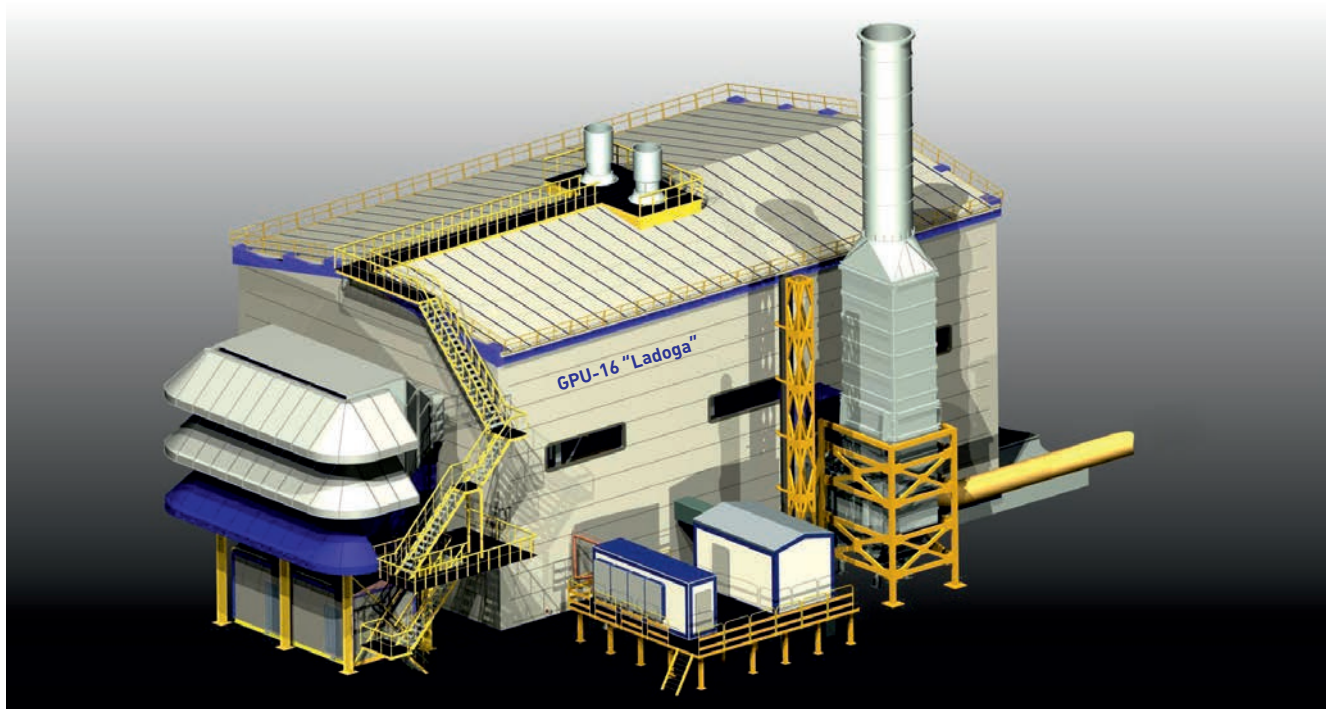




Gas-Pumping Unit GPU-16 "Ladoga"



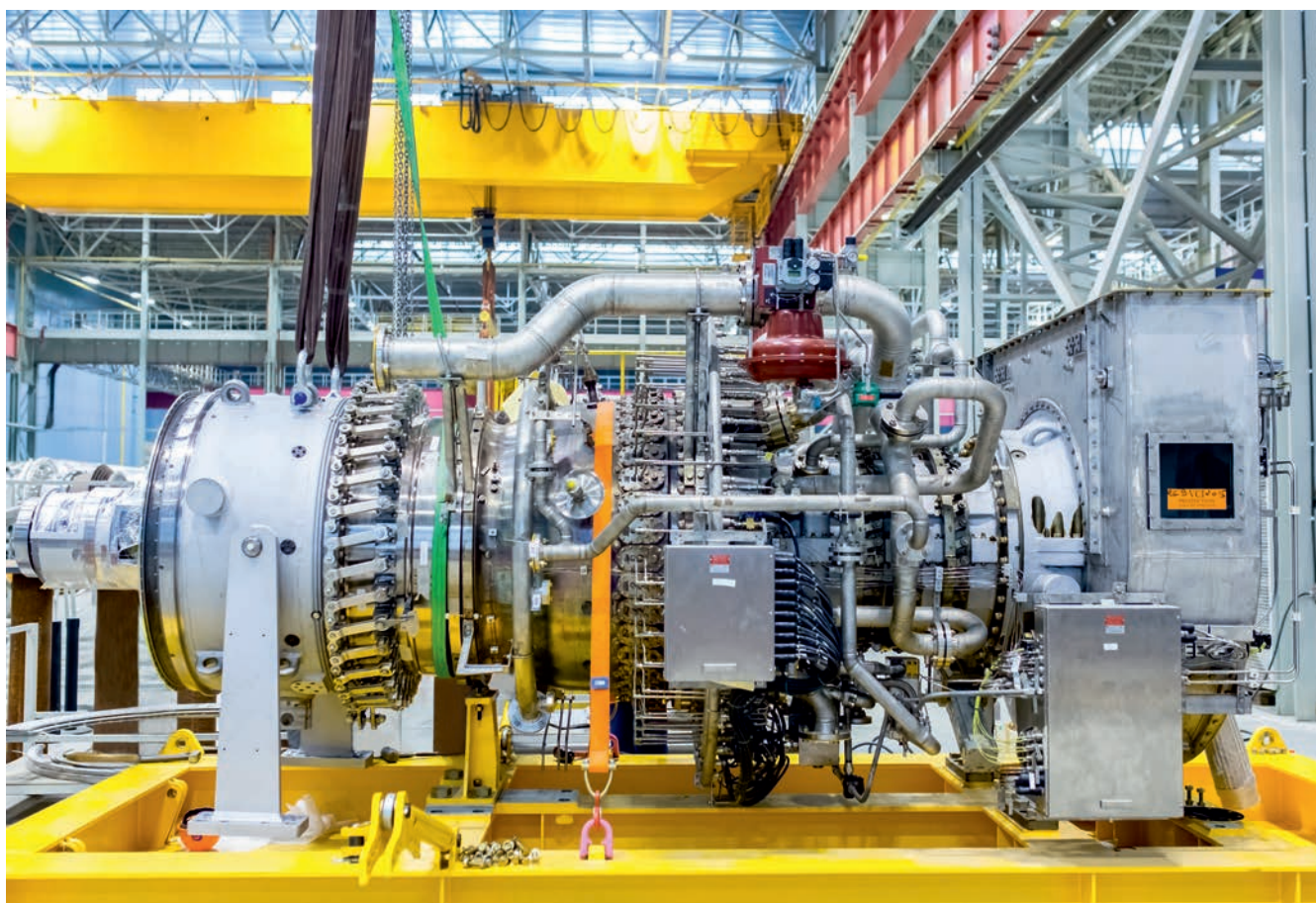
Package supplies of power equipment

www.reph.ru

Gas-Pumping Unit GPU-16 "Ladoga"

"REP Holding" is the leading Russian power-plant engineering Holding that manufactures and supplies new-generation power-generating equipment.

The company engineers, manufactures, and package-supplies the power-generating and electrical equipment for gas, oil, metallurgical, and chemical sectors, for power generating and power supply complex.



GTU-T16

"REP Holding" offers manufacturing "Ladoga" series GPU-16 to be installed on the compressor stations of the main gas pipelines with the operating pressure from 5.5 to 12.0 MPa.

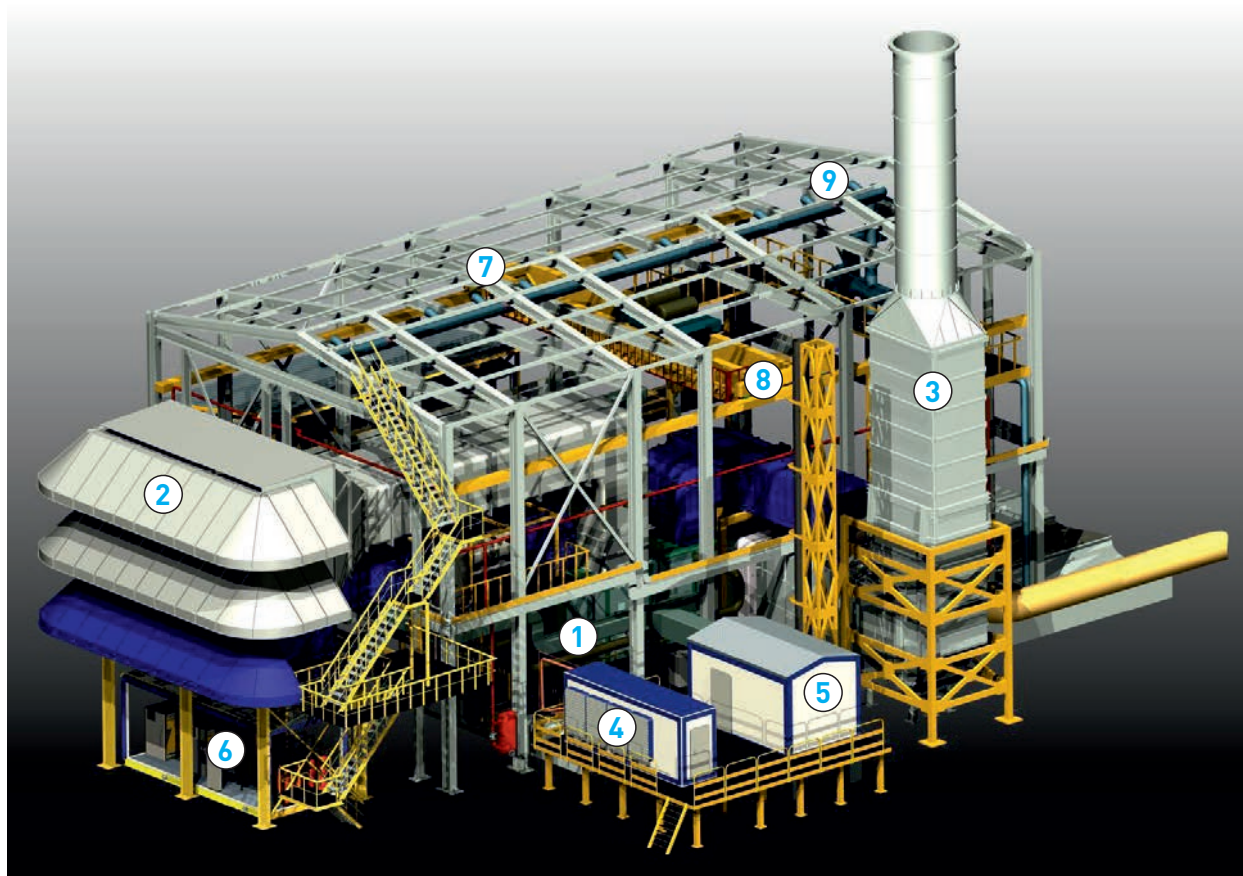
GPU-16 "Ladoga" is designed to transport the natural gas, and can be used both for reconstruction of existing gas transfer stations, and for construction of new gas transfer stations on the main gas pipeline. The unit is delivered as a turnkey package along with the individual hangar-type shelter building.

"REP Holding" is the developer of GPU-16 "Ladoga".

16 MW Gas-Pumping Unit is manufactured and assembled by "REP Holding" at the manufacturing facilities of "Nevsky Zavod".

Unit Components

- 16 MW Gas-Turbine Unit ;
- Centrifugal Natural Gas Compressor;
- Complex Automatic Control System (KSAU);
- Filter House, including the Anti-Icing System;
- Dry Gas Seal Control System;
- Separation and Buffer (Sealing) Gas Treatment and Supply System;
- Oil Supply System;
- Instrument Air Treatment and Supply System;
- Fuel Gas Conditioning and Supply System;
- Exhaust System;
- GPU Fire Fighting System;
- Turbounit Cooling System;
- Axial Compressor Washing System;
- Hangar-type Shelter Building together with emergency, exhaust, and supply ventilation, lighting, heating systems, etc.;
- Lifting Equipment inside the Building;
- Air Heating Unit of the Building;
- Auxiliary Equipment as specified by the individual requirements of the Customer and as required by the construction climatology.



Components of GPU-16 "Ladoga"

- 1 - GTU; 2 - Filter House; 3 - Exhaust System; 4 - Oil Cooler;
 5 - Building Heating Unit; 6 - Instrument Air Treatment; 7 - Metal Framework
 of the Hangar-Type Building; 8 - Lifting Equipment; 9 - Ventilation System of the Building

Gas-Turbine Unit

GTU-T16 "Ladoga" is a new standard of 16 MW turbines.

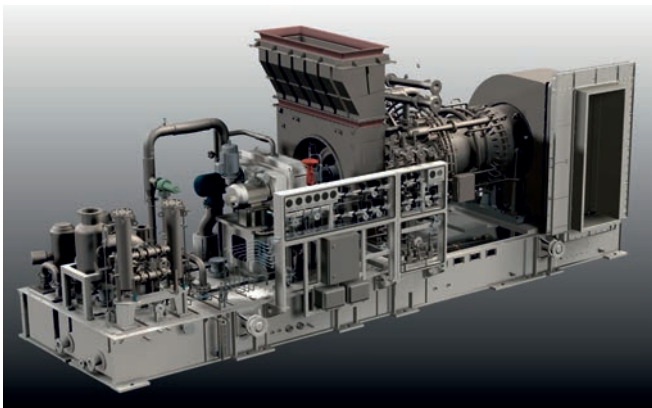
New hi-tech gas-turbine unit T16 rated for 16.5 MW is produced by "REP Holding" at the manufacturing site of "Nevsky Zavod".

Stationary gas turbine T16 is designed by "REP Holding" engineers in partnership with GE Oil & Gas based on GE innovative technologies.

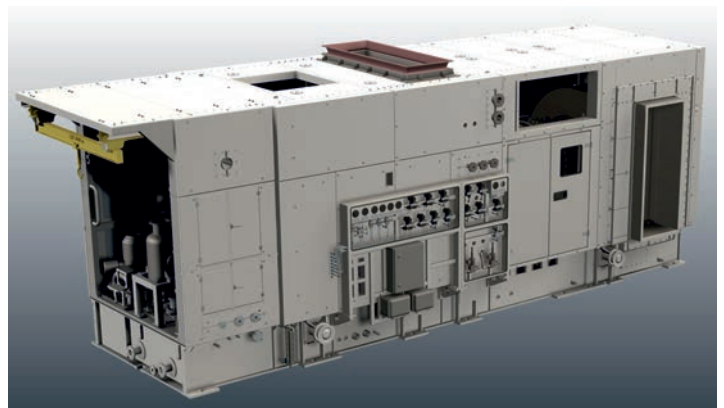
The new GTU-T16, which is designed to be a mechanical drive and to generate power, is noted for its high efficiency together with low emission level, and exceptional operational readiness. T16 refers to the industrial GTU with a prolonged service life and high flexibility for on-site service maintenance, which is achieved by the modular maintenance concept.

Components of GTU -T16

- Turbounit of Frame
- Auxiliary Equipment on Frame
- Automatic Control System
- Noise-and Heat-Insulating Enclosure of GTU (Enclosure)



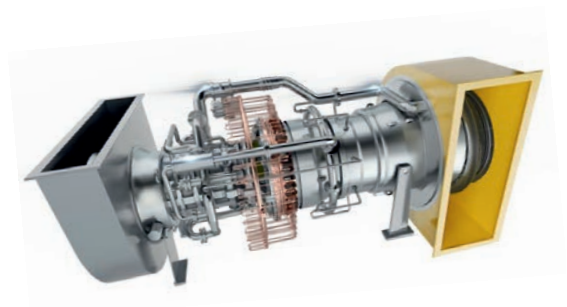
GTU-T16 on frame



GTU-T16 on frame inside enclosure

Key Features

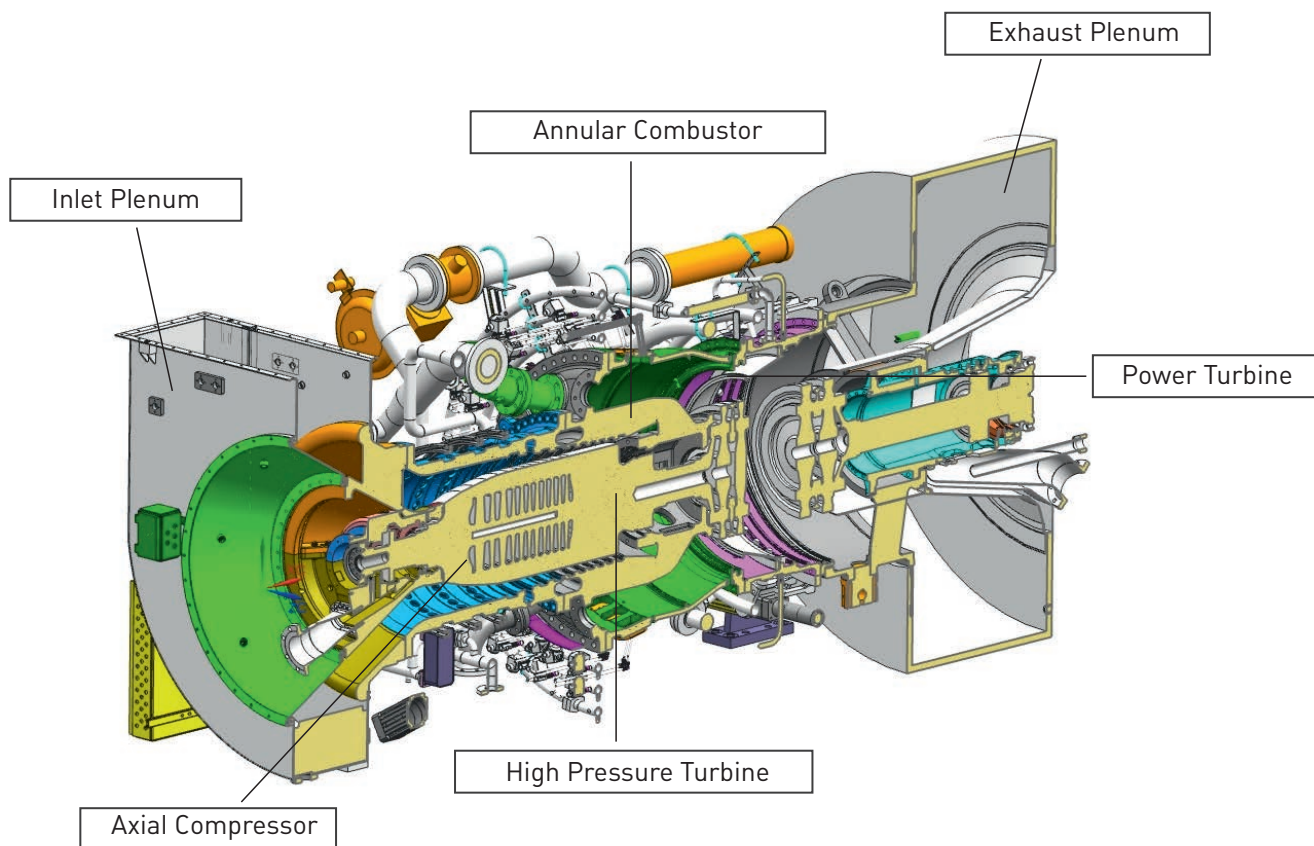
- 16.5 MW is the shaft output
- 37% is the efficiency of the mechanical drive
- 36% is the electrical efficiency (simple cycle)
- 80% is efficiency of the combined power and heat generation plants
- 200 000 hours - full life cycle
- NOx emission - no more than 25 ppm



16 MW Gas-Turbine Engine, 3D Model

Design Features

- Type of GTU is a stationary two-shaft unit
- 2 stage HPT and 2 stage LPT
- 12 stage axial compressor, compression ratio is 19
- Low-emission Combustion Chamber



Longitudinal Profile of T16 Turbine

- Two-stage high pressure turbine with cooled blading
- The two-stage low pressure turbine with the 1st stage variable nozzle assembly, maintains high efficiency over a wide working range
- The combustion chamber ensures NO_x emission no more than 25 ppm
- Three stages of the axial compressor with variable guide vanes assembly

Key Parameters of GTU-T16

Description of Parameter	Value
Rated Power on Power Turbine Coupling as per ISO conditions, MW, not less than	16.5
Efficiency, calculated on the basis of the power turbine coupling power, as specified in the item 1 as per ISO conditions, not less than, %	37.0
Power on the power turbine coupling in the site, MW, not less than	16.0
Efficiency, calculated on the basis of the power turbine coupling power, as specified in the item 3, not less than, %	36.5
Maximum Power on the driver's coupling in the site at the negative ambient air temperature, MW, not more than	19.2
Rated/Maximum Temperature of Combustion products downstream of the power turbine , °C	492* / 600*
Rated Speed of HPT Rotor, rpm	10204*
Rated Speed of LPT Rotor, rpm	7800*
Rotation direction of LPT rotor	Clockwise when viewing from the compressor side GOST 22378
LPT speed variation range, % of the rated value	70* / -105*
Time required for Start-Up and Reaching the Minimum Operation Speed (from "Hot Standby" status), min	25
On-Site Rated Flow Rate of Fuel Gas (at the fuel specific energy 50 MJ/kg), kg/s	0.88
Fuel Gas Pressure upstream of the Isolation Valve (Gauge), MPa	from 3.4 to 3.7*
Anti-Icing Air Flow Rate (reference value), kg/s	53.7*
Pressure Ratio of the Axial Compressor	19*

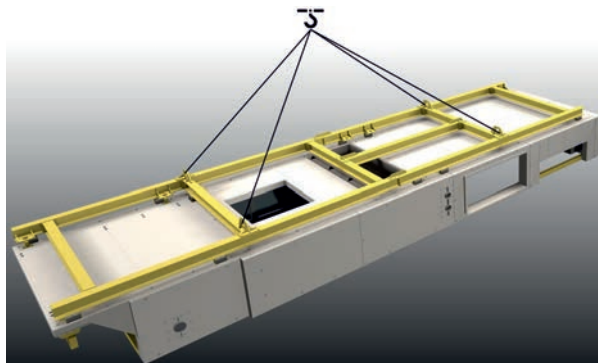
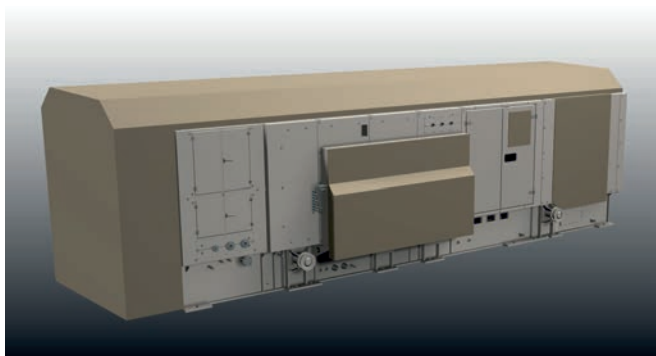
Note

*The parameters are to be corrected on the design phase.

GTE Weight is 58 000 kg without the Enclosure and 66 000 kg with the Enclosure.

Advantages of GTU-T16

- High Performance
- Classic Environmental Performance
- Long Service Life
- Easy for Maintenance
- High level of Operational Availability
- Lateral Rolling-Out of both Turbounit, and LPT and Gas-Generator
- Delivery in turnkey condition due to modular and compact structure of GTU



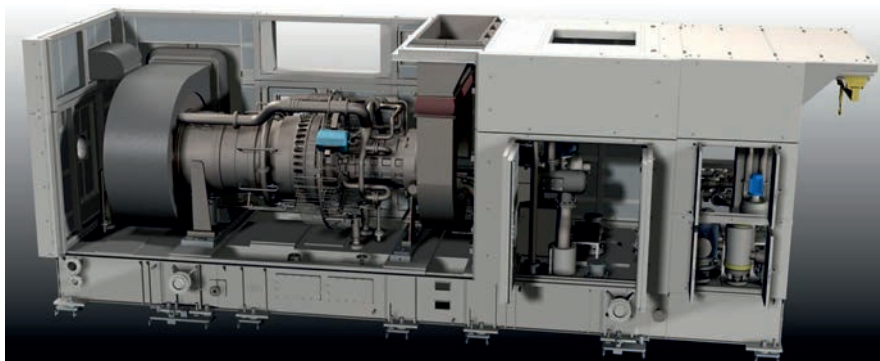
Delivery of GTU-T16 in the turnkey condition

GPU as a part of the gas transfer system

Due to the optimum power rating (16.5 MW) and the output shaft speed (7800 RPM), T16 is perfect for modern compressor stations while transmitting gas via the gas trunk-line system.

Performance

- T16 is noted for its operational flexibility across a wide variety of loads. The high efficiency along with the low emissions are obtained within the range from 20% to 100% of operation load.
- The implemented fuel combustion algorithms do not require seasonal tuning of the combustion chamber, with the low level of harmful emission maintained.
- Modular structure of T16 significantly facilitates maintenance of GTU due to the fact that the roof and the lateral enclosure panels can be quickly dismantled without disassembling of the the ventilation, anti-icing and heating air ducts.

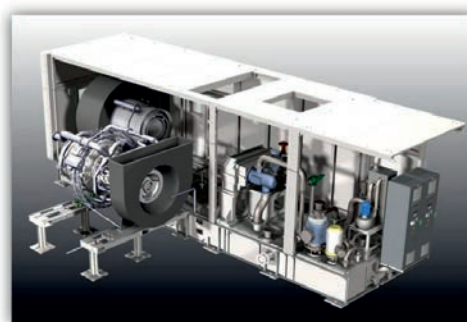


Modular Structure of T16

- The gas turbine has the integrated remote monitoring and diagnostics devices which provide collection and complex data analysis.
- T16 arrangement on the base plate provides lateral roll-out of the high and low pressure parts, as well as the entire unit, which makes it possible to perform comprehensive prompt technical maintenance.



Rolling-Out of the Entire Turbounit



Rolling-Out of Gas-Generator

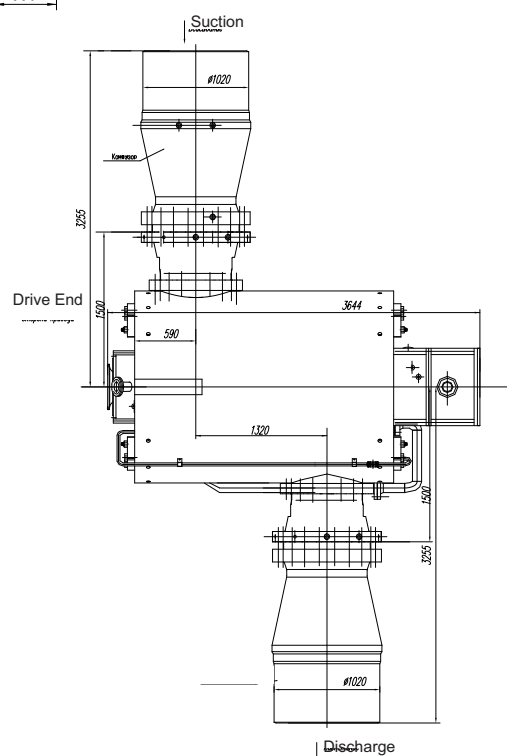
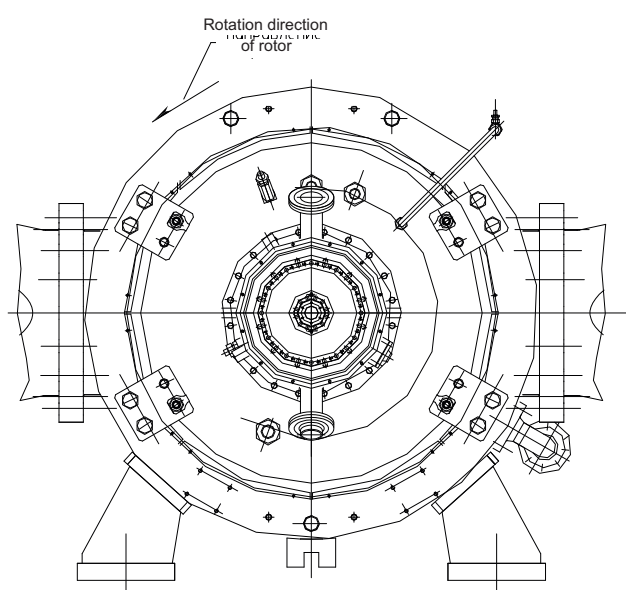
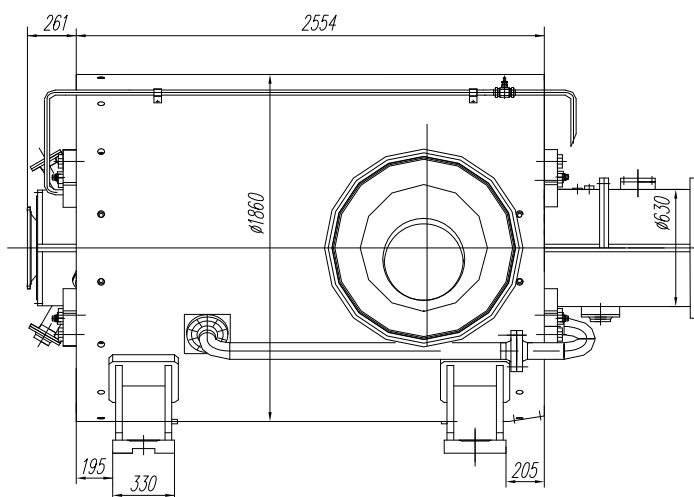
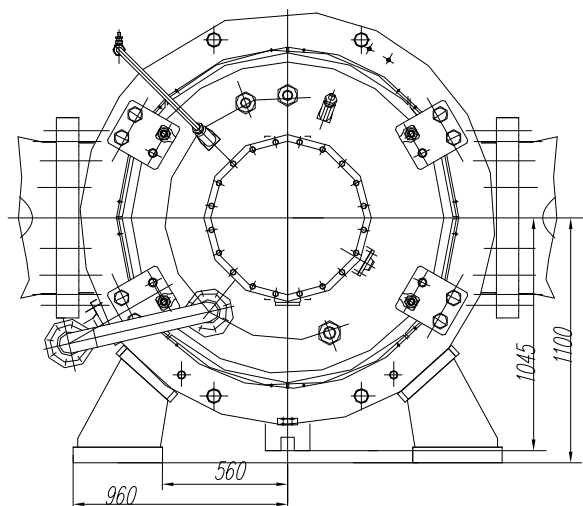


Low Pressure Turbine Rolling-Out

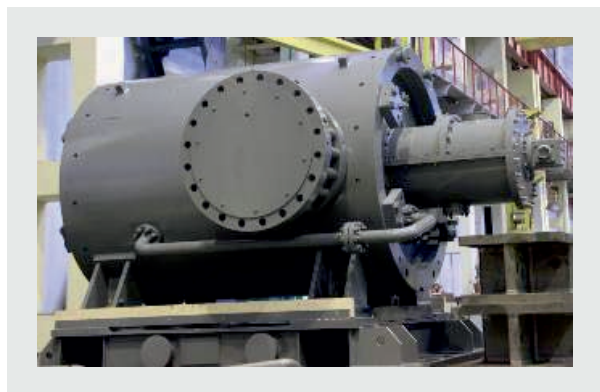
Centrifugal Compressor, GTU-T16 Project

Description of Parameter	Centrifugal Compressor Type			
	650-11-1C	650-11-1C	650-11-1C	650-11-1C
Efficiency at 20° C and 0.1013 MPa, mln.nm3/day	62.3	45.6	32.7	21.4
Volumetric Efficiency under the initial conditions, m3/min	658	522	385	315
Final absolute gas pressure at the outlet of the discharge pipe, MPa	7.45	7.45	7.45	7.45
Initial absolute gas pressure at the inlet of the compressor's suction pipe, MPa	5.96	5.52	5.17	4.38
Initial Gas Temperature at the inlet of the compressor's suction pipe, ° C	15			
Pressure Ratio	1.25	1.35	1.44	1.7
Polytropic Efficiency	0.89	0.89	0.88	0.87
Compressor Power Consumption, MW	15.2	15.1	15.1	15.4
Rated Rotor Speed, rpm	7800	7800	7800	7800
Operating Speed Range, % of the rated value	70÷105			

Pressure Ratio	1.25	1.35	1.44	1.5	1.7
Flow Path Type	with one impeller	with one impeller	with two impellers	with two impellers	with two impellers
Gas Pressure at the outlet of the Centrifugal compressor (for a line compressor station), MPa	5.5 7.45	5.5 7.45	5.5 7.45 8.3 10.0 12.0	5.5 7.45 8.3 10.0 12.0	7.45 8.3 10.0 12.0



General View of the Centrifugal Compressor for T16. Sketch



compressor 405-21-1C



compressor 400-21-1C

Unified casing of centrifugal Compressor of T16

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