

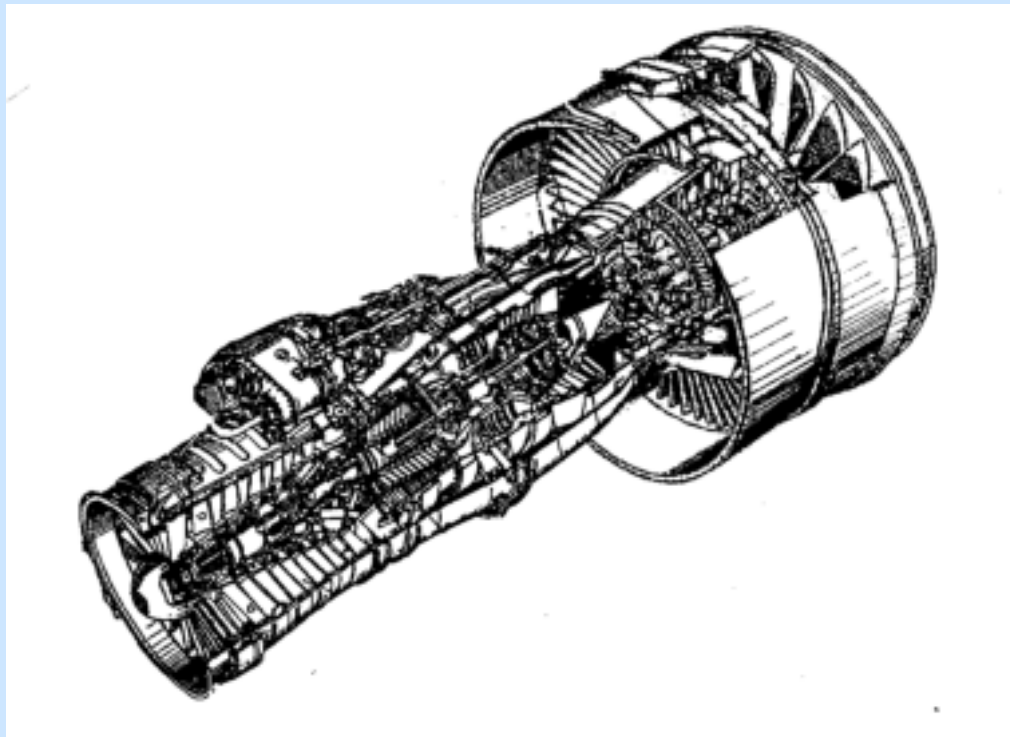


**DEPARTMENT OF AVIATION ENGINES
AEROSPACE FACULTY
NATIONAL AVIATION UNIVERSITY**



DOUBLE BYPASS MODULE ENGINE WITH A TURBOFAN UNIT FOR THE NEXT-GENERATION AIRCRAFT

(Technological offer for the investment project)



- **Aim of the project is to develop a fundamentally new, competitive in the global market double bypass engine of module design for aircraft**
- **The use of a double bypass module engine with enhanced economic characteristics will allow to solve tasks of Increase effectiveness of next generation aircraft with respect to economic and environmental parameters.**

Next generation medium range aircraft with a double bypass turbojet engine

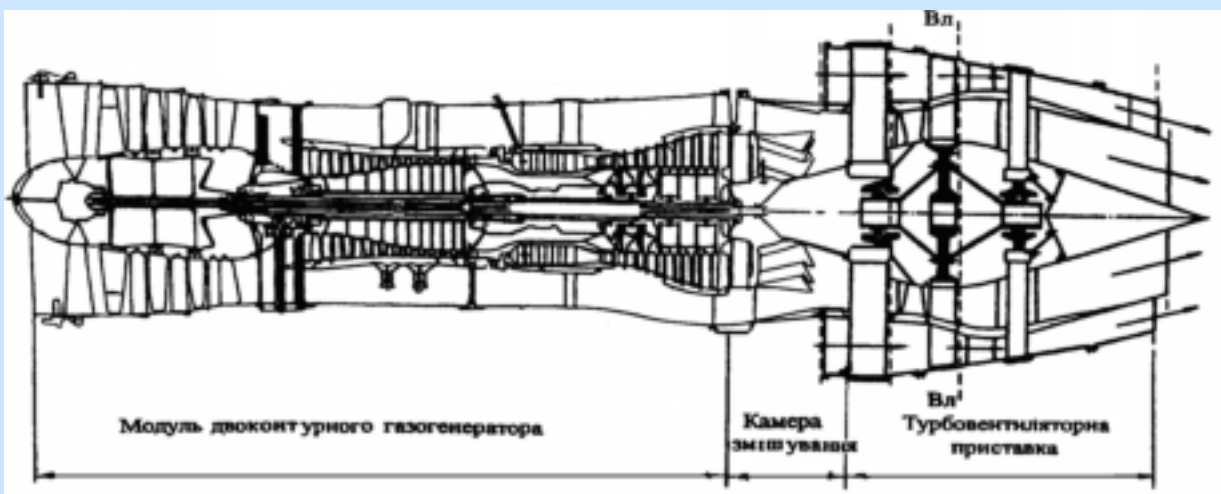


Maximum take off weight (kg)	70000-100000
Cruise speed (M)	0,8-0,9
Flight range (km)	5000-6000

Next generation double bypass turbojet engine with bypass base generator development concept

Advantages of a double bypass turbojet engine

- Realization with the least economic loss of the module principle when developing the family of gas turbine engines based on the base bypass gas generator;
- The possibility of the thrust increase during start by 35-40% compared to the parameters of the current engine. In the cruise regime of flight with subsonic velocity the thrust increase by 15% . Improvement of engine efficiency by 20...25% in subsonic velocities.
- Improvement of acoustic characteristics of the power unit
- Decrease of radial temperature gradient in critical elements of turbofan module



Development of double bypass engine based on the units serial bypass gas generator

1. Based on a basic bypass gas turbine engine a double bypass engine of the module type with enhanced technical and economical properties in a very short time .
2. The combined use of a serial bypass gas generator module and a turbofan module adapted to the parameters of aircraft will allow 40 to 60% decrease in development cost if compared to the average global cost of engines with similar parameters development.
3. A competitive advantage of this engine on the global market is determined by the simplicity of a module design, high parameters and characteristics of a bypass gas generator, and low engine price.
4. The replacement of engines may increase their operations efficiency on the market of air transportation.

Calculated parameters of turbojet double bypass engine with turbofan module and bypass gas generator, based on serial bypass engines with flow mixing

Engine used as bypass gas generator	Adour (France)	RB-153 (UK-Germany)	RB-199 (UK)	TF-30 (USA)	RD-33 (Russia)	AL-31 (Russia)
Temperature T_r , K	1500	1500	1590	1439	1536	1665
Total of pressure ratio $\pi_{\kappa\Sigma}^*$	12	18	25	17,5	21	23
Total use of air through gas generator G_{bl} , kg/s	46	55	74	95	76,5	112
Total use of air through engine, $G_{b\Sigma}$, kg/s	173,5	208	249	279	336	539
Degree of double bypass	5	5	5	4	5	6
Statistical thrust, kN	24,5 45,6	31,75 51,94	43 64,69	55,7 73,27	50 96,26	78 154,4
Specific fuel consumption, kg/Nh	0,067 0,044	0,06 0,0352	0,065 0,0350	0,064 0,037	0,078 0,032	0,075 0,0351

Project execution stages

- 1. Research. Parameters and characteristics of the power unit for the next generation aircraft development and justification. (NAS of Ukraine, National Aviation University, Ministry of Education of Ukraine, SE Ivchenko Progress, JSC Motor Sich, SE Antonov). (\$10.0 M) .
- 2. Development. Development of the draft project of a turbojet double bypass engine within the 5 000 – 15 000 kgs class of thrust; conducting of a complex of project, experimental and technological research. (SE “Ivchenko Progress”, JSC “Motor Sich”, SE Antonov, National Aviation University). (\$10.0 M) .
- 3. Development of fundamental technologies necessary for the creation of an next generation aircraft engine within the 5 000 – 15 000 kgs class of thrust (SE Ivchenko Progress, JSC Motor Sich). .

Current state of the project

- During the research stage basics of double bypass turbojet engines with a rear location of a turbofan module have been developed. The use of which allows analyzing the working process of double bypass turbojet engines and determining of the optimal parameters of the engine working process according to the parameters and characteristics of the aircraft.
- Currently, national and foreign companies are producing bypass gas turbine engines with cumulative air output of 40 to 200 kg/s, which can be used as module gas generators in suggested project.
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- The results of the research have shown that thrust of the basic bypass engine in take-off mode may be increased by 40...55%. Specific fuel consumption of a double bypass engine is 20...25% less than of a bypass engine with similar parameters.

Research stage

Theoretical research, development of models and methods for calculation of the working process and determination of parameters of double bypass engine with turbofan module.

(SE Ivchenko Progress, JSC Motor Sich, SE Antonov, National Aviation university)

Development of models, methods and techniques for calculation and solving problems of harmonization and optimization of double bypass turbofan engine gas generator modules and turbofan module.

(Institute of Mechanical Engineering problems of NAS of Ukraine, SE Ivchenko Progress, National Aviation university)

Research of problems of integration of double bypass turbojet engine with turbofan module with aircraft.

(SE Antonov, SE Ivchenko Progress, JSC Motor Sich, National Aviation university)

Development of models, methods and techniques for calculation of small size mixture chambers. Research of small size mixing chambers of a double bypass engine

(IET of NAS UKRAINE, SE Ivchenko Progress, National Aviation university)

Research of the strength of the critical elements of a double bypass turbojet turbofan module

(Institute of Problems of Strength of NAS of Ukraine, Institute of Mechanical Engineering problems of NAS of Ukraine, SE Ivchenko Progress, National Aviation university)

Economic justification of the project

The world cost of development of double bypass turbojet engine for medium range aircraft (e.g. B-737) is approximately \$1,5...2,0 billion.

The cost of development of a double bypass engine with a turbofan module is 75...80% less than the cost of development of new bypass engine with similar parameters due to the use in a double bypass engine of tested serial bypass gas turbine engines modules.

The use of double bypass engine with the turbofan module located in the back of the middle range aircraft may allow the decrease in fuel consumption of 450...600 kg of fuel per hour at a cruise flight, which is equivalent to \$ 675...900.

If the annual flight time of one medium range flying wing type aircraft is 2000 hours \$ 1,35...1,8 M may be saved in fuel economy.

The aerodynamic assembling of the B-737 aircraft of different modifications and also next-generation of domestic and foreign projects has exhausted the possibilities for improvement.

If we have a fleet of 100 medium range flying wing type aircraft the revenues due to the decrease of direct costs of fuel can increase by \$ 2,0 billion.

The potential capabilities of the next-generation medium range flying wing type aircraft with a double bypass engine allow to forecast its modernization and exploitation for 50 years ahead.

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