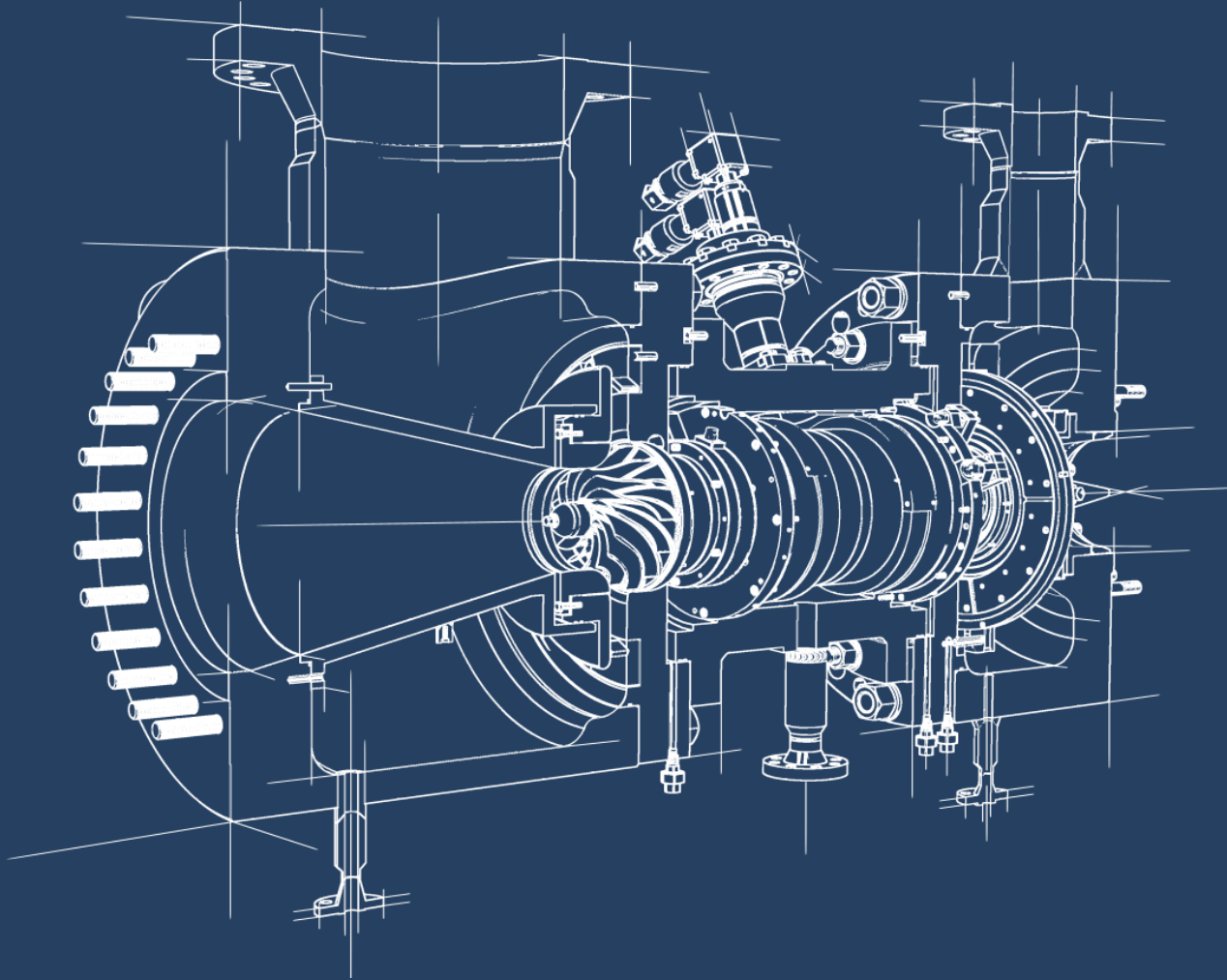




TURBOGAZ
TURBINE EXPANDERS, OIL & GAS EQUIPMENT



Experience that brings results



COMPANY MISSION

We contribute to success of our clients by implementing complex solutions in development and manufacture of competitive turbo-expanding, compression, process equipment for the oil and gas industry based on modern technologies.

PrJSC "Turbogaz"
provides Clients with

Individual approach

Flexible pricing policy

Optimal production
and supply timing

Technical support 24/7

Wide range of equipment
models

High quality
and reliable product

Supply of spare parts

Engineering

Repairing

Modernization

COMPANY DEVELOPMENT HISTORY

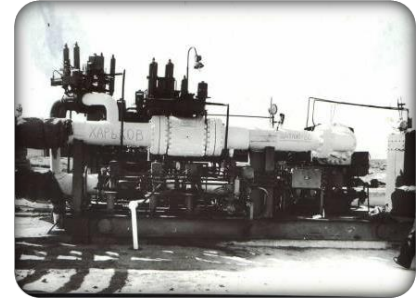
1975-1991 - All-Union Scientific and Production Association
"Soyuzturbogaz" (until 1991 it was part of "Gazprom" Concern)

1992-1994 - State Research and Production Enterprise
"TURBOGAZ" (a part of "Ukrgezprom»)

1994-2011. – Open Joint Stock Company "TURBOGAZ"

2011-2017 – Public Joint Stock Company "TURBOGAZ"

2017 – till present time - Private Joint Stock Company
"TURBOGAZ", which includes the Parent Company (Kharkov),
"TURBOGAZ" pilot plant as subsidiary and a test range (Kharkov
Region)



PrJSC "TURBOGAZ" Organizational Structure

**"TURBOGAZ"
Subsidiary
Pilot Plant**



**PrJSC "TURBOGAZ"
Engineering Center**



**PrJSC "TURBOGAZ"
Test Facility**



COOPERATION GEOGRAPHY



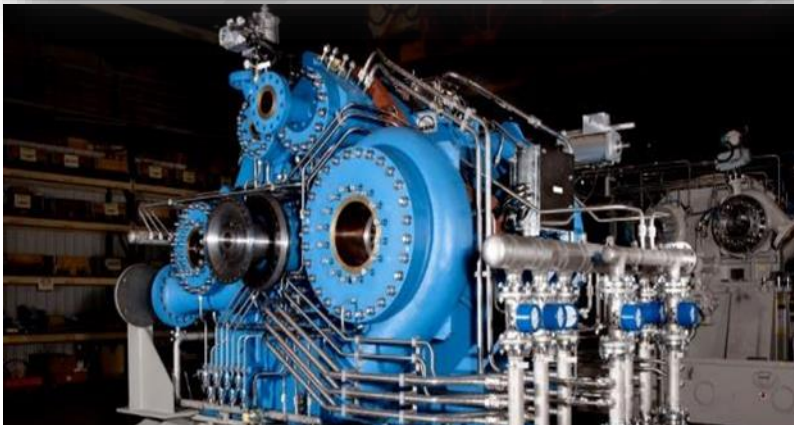
PrJSC "Turbogaz" Main Activities



Expander-compressors for preparation and treatment of natural and associated petroleum gas



Expander-generators



Centrifugal compressors



**Expander-Generators 3.5kW and 8kW
for self-contained power supply**

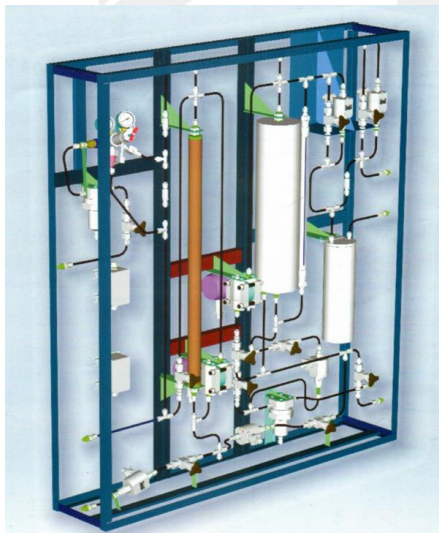
PrJSC "Turbogaz" Main Activities



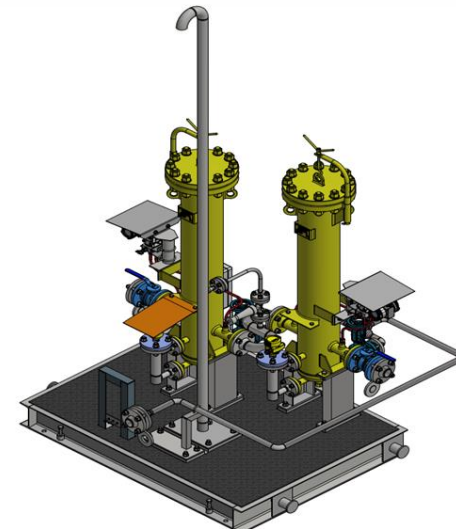
API 614 Lub-oil systems for compressors and Expanders



Facilities for cleaning oil sludge and other types of industrial pollution



"Odotronik" Gas Odorization Plant



Gas treatment unit

EXPANDER-COMPRESSOR FIELD OF APPLICATION

Industrial Gases

- Air-separation plants

Oil and Gas industry

Hydrocarbon applications:

- Liquefied Petroleum Gas (LPG)
- Natural Gas Liquids (NGL)
- Dew-Point Control (DPC)
- Liquefied Natural Gas (LNG)

Chemical / Petrochemical Plant's

- ethylene-olefin recovery,
- ammonia purification,
- carbon-monoxide purification,
- propane dehydrogenation,
- hydrogen recovery.

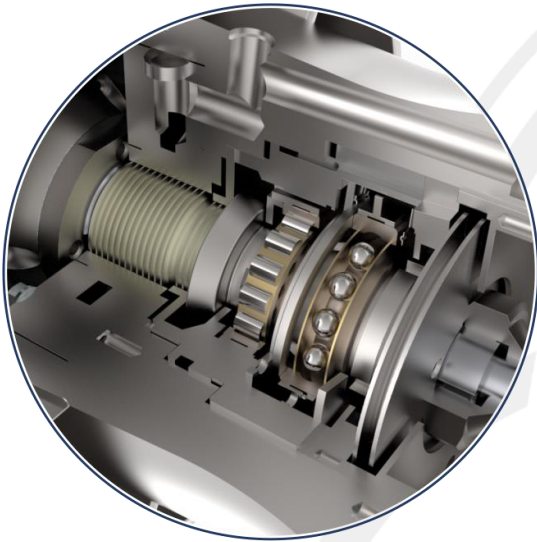


Expander-compressor basic characteristics

Standard size	Flow rate, St.m3 / h	Inlet pressure, bar	Temperature, °C	Bearing type	Compliance with API 617 (Yes / No)
Q 1	Up to 45,000	Up to 209	-200°C to 280°C	AMB or OB	Yes
Q 3	Up to 125,000	Up to 209	-200°C to 280°C	AMB or OB	Yes
Q 5	Up to 210,000	Up to 209	-200°C to 280°C	AMB or OB	Yes
Q 10	Up to 425,000	Up to 209	-200°C to 280°C	AMB or OB	Yes
Q 20	Up to 850,000	Up to 209	-200°C to 280°C	AMB or OB	Yes

AMB – Active Magnetic Bearing; OB – Oil Bearing.

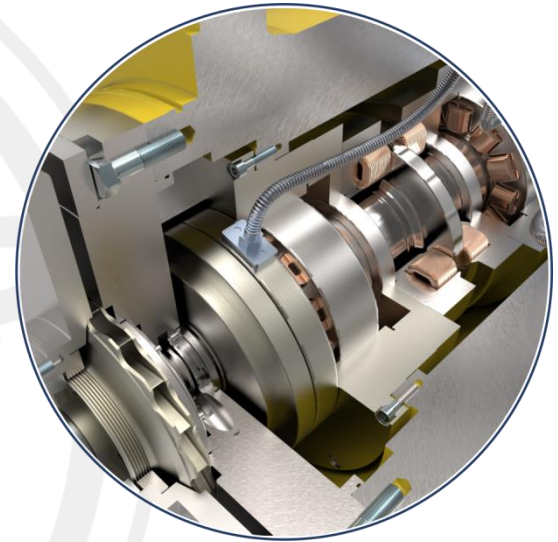
Expander-Compressor Design Solutions



**Expander - compressor
on rolling bearings**



**Expander - compressor
on plain bearings**



**Expander - compressor
on active magnetic bearings**

EXPANDER-GENERATORS

Designed for gas excessive pressure energy to green electric power conversion.

There is an option of cold generation to cool premises (warehouses, freezers, etc.) or other processes.



EXPANDER-GENERATOR UNITS ARE APPLIED:

1. To generate electric power by Natural Gas Reducing Units at Gas Distribution Stations, at Gas Distribution Points of major gas consumers i.e. Thermal Power Plants, Steel and By-Product Plants, Chemical Integrated Plants and other gas transmission network major consumers.
2. To generate electric power when letting down various process gases of surplus pressure at chemical, petrochemical, steel and by-product industries etc.
3. To generate electric power by liquefied natural gas regasification process.
4. To generate electric power by low-grade (low-pressure) heat recovery (ORC-cycle or Rankine cycle).
5. Geothermal energy.

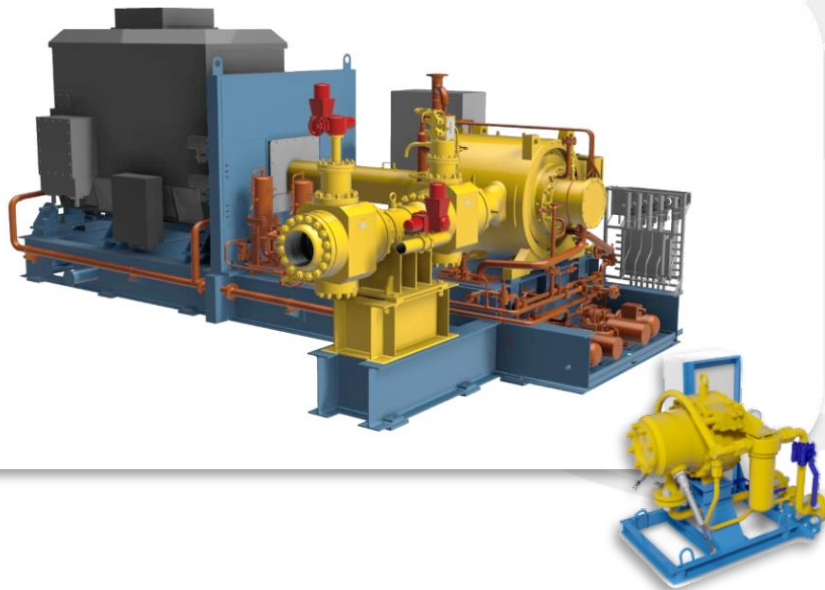


EXPANDER-GENERATOR UNITS CATEGORIZATION

Skid Size	Capacity, kW	Gas flow, nm3/hr	Gas pressure, bar*	Expander type	Reduction gear (Yes or No)	Generator type	Bearing type
G1	Up to 100	Up to 10.000	Up to 63	Radial	Not applicable	High Speed	Sliding or Rolling
G10	100 to 1000	Up to 50.000	Up to 63	Radial	Not applicable	High Speed	Active Magnetic Bearings or Sliding(Journal) Bearings
G100	1000 to 6000	Up to 250.000	Up to 160	Radial or Axial	Yes	Synchronous or Asynchronous (1500 or 3000 rpm)	Journal
G250	6000 to 16000	Up to 800.000	Up to 160	Radial or Axial	Yes	Synchronous or Asynchronous (1500 or 3000 rpm)	Journal

PRODUCT RANGE OF EXPANDER-GENERATORS

Capacity Range	Gas Pressure Range	Gas Consumption Range
3.5 kW to 16.0 MW	up to 6.3 MPa	0.05 – 20.0 MMSCMD



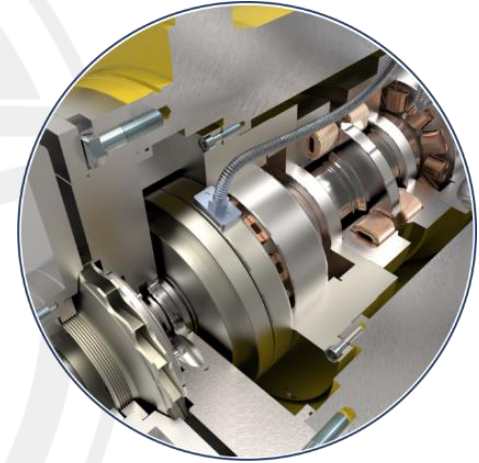
VARIOUS DESIGNS OF EXPANDER-GENERATOR UNITS



**Rolling Bearing -
based**

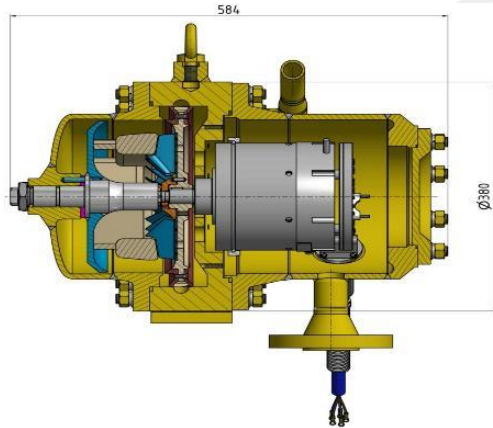


**Slide (Journal) Bearing -
based**

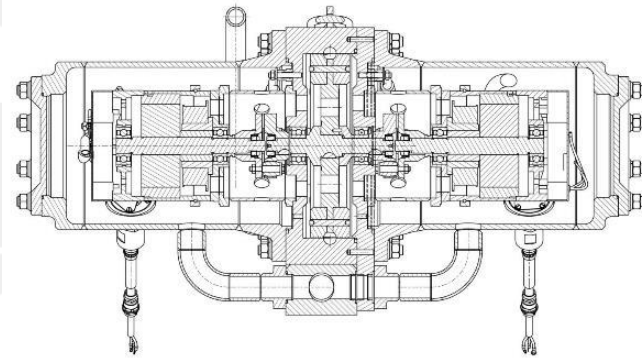


**Active Magnetic
Bearing - based**

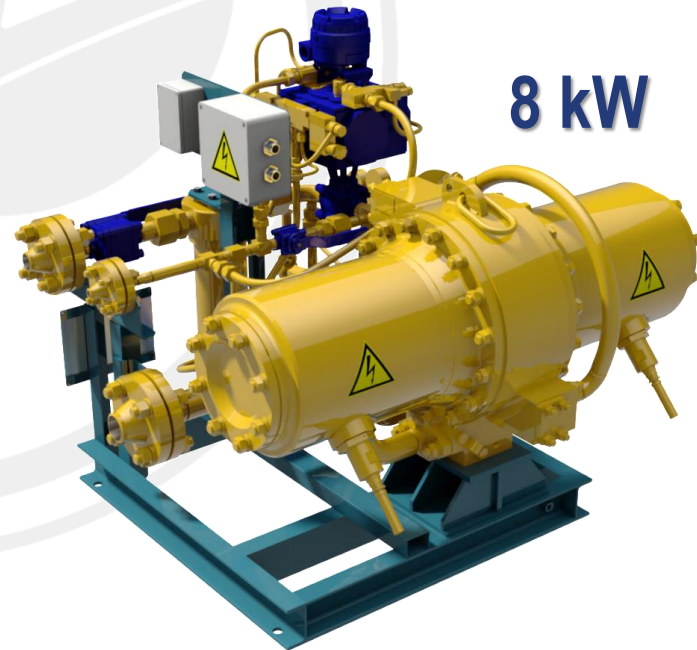
EXPANDER-GENERATOR



3.5 kW



8 kW

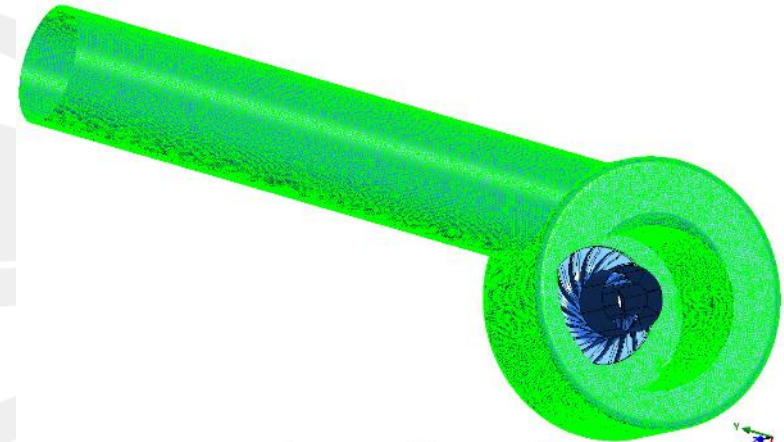
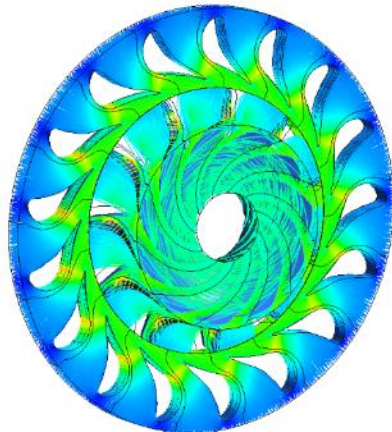


Gas-dynamic calculations of the flow parts of the units produced by PrJSC "TURBOGAZ"

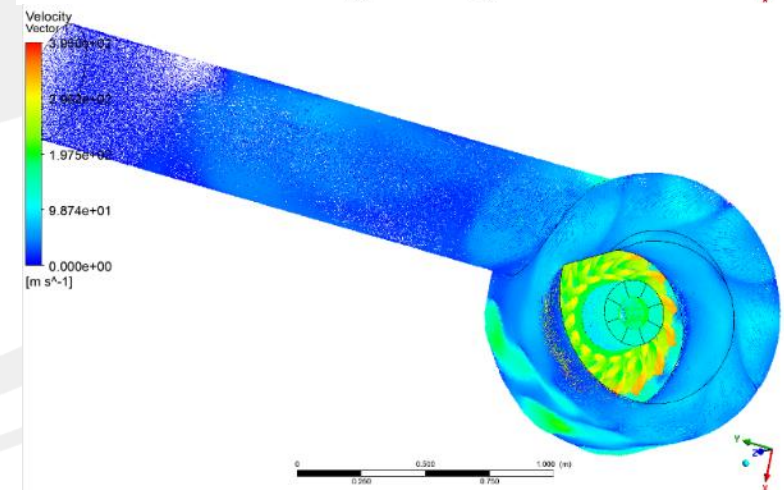
Modern computing stations make it possible to perform 3-D calculation of a viscous gas flow, with consideration of compressibility, along the entire flow path of the expander and compressor.

As a result, the Customer is offered the best possible solution.

Velocity
Streamline 1
4.321e+02
3.242e+02
2.163e+02
1.084e+02
5.484e-01
[m s⁻¹]



Velocity
Vector 1
3.980e+02
2.652e+02
1.975e+02
9.874e+01
0.000e+00
[m s⁻¹]



Wheels of units produced by PrJSC "TURBOGAZ"

Previously, the wheels were of a shrouded type with 2-D blade profiling; they had an efficiency of $80 \div 82\%$

Expander wheel

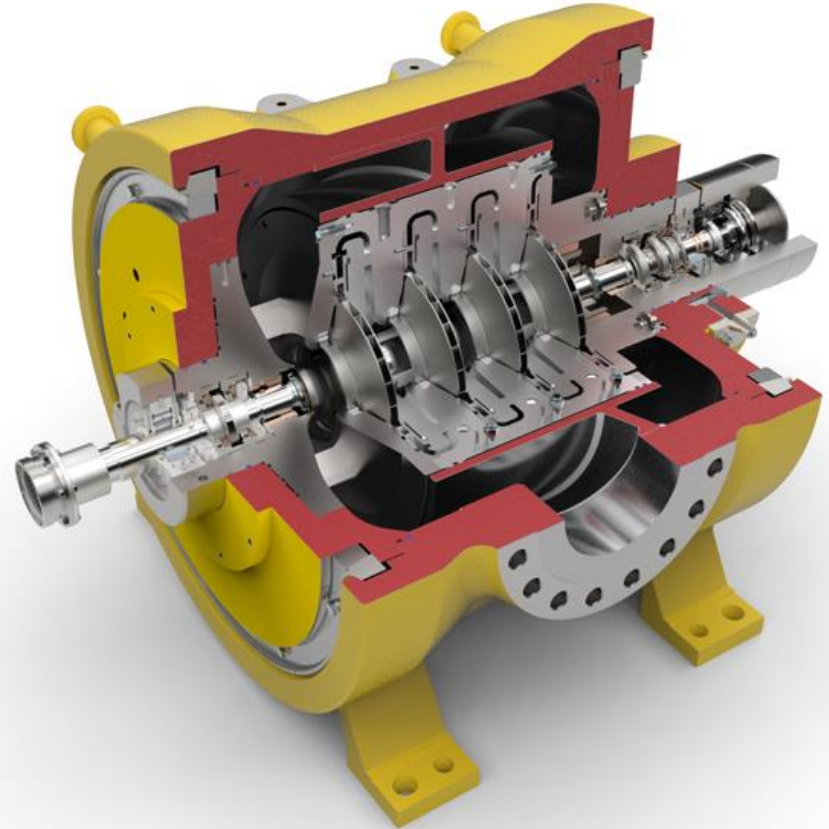
Compressor wheel

Modern semi-open wheels with 3-D blade profiling have efficiency of **$86 \div 88\%$**

MULTISTAGE CENTRIFUGAL GAS COMPRESSORS

Applications of centrifugal compressors:

- Oil refineries
- Chemical & petrochemical plants
- Ethylene plants
- Gas lift & gas injection applications, gas gathering
- Transportation and storage of natural gas, including associated petroleum gas (APG).



MULTISTAGE CENTRIFUGAL GAS COMPRESSORS

Designed and manufactured as per API 617.

The following drives are used:

- Synchronous or induction electric motors (equipped with a frequency controller (VFD))
- Steam turbines made in compliance with API 611 & 612

Centrifugal compressors are designed for the following **process parameters**:

- Capacity corresponds to inlet conditions: 500 to 150 000 m³/h
- Discharge pressure up to 200 bar
- Discharge temperature up to +200 °C
- Compressor inlet temperature varies over a wide range from -195 °C to + 100 °C

The compressors are used to compress almost **all types of gases**:

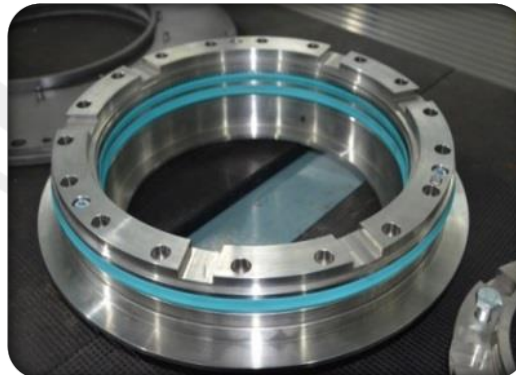
- hydrocarbons (HC)
- nitrogen (N₂)
- natural gas (NG) including those with a high content of hydrogen sulfide (H₂S).

In this case, materials for the design of the compressor flow passage are selected in accordance with NACE MR 0175 / ISO 15156-1: 2001 (E).

MANUFACTURING

PrJSC "TURBOGAZ" manufacturing process is based on the principle of placing orders for manufacture of units with specialized co-executor companies, each of which is the most qualified in its segment of the industry. Purchased parts are bought from approved suppliers.

PRODUCTION COMPONENT PARTS



APPROVED SUBVENDOR LIST

Description	Subvendor	Country
AMB		
Active Magnetic Bearing	S2M	France
EQUIPMENT		
Inlet Guide Vanes electrical actuator	AUMA Riester GmbH&Co.KG	Germany
Seal gas heaters	EXHEAT LTD	United Kingdom
	ELMESS GvdH&Co.KG	Germany
Seal Gas Filters	HYDAC International	Germany
	Progetti	Germany
	Bollfilter	Germany
INSTRUMENTATION		
Instrumentation	WIKA ALEXANDER	Germany
	Honeywell	USA
	Siemens	Germany
	Schneider Electric	USA
	KROHNE	Germany
Automatic Control Systems		
Programmable Logic Controller including anti-surge control	Siemens	Germany
Control panel	OOO "CAC"	Ukraine
	"KB Promavtomatika" JSC	Ukraine

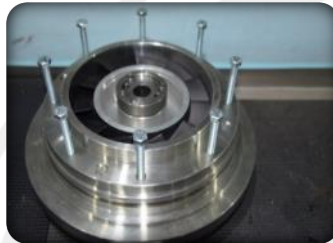
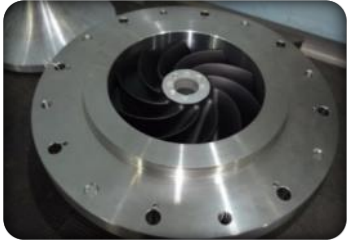
APPROVED SUBVENDOR LIST

Description	Subvendor	Country
Body Group (Compressor and expander casing, replaceable flow channel)		
Castings	Faces	Italy
	SeKang MTeK Co Ltd	Korea
Forgings	Gruppo T.T.N. Friulforgia	Italy
Machining	Vecchiato Officine Meccaniche	Italy
	Peresan Welding Solutions	Italy
	Pump-gas equipment Plant	Ukraine
Rotary and Stator Group		
Forgings	Gruppo T.T.N. Friulforgia	Italy
	L'Union Des Forgerons	France
	SBS Group Genoyer	France
	PGO S.A.	Poland
	CZECH PRECISION FORGE	Czech Republic
	State company “YuZh Mash”	Ukraine
	“Ddepropress steel”	Ukraine

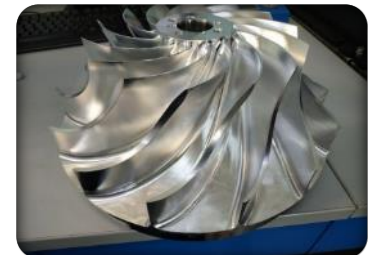
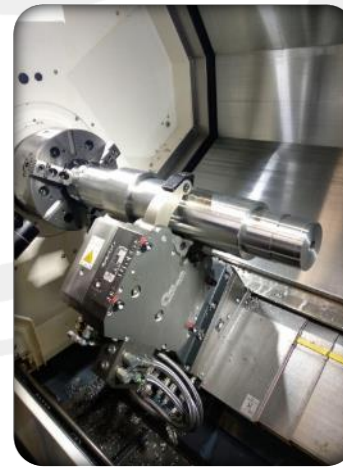
APPROVED SUBVENDOR LIST

Description	Subvendor	Country
Rotor and Stator Group		
Shaft and shaft assembly Impellers Gas flow channel parts Sealing assemblies Variable IGV blades (machining)	“Triz” Ltd.	Ukraine
	TCT	Korea
	“Faktorial K” LLC	Ukraine
	“Oil and Gas Equipment Plant” LLC	Ukraine
	“Alfa-Center” LLC	Ukraine
	“FED” JSC	Ukraine
	“Sumy Pumping Equipment” Ltd.	Ukraine
SHUT-OFF AND CONTROL VALVES		
On-off valves, Check valves, Isolation valve, Anti-surge valve, Control valves, Safety valves	PEKOS Group	Spain
	NELES	Finland
	Samson AG	Germany
	Habonim	Israel
	Adams	Germany
	Technical s.r.l.	Italy
	MSA	Czech Republic

MANUFACTURING PROCESS AND READY-MADE COMPONENTS AT CO-CONTRACTORS' FACILITIES



Having wide range of sub-contractors all over the world we provide services for manufacturing of all kinds of stator and rotor parts under supervision of our production and QC departments



EQUIPMENT ASSEMBLING AND TESTING AT PJSC «TURBOGAZ» TESTING FACILITY



The following works and tests are carried out to check the equipment:

- Impellers and Rotor Balancing;
- Shaft Mechanical and Electrical Run-out Tests;
- Impellers Overspeed Tests;
- Impellers' Shaker Tests;
- Mechanical Tests of Changeable Gas Flow Section;
- Changeable Gas Flow Section Performance Tests;
- Unit Tests of the Unit Assembly with all the Auxiliary Systems.



TESTING FACILITIES

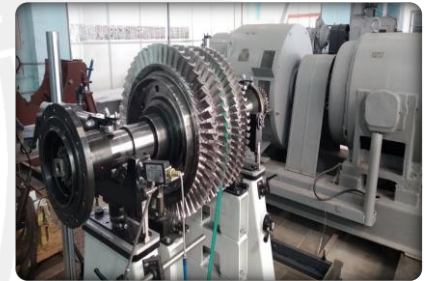
BALANCING BENCH



Balancing services used to be outsourced.

Having purchased a state-of-the-art Balancing Machine, we comply with the international standard for accuracy class G 0.67 ISO1940 and balance the rotors with high precision on our own.

Broad range of products to be balanced weights from 15 kg to 1500 kg having a support-to-support distance up to 2700 mm. PJSC "Turbogaz" experts have successfully been trained and are licensed and authorized to carry out these works.



OVERSPEED TEST BENCH



Allows impellers to be strength-tested as per API 617.

TESTING INFRASTRUCTURE

- A modern CT-111 bench allow conducting of pressure and mechanical run tests of expander-compressors with up to 20 mln. St. cub. m/day flowrate.
- The bench is made according to all requirements of API617 and ASME PTC10.
- The tests are conducted at permanent monitoring of a group of experts with many years of experience.



Maintenance of the equipment at Site

High qualified experts are ready 24/7 to support Client in maintenance and repairing of the equipment at Client Site



CERTIFICATION

Certificate

Standard **ISO 9001:2015**
 Certificate Registr. No. **01 100 1818801**

Certificate Holder: **Private Joint Stock Company "Turbogaz"**
 Troitsky Lane 6/4,
 61003 Kharkov
 Ukraine

including the locations according to a


Scope: Development, manufacturing, installation and maintenance of equipment for the oil and gas industry

Proof has been furnished by means of which the requirements of ISO 9001:2015 are fulfilled

Validity: The certificate is valid from 2021-06-07 to 2024-06-07

2021-06-07

www.tuv.com




Certificate

Standard **ISO 14001:2015**
 Certificate Registr. No. **01 104 1818801**

Certificate Holder: **Private Joint Stock Company "Turbogaz"**
 Troitsky Lane 6/4,
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 Ukraine

including the locations according to a

Scope: Development, manufacturing, installation and maintenance of equipment for the oil and gas industry

Proof has been furnished by means of which the requirements of ISO 14001:2015 are fulfilled

Validity: The certificate is valid from 2021-06-07 to 2024-06-07

2021-06-07

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Precisely Right.

Certificate

Standard **ISO 45001:2018**
 Certificate Registr. No. **01 213 1818801**

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 61003 Kharkov
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including the locations according to a



Scope: Development, manufacturing, installation and maintenance of equipment for the oil and gas industry

Proof has been furnished by means of which the requirements of ISO 45001:2018 are fulfilled

Validity: The certificate is valid from 2021-06-07 to 2024-06-07

2021-06-07

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Due Diligence Summary

Private Joint Stock Company "TURBOGAZ"
 Tcertification ID: TC4221-9610

15 August 2022 - 14 August 2023

Due diligence is not a guarantee against past or potential wrongdoing or against potential liability.

Depending on the nature, size, scope and location of the proposed project with an intermediary, more extensive due diligence may be warranted.

The following "red flags" or significant areas of concern were identified during the due diligence review:

- Disclosed intention to work with a third party intermediary
- Third party Mahsusenergaz JSC is a subsidiary of government-controlled Uzbekneftegaz JSC. See Associated Offices & Entities.



Due diligence undertaken by Tcompliance shall not be used to support or promote business in Iran or other sanctioned countries.



Thank you for your attention

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