Customer's requirements

Take-off

Certification

Analysis of requirements, determination of configuration

Tests

PDM-System

CAD-System

CAE-System

ASTPP-System

Prototype

Units and Parts Manufacturing, Inc. Different Types of Casting, Stamping, Welding, Machining

Advanced Technologies Development with CAM Systems and Complex Prototyping Systems

Separate Units and Parts Testing

Engine Special Bench Tests

Prototype-Flight Tests

Engine Endurance Certification Testing

CAD-System

CAE-System

ASTPP-System

Prototype
Aircraft builders know that a Klimov product is not just an engine manufactured by its developers. A Klimov engine synthesizes knowledge, experience and state-of-the-art technology that brings the boldest ideas to life.

Klimov means excellent flight performance for the aircraft that you conceived.

We take care of certifying our engines in any country of the world.

Our research and design involves the best centers in Russia such as:

- The Russian Academy of Science
- The Baranov Central Institute of Aircraft Engines
- The National Research Institute of Aviation Materials
- The National Institute of Light Alloys
- The Institute of Standardization and Unification
Concept generation means that the customer’s requirements are analyzed and transformed into the configuration of the future engine. It is a starting point of a long journey ending in the mandatory certification of the product. Demands to the reliability, minimum takeoff weight, efficiency, service life and power (thrust) vary depending on the customer.

We specialize in the development of the following power plants for helicopters and airplanes:

- auxiliary power units (100-400 hp)
- turboshaft power plants (400-6000 hp) for helicopters with the maximum takeoff weight of 15 tons
- turboprop power plants (2000-6000 hp) for airplanes with the takeoff weight up to 24 tons
- turbojet power plants (1-120 kN) for military airplanes including drones.

Principal requirements for engines and power plants

- Efficiency, compact size and weight, easy maintenance
- Specific mass
- Reliability, long service life, efficiency of components
- Maximum specific thrust
Today’s aviation technology is inconceivable without computerization at all the stages of product development. The design process requires that numerous variants of the future engine are analyzed, which means processing an enormous amount of information. Engine research and development is a time-consuming and expensive business. However, it can be optimized to reduce costs, save time, improve quality and therefore benefit the customer. At the engineering department of the Klimov Company, the design management process is streamlined with the help of the PDM-system. This automatic system handles all the information concerning the product (specifications, simulation data, test results and so on) and facilitates the integration of existing experience in new projects, therefore saving time and reducing costs. The combination of expertise and automated design techniques employed by engineers at the Klimov Company translates into fast delivery and top-quality performance.

PDM - Product Data Management (design and engineering data control system)
Building a prototype engine involves a test of all the designed parameters of the machine.

The development of radically new products depends on ground-breaking engineering solutions as well as advanced production technologies and new materials.

The Klimov Company manufactures gas turbine engines, main gearboxes and accessory drive gearboxes with the use of the following state-of-the art technologies:

- all types of casting, including directed crystallization with surface modification;
- stamping, including hydromechanical and hydroelectric pulse stamping;
- machining of most sophisticated components such as centrifugal wheels and asymmetric tooth transmissions;
- argon-shielded, electron beam and contact welding;
- deposition of metal and ceramic metal composite coatings;
- thermochemical and thermal treatment, particularly in a shielding environment such as argon or vacuum.

Our technologies are certified by the Aviation Register of the Interstate Aviation Committee. They meet all the international requirements for the aircraft building industry.
Tests

Bench tests that verify the theoretical design parameters are a very special stage of gas turbine engine development. Bench testing must simulate the actual conditions of operation as close as possible. The testing equipment at the Klimov Company consists of 70 special benches (including two thermal vacuum chambers) fit for examining the performance of individual parts and components, actual full-size turbojet, turboshaft and turboprop engines as well as gearbox-equipped helicopter power plants.

Test benches at the Klimov Company are good for investigating the performance of the entire range of gas turbine engines developed by the engineering department. Gas turbine engines that have a power from 70 to 6000 hp are tested at a hydraulic drag bench. Aircraft rotor benches are used to test engines that feature a takeoff power from 400 to 6000 hp. Turbojet engine test stands that simulate intake conditions at various speeds (up to M=2.5) are suitable for engines whose thrust ranges up to 120 kN. The Klimov Company also has a unique test bench for the full-size MiG-29 fighter power plant (both engines with an integrated accessory drive gearbox).

The benches are equipped with a modern stationary and non-stationary test data processing system.
Certification is the ultimate means of quality control, an efficient regulatory instrument governing the relations between manufacturers, suppliers and customers both domestically and internationally. Certification promotes longer-term market success, provides consistent protection against competition from non-certified products, improves product quality and encourages research and design efforts.

-- More than 50% of engines designed by the Klimov Company are put into serial production
-- 100% of civil aviation engines designed by the Klimov Company are certified.
Type Certificate

IE-35

Pursuant to Canadian Aviation Regulations PART V, SUBPART 11, this Type Certificate is issued to:

Klimov Corporation
St. Petersburg
194 100, Russian Federation

For the Following Aeronautical Products:

TV3-117BM
TV3-117BM series 02

Details of the type design, basis of certification, operating limitations and other associated airworthiness requirements are specified in:

Department of Transport Type Certificate Data Sheet IE-35 Issue 1

May 11, 1998

Date of Issue

Hand, Aircraft Certification
For Minister of Transport

Transport Canada

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1. fan module  
2. accessory drive gearbox  
3. central drive  
4. front cover of bypass duct  
5. gas generator  
6. low pressure turbine rotor  
7. turbine support module with cone and mixer  
8. rear cover of bypass duct  
9. mixer cover  
10. afterburner and jet nozzle
Cooperation among companies contributes to faster development of high-tech and knowledge-intensive products. The Klimov Company seeks to consolidate its research and design efforts with engine units (systems) developers, serial production plants and leading R&D centers.
Fan and compressor

Background
The fan and the compressor increase air pressure inside the engine.

Main requirements:
- low air consumption, high efficiency, stability of pressure
- reliability
- long service life
- resilience to ingested foreign objects

Our experience: The RD-33 turbojet engine fan and compressor feature a high capacity for stable operation in a variety of stationary and transient modes under a wide range of ambient conditions such as air pressure and temperature, thus contributing to the excellent gas dynamic stability of the power plant as a whole.

Further improvements: To reduce the number of stages, simplify design and reduce weight while maintaining the current performance (compression ratio and efficiency) by taking advantage of modern engineering methods, materials and technologies.

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Combustion chamber

Background
The combustion chamber supplies heat to the working medium.

Main requirements:
- high extent of combustion
- uniformity of temperature
- multimode operation capacity
- low emission level
- minimum overall dimensions

Our experience: The circular reverse-flow combustion chamber of the TV7-117S turboprop engine reduces the length of the engine. It is a small unit that features a high extent of combustion and restores full pressure fast. Thanks to the chamber’s superb emission parameters it may be installed without modifications in a more powerful version of the engine, the TV7-117SM (ST).

Further improvements: To use new materials, particularly ceramic metal composites for operation at higher temperatures.
Turbine

Background
The turbine converts the potential energy of gas to mechanical work of the rotor that can be used by the consuming device.

Main requirements:
- high efficiency
- reliability
- long service life at high temperature

Our experience: The high temperature non-cooled turbine of the VK-2500 engine was based on the TV3-117 model. New materials made it possible to increase the gas temperature before the turbine without changing the geometry of the flow section and increase the takeoff power by 10 percent compared to the original model.

Further improvements: To develop an advanced cooling system, to use new materials including cermetes, reduce the number of stages, reduce the weight of the turbine and streamline its design using modern engineering methods, materials and technologies.
Nozzle of the jet engine

Background
The nozzle converts the potential energy of the gas into kinetic energy of the flow as it leaves the engine.

Main requirements:
- High efficiency and dependability
- Minimum size and weight

Our experience: The thrust vectoring nozzle is a proprietary high technology product that vastly improves the maneuverability of aircraft. The crucial difference between the TVN and the traditional nozzles is that the new design features a far superior all-direction system of the thrust vector control, as it can be deflected in any direction in all flight modes including the afterburning mode.

Further improvements: To employ new materials including ceramic metal composites to reduce the weight of the nozzle; to increase the temperature limit of operation; to increase the nozzle deflection angle to ±20.
Gearbox

Background
Transmits power from the turbine shaft to the output shaft at a reduced rate of rotary speed.

Main requirements:
- operation at the required transmission ratio
- reliability
- minimum weight
- minimum size
- simple design
- long service life

Our experience: The VR-80 gearbox for Ka-50 and Ka-52 helicopters features separate intermediate transmissions to simplify maintenance and improve operation. It can be easily repaired both by the manufacturer and on-site. Aircraft equipped with the VR-80 gearbox can continue the flight after the failure of one engine, while in the event both engines fail the aircraft can land in the autorotation mode.

The popular VR-14 gearbox for civil and military helicopters (Mi-8AMT, Mi-8MTV, Mi-17 and its modifications) is used in 80 countries of the world. It is a highly dependable unit with a long service life.

Further improvements: To use modern materials and technologies, particularly powder metallurgy, for manufacturing gearbox cases and rotating parts in order to reduce their weight and extend service life.
Automatic Control and Monitoring System

Background
The ACMS monitors and controls the operation of the engine and its systems in all modes. Automatic control extends the life of the engine’s hot area and helps run the engine in a mode that corresponds to its state. It is a powerful means of adapting engine control to changing ambient conditions and various failures.

Main requirements:
- reliability
- trouble-free operation
- long service life
- high accuracy of monitoring
- precision of control

Our experience: BARK-42 is installed on the modified RD-33 engine to replace as many as 4 devices while performing significantly more functions and reducing the weight of the power plant (the unit is relatively lightweight and needs shorter cables). Its generous independent memory stores flight data for the ex-post monitoring and diagnostics of the power plant.

Further improvements: To switch the unit to the FADEC (Full Authority Digital Electronics Control) system.

Gas Temperature variation at Acceleration

Gas temperature variation with the previous generation control system

Gas temperature variation with the BARK (FADEC) system

Time, s

Gas temperature before turbine

ΔT=10°
# List of models in serial production

## Aircraft power units

<table>
<thead>
<tr>
<th>Model, power class</th>
<th>Serial manufacturer</th>
<th>Aircraft models</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Helicopter turboshaft engines and power plants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GTD-350, 400 hp, VR-2 main gearbox</td>
<td>WSK PZL, Rzeszów, Poland</td>
<td>Mi-2</td>
</tr>
<tr>
<td>TV2-117, 1500 hp, VR-8 main gearbox</td>
<td>Perm Machine Works, Reduktor PM Company</td>
<td>Mi-8T, Mi-8P, Mi-8PS</td>
</tr>
<tr>
<td>TV3-117 (all modifications), 2000-2400 hp, VR-14, VR-24, VR-80, VR-252 main gearboxes</td>
<td>The Klimov Company, Motor Sich Company, Krasnyi Oktiabr Company, Reduktor PM Company</td>
<td>Mi-8MT, Mi-17, Mi-14, Mi-24 Mi-25, Mi-35, Mi-28N, Ka-27 Ka-28, Ka-29, Ka-31, Ka-32 Ka-50, Ka-52, Ka-50-2</td>
</tr>
<tr>
<td>BK-2500, 2400-2700 hp</td>
<td>The Klimov Company, Motor Sich Company</td>
<td>Mi-8MT, Mi-17, Mi-24, Mi-25 Mi-35, Ka-32, Ka-52</td>
</tr>
<tr>
<td><strong>Turbojet bypass engines with afterburner for airplanes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RD-33 (all modifications), 81-86 kN, deflecting thrust vector nozzle</td>
<td>Chernyshev MMPP Company, Baranov OMO Company</td>
<td>MiG-29, MiG-29UB, MiG-29M MiG-29SMT, MiG-29UBT MiG-29K, FC-1 (Super-7) Super Mirage F-1 Super Cheetah D-2</td>
</tr>
<tr>
<td><strong>Turboprop aircraft engines</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TB7-117, 2500-3000 hp</td>
<td>Chernyshev MMPP Company, Baranov OMO Company</td>
<td>Il-114, Il-114T, Il-112</td>
</tr>
<tr>
<td>TV3-117VMA-SBM1 2500-2800 hp</td>
<td>Motor Sich Company</td>
<td>An-140</td>
</tr>
</tbody>
</table>
### Land use engines

<table>
<thead>
<tr>
<th>Model, power class</th>
<th>Serial manufacturer</th>
<th>Tank model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family of GTD-1250 tank engines, 1250 hp</td>
<td>Kaluga Machine Works (KADVI)</td>
<td>T-80, BREM-80U Black Eagle, Ladoga</td>
</tr>
</tbody>
</table>

### Equipment for the energy sector

<table>
<thead>
<tr>
<th>Model, power</th>
<th>Serial producer</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modular pumps based on helicopter engines with the power of 1.25-2.5 МWт.</td>
<td>The Klimov Company</td>
<td>1) Arctic Oil Company (Kolguev Island, Nenetsky Province); 2) LUKoil North (Ardala and Teida oil fields); 3) Research Centre for Energy-Saving Processes and Equipment (Russian Academy of Sciences) 4) The Baltic Fleet 5) Geoilbent Company</td>
</tr>
</tbody>
</table>

### Automatic monitoring and control systems

<table>
<thead>
<tr>
<th>Model, power</th>
<th>Serial producer</th>
<th>Host engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>BARK-65, IDK-65</td>
<td>The Klimov Company</td>
<td>TV7-117SM</td>
</tr>
<tr>
<td>BARK-78, KPA-78</td>
<td>The Klimov Company</td>
<td>VK-2500</td>
</tr>
<tr>
<td>BARK-42, IDK-42</td>
<td>The Klimov Company</td>
<td>Modifications of RD-33</td>
</tr>
<tr>
<td>BARK-93, IDK-93</td>
<td>The Klimov Company</td>
<td>Modifications of RD-33</td>
</tr>
</tbody>
</table>