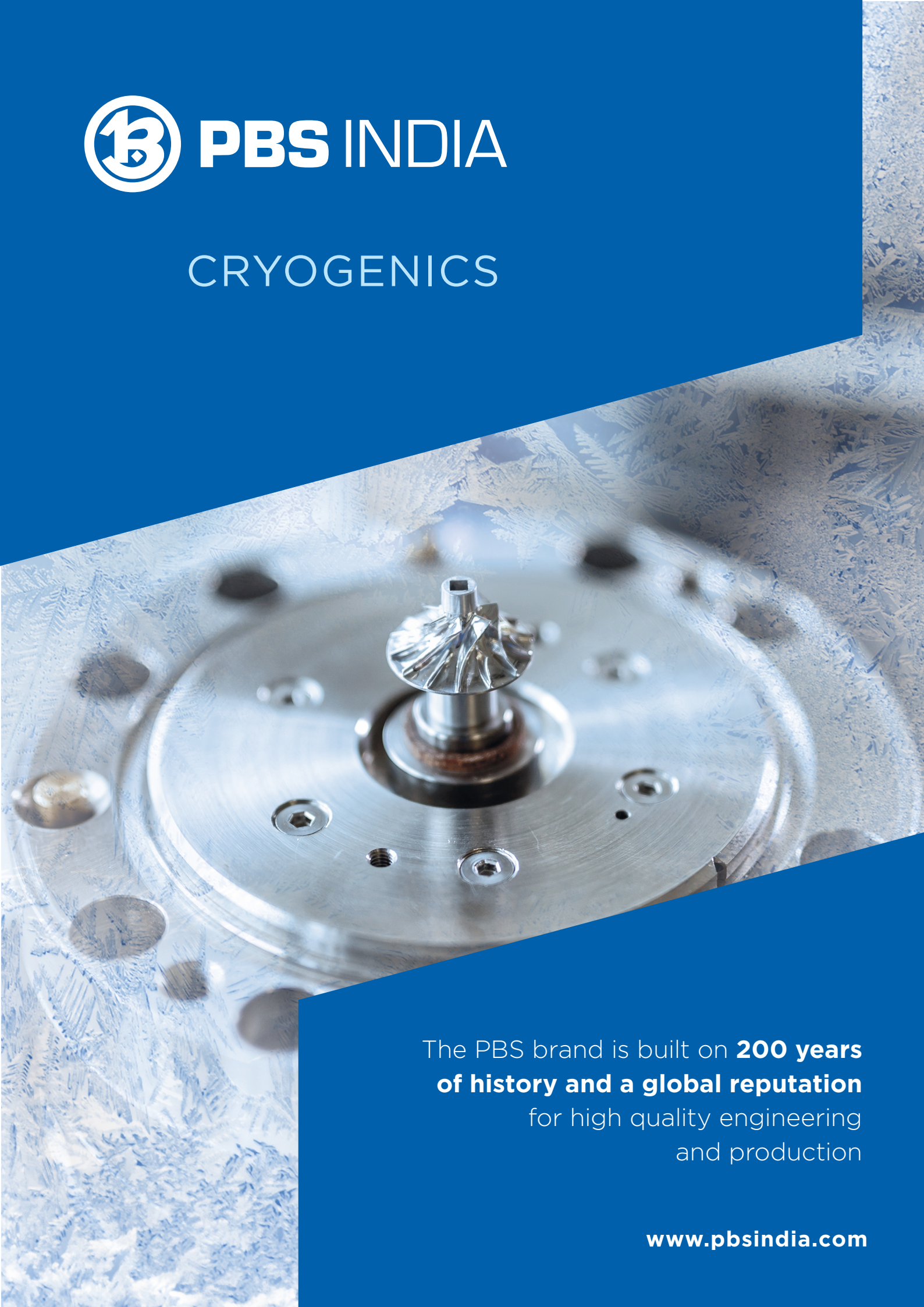




CRYOGENICS



The PBS brand is built on **200 years
of history and a global reputation**
for high quality engineering
and production

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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
- aerodynamic 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 ⁻¹ |

*** 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 ⁻¹ |

** 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 inleak
- Maintenance-free operation

Main references



ILK Dresden



Max Planck Institute for Plasma Physics



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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