WAS AWARDED THE BEST APPLIED RESEARCH PROJECT LAST YEAR

Besides production of aircraft devices, PBS is also a leading European precision casting foundry. Its Investment Casting Foundry supplies nickel- and cobalt-based superalloy castings for the power engineering, transportation, aviation, and glass industries. Last year, PBS managed to develop an alloy which will extend the service life of spinner discs by about a third. In 2019, the Technological Agency of the Czech Republic presented PBS with an award for the best applied research project, specifically for the development of new casting technologies and for the use of relatively new materials for the production of castings.

*Award from the Technological Agency of the Czech Republic for the best applied research*



The PBS Investment Casting Foundry is among the suppliers of castings for world-leading manufacturers of turbochargers, combustion turbines, aircraft components, and glass wool based insulation materials.

**The newly developed alloy has extended the service life of castings by a third**

PBS managed to develop a new type of alloy for the manufacture of spinner discs used in the production of glass wool. Spinner discs work at temperatures of up to 1,050 °C. Such high temperatures inevitably have a negative impact on the service life of these types of castings. With standard alloys, a service life of 250 to 300 hours of operation is currently achieved. After this, the spinner disc has to be removed and replaced.

The objective of the project, which lasted from 2016 to 2019, was to find alloys which could be used for the production of spinner discs in order to increase the service life of these castings by at least 20%. The PBS Investment Casting Foundry closely cooperated with the Institute of Physics of Materials of the Academy of Science of the Czech Republic when working on this project. The project resulted in an increase in the service life of spinner discs by up to 350 to 380 hours. Thanks to this know-how, PBS is currently able to offer its customers these alloys, which are able to endure temperatures of up to 1,050 °C and have a service life of about 350 hours.

**The best applied research project in the Czech Republic for 2019**

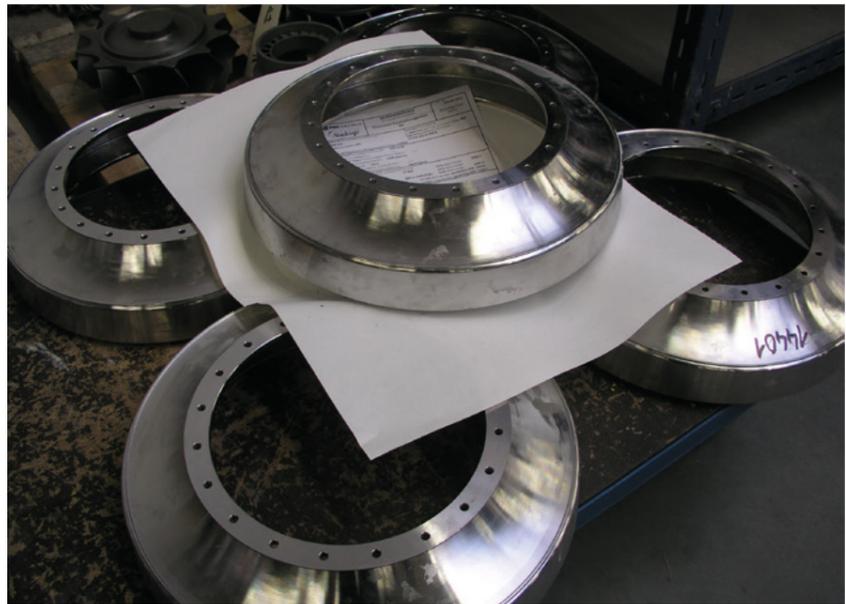
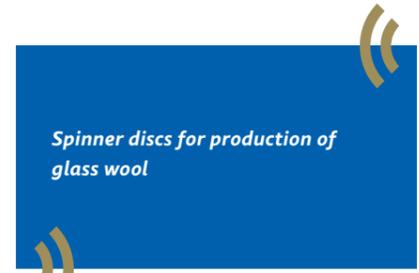
In another project, PBS, again in cooperation with the Institute of Physics of Materials of the Academy of Science of the Czech Republic, focused on the research

and development of precision casting technologies for the production of radial wheels for new-generation turbochargers and new types of blades for gas turbines. Specifically, this involved the development of new casting technologies and the use of relatively new materials for the production of castings. The technologies which have been verified in operation and will be introduced in the serial production of the aforementioned components, represent the results of the project.

The Technological Agency of the Czech Republic awards the best applied research projects and the abovementioned PBS project won the award in 2019. It brought technical advancement in mastering the casting of the B1914 alloy for atypical castings of axial wheels and development of the super-fine macrostructure of the castings of small axial wheels for the aerospace industry. PBS also

developed a new method of casting using mechanical oscillations in vacuum furnaces.

This fairly unique technology has been patented and is utilised for special castings with requirements for extreme strength which cannot be complied with using standard production technology.



**PBS TJ150**



**1,500 N**  
19.6 kg  
Ø 272 mm

**PBS TJ100**



**1,300 N**  
19.5 kg  
Ø 272 mm

**PBS TJ80**



**900 N**  
12.5 kg  
Ø 235 mm

**PBS TJ40**



**395 N**  
3.3 kg  
Ø 147 mm

**MEET US IN 2020**

We look forward to seeing you at these exhibitions where you can sit with our professionals and discuss the best solution for your aerospace project.

We have sold more than **7000** turbine products including APU and ECS worldwide.

Thanks to our research and development we are prepared to modify our engines according to your needs.





**PBS INDIA**

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www.pbsindia.com



PBS is one of the oldest engineering brand which is a synonym of innovation and quality. PBS GROUP, a.s. is the holding that consists of three companies: Prvni brnenska strojirna Velka Bites, a.s. (PBS), which has an established reputation as an expert in the field of aerospace industry and precision engineering; Prvni brnenska strojirna, a.s. (PBS Brno) that supplies complex power equipment with a special focus on industrial boilers, and PBS Energo, a.s. which focuses on the development, production, delivery and servicing of steam and expansion turbines.