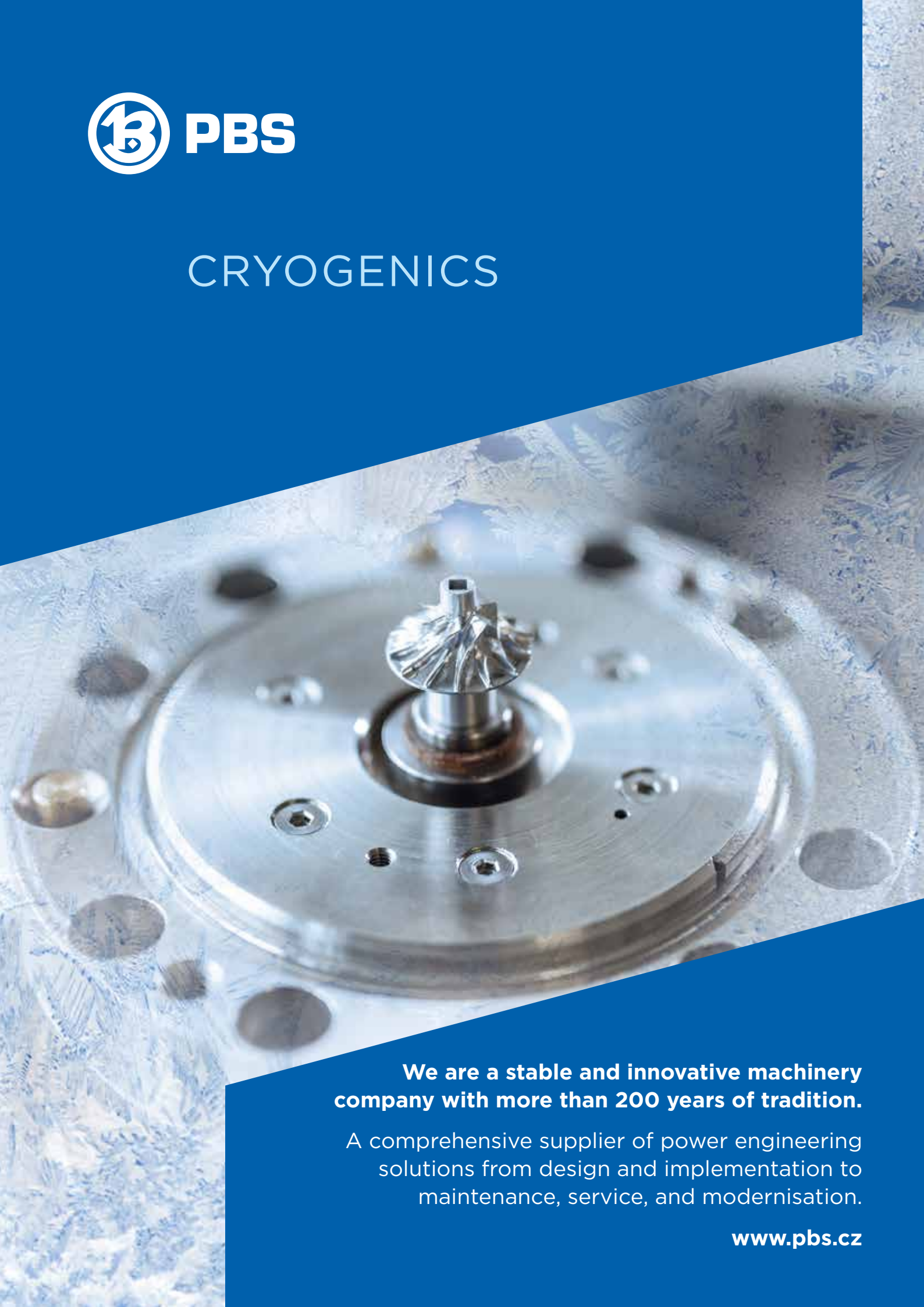




# CRYOGENICS



**We are a stable and innovative machinery company with more than 200 years of tradition.**

A comprehensive supplier of power engineering solutions from design and implementation to maintenance, service, and modernisation.

[www.pbs.cz](http://www.pbs.cz)



## CRYOGENICS

PBS has been in cryogenic business for more than 30 years. During this time PBS has built a significant position in the market of cryogenic turboexpanders, compressors and pumps. PBS cryogenic products are used in helium and hydrogen liquefiers and refrigerators working at low gas or liquid temperatures ranging from 4 K to 150 K.

Our clients are the world's leading manufacturers of large cryogenic units and research organizations including the European Organization for Nuclear Research CERN and the Rossendorf Research Center, which demonstrates high technical level and quality of our products.

In PBS we deal with each project for each customer individually, which allows flexible adaptation to individual customer requirements.

## ABOUT PBS

PBS has a unique ability to carry out in-house design and development, manufacture and test of cryogenic turboexpanders, cryogenic compressors, cryogenic pumps.

The PBS manufacturing program also includes production of small turbojet, turboprop and turboshaft engines, auxiliary power units (APU), environmental control systems (ECS), investment castings and surface treatment.

## CRYOGENIC TECHNOLOGY BY PBS

**PBS is a successful and reliable partner** to many significant CRYOGENIC manufacturers and final assemblers.



*Cryogenic Pumps*



*Cryogenic Turboexpanders*



*Cryogenic Compressors*

# TURBOEXPANDERS

PBS turboexpanders are primarily designed for the expansion of gases such as helium, hydrogen, nitrogen, argon, air, etc., in gas liquefiers.

## MAIN FEATURES

- Easy regulation
- High efficiency
- Rotor placement
- on gas-dynamic bearings
- High reliability and long service life



Main parameters of turboexpanders	HEXT / CTE 100	HEXT / CTE 200	HEXT / CTE 300
Cooling power	0,1 – 3 kW	2 – 16 kW	10 – 100 kW
Mass flow**	4 – 150 g/s	150 – 600 g/s	300 - g/s
Max RPM	360 000	180 000	100 000
Max. Inlet pressure	1,8 Mpa	2,8 Mpa	5 Mpa
Inlet temperature	6 – 150 K	6 – 150 K	6 – 150 K
Impeller diameter	9 – 20 mm	20 – 50 mm	30 – 100 mm
Bearing Types	Aerodynamic	Aerodynamic	Aerodynamic
Turboexpander configuration	Eddy current brake	Eddy current brake / Generator*	Generator* / Compressor*

\* under development, \*\* presented data are for helium

PBS turboexpanders have a unified design that makes it possible to quickly respond to customer requirements for various input and output parameters of the expanding gas.

The main advantage of PBS turboexpanders is the very easy and precise speed control with the turbine brake, as well as their long-term trouble-free and maintenance-free operation thanks to the placement of the rotor on gas-dynamic bearings.

# COMPRESSORS

Cryogenic compressors are designed for compressing gases such as helium, hydrogen, nitrogen, argon, air, etc.

## MAIN FEATURES

- Compact design
- Possibility of connecting an intercooler
- High efficiency
- High reliability and long service life



## Main parameters of cryogenic compressors

Mass flow**	10–115 g/s
Impeller diameter	40–280 mm
Min. inlet pressure	0.001 MPa
Min. inlet temperature	4 K
Max. RPM	90,000 min <sup>-1</sup>

\*\* presented data are for helium

Single, or multi-stage compressors are primarily designed to exhaust very low temperature vapor from liquid helium tanks. They can also be used with other inert gases such as nitrogen, argon, air, etc.

In PBS we deal with each project for each customer individually, which allows flexible adaptation to individual customer requirements.

Currently, PBS is developing its own drive unit for compressors, which will use more than 30 years of experience with aerodynamic bearings.

Aerodynamic bearing technology ensures trouble-free and maintenance-free operation. The developed drive offers power up to 15kW.

# PUMPS

Cryogenic pumps are designed to deliver liquefied gases such as helium, hydrogen, nitrogen, argon, air, etc.

## MAIN FEATURES

- Compact design
- Possibility of connecting an intercooler
- High efficiency

### Main parameters of cryogenic pumps

Mass flow**	50–500 g/s
Impeller diameter	40–110 mm
Min. inlet pressure	0.1 MPa
Min. inlet temperature	3 K
Max. RPM	45,000 min <sup>-1</sup>

\*\* presented data are for helium

PBS centrifugal pumps are primarily designed for transporting liquefied inert gas (helium, nitrogen, argon, air, etc.) to a cryogenic device.

The flow units are always designed individually based on parameters specified by the customer.

Currently, PBS is developing its own drive unit for pumps, which will use more than 30 years of experience with aerodynamic bearings.

Aerodynamic bearing technology ensures trouble-free and maintenance-free operation. The developed drive offers power up to 15kW.



## Main features

### Turboexpanders

- Aerodynamic bearings
- Modular solution suitable for customization
- Compact design
- High speed – up to 360,000 RPM
- Wide range of mass flow from 4 g/s to 600 g/s
- Power consumed by water-cooled eddy current brake or generator
- Simple and accurate operation controlled by special control unit
- Maintenance-free operation

### Compressors and Pumps

- Aerodynamic bearings
- Modular solution suitable for customization
- Compact design
- Speed – up to 90,000 RPM (CC) and 45,000 RPM (CP)
- Single-stage axial-radial impeller with a pressure ratio up to 4
- Used independently or as a part of compressor cascades with total pressure ratio up to 20–25
- Unit driven by variable frequency electric motor with aerodynamic bearings
- Insulation system ensuring low heat leak
- Maintenance-free operation

## Main references



# Licences and Certificates



→ AEASA approval to design, production and maintain turbine machines and equipment

→ Certificates: **AS 9100, ISO 9001, ISO 14001**

→ Certificate of Conformity with the quality system and with the requirements of **ČSN EN ISO 9001:2009** and **ČOS 051622 (AQAP 2110)** from the Defence Standardisation, Codification, and Government Quality Assurance Authority

→ **NADCAP** for non-destructive testing (PT, RT) and chemical processes



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