

SE Ivchenko-Progress State and Prospects of its Development

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Abstract. SE IVCHENKO-PROGRESS – state and prospects of enterprise development. September 2021.

SE “Ivchenko-Progress” celebrated the 76th anniversary of the founding of the State Enterprise “Zaporizhzhya Machine-Building Design Bureau” Progress “named after Academician OG Ivchenko.

Ivchenko-Progress’s cooperation with the institutions of the National Academy of Sciences of Ukraine is constantly expanding.

Keywords: Ivchenko-Progress SE.

Introduction

May 5, 2021 marked the 76th anniversary of the foundation of Zaporizhzhia Machine-Building Design Bureau Progress State Enterprise named after Academician O. H. Ivchenko (Ivchenko-Progress SE).

On May 5, 1945, by order No. 193 signed by the People's Commissar of the Aviation Industry of the USSR O. Shahurin a research and development bureau (RDB) was established at the State Union Plant No. 478 in Zaporozhye to develop new and update earlier designed medium and low power aircraft engines for civil aviation.

On August 20, 1957, by order of the MAP, Design Bureau of the plant No. 478 was reorganized into an independent State Union Research and Design Bureau No. 478. In 1966 the enterprise was renamed to Zaporizhzhia Machine-Building Design Bureau (ZMKB) Progress. Since 1994, the enterprise is named after the first General Designer, Academician O. Ivchenko, the founder of the Design Bureau.

Since 1998 on the initiative of the General Designer F. Muravchenko by order of the enterprise No. 77, dated

February 10, 1998, the day of the enterprise foundation began to be celebrated every year at the end of the second decade of May as the “Enterprise’s Day”.

The exception was 2020, the year of the 75th anniversary of the enterprise foundation, when due to the difficult sanitary and epidemiological situation in the country it was decided not to celebrate the Enterprise’s Day.

Ivchenko Progress SE has made a significant contribution to the development of world’s aviation industry. For 76 years, Ivchenko-Progress SE has been developing engines for many types of aircraft and helicopters, as well as drives and special equipment for industrial use. During this period, the world’s engine manufacturers have produced more than 80,000 aircraft piston and gas turbine engines, turbine starters and industrial drives designed by the staff of our enterprise. Aircraft engines developed by Ivchenko-Progress SE are installed in 66 types and derived versions of aircraft. Serially manufactured engines are operated in more than 100 countries worldwide. The total operating time of the entire fleet of gas turbine engines in operation is more than 300 million hours. The enterprise has more than 230 business partners from a variety of countries. The enterprise’s right to design, manufacture, repair and update engines is confirmed by more than 60 certificates and additions issued by the State Aviation Administration of Ukraine (SAAU), Bureau Veritas Certification of Ukraine (BS EN ISO 9001: 2015, EN 9100: 2018), European Aviation Safety Agency (EASA), the General Directorate of Civil Aviation of China (CAAC), the Aviation Register of the Interstate Aviation Committee (AR IAC). Since 2004,

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Ivchenko-Progress SE has been a full member of the Eastern European Air Transport Association (EEATA) and has a Certificate of Compliance with the requirements of this Organization. Since 2007 the enterprise is a member of O. Ivchenko SPC corporation, and since 2011 it is included into the Ukroboronprom State Concern.

Since 2016, the enterprise has been included into the State Register of Scientific Organizations, which is confirmed by Certificate No. 02253, dated December 13, 2016, awarded by the Ministry of Education and Science of Ukraine. On May 31, 2019, Ivchenko-Progress SE was awarded a Certificate confirming its status as a scientific organization. The enterprise is included into the second classification group for a period of 3 years until May 31, 2022. According to the order of the Ministry of Education and Science of Ukraine No. 1714 dated December 28, 2017, the enterprise established a specialized academic council with the right to accept for approval and defend dissertations, and at the present time there are six dissertations successfully defended for scientific degree of Candidate of Science (Engineering).

Success achieved by the enterprise in the field of a variety of development trends for a period from 2019 to 2021 should be noted.

Activities on design of D-18T 3M series engine derivative were in progress. The bench tests of the 3M No.1 series experimental engine with check of additional measures for noise reduction, on strain gauge of excellent pipelines and vibrographing of spots for attachment of the automatic control system units, on test of the improved system of preparation of the aircraft air, on strain gauge of the moving casing of the reversible device, with testing the fan casing with the modified flow path, on check of emission of gaseous hazardous substances, on the development of the automatic control system software. The experimental 3M No.2 series engine was involved in the bench tests on adjustment of the automatic control system with participation of specialists from UNIS (Czech Republic) and DB KP Ltd. (Kiev), and 100 hour life equivalent-cyclic tests were also completed. After the equivalent-cyclic tests the condition of the engine parts was satisfactory, and a corresponding technical report was issued. The experimental D-18T engine was tested with a research of strength of the fan turbine stages 1 through 4 blades.

To ensure certification tests of An-124-100 aircraft with four D-18T 3M series engines, the assembly, testing (with emission verification) and delivery of two experimental engines to Antonov State Enterprise, as well as testing the other two experimental engines assembled at MOTOR SICH JSC were conducted.

Activities on support in the production, operation and repair of D-18T series 3 engines continued. 30 units of D-18T series 3 engines were repaired for operating organizations. Design support in operation of D-436-148 engines in An-148 and An-158 aircraft, D-436TP engines in Be-200 aircraft and flight tests of D-436-148FM engines installed in An-178 transport aircraft was performed. As of

May 1, 2021, the total operating time of the D-436-148 engine fleet since launch into service amounted to 474,347 hours (260,675 cycles), D-436TP engines to 42,325 hours (26,325 cycles), D-436-148FM engines to 407 hours (506 cycles). The D-436-148FM engine has passed special certification tests for compliance with European standards and is now under preparation for long-term certification tests.

In 2021, a government order was received for three An-178 aircraft powered by D-436-148FM-1 engines for the Ministry of Defense of Ukraine, the derived versions of D-436-148FM engine

The development work has been performed on the next stage of increasing the AI-450 family engines service life, as a result of which SAAU and AR IAC have extended their service life in the Certificates Data Card of the AI-450M/ M1/ M-B/ M-P/ M1-P turboshafts and AI-450C/ CD/ CM/ CP turboprop engines.

Certification works have been carried out in accordance with AP-33 of the turboprop engines developed on the basis of the AI-450C engine. In August 2019, the AR IAC issued the Approval of the Main Changes No. ST350-AMD/ OGI-03 for the certification of 4 AI-450C-1; AI-450CM-1; AI-450CD-1; AI-450CP-1 turboprop engines

The contract execution with Turkish Baykar Makina Sanayi ve Ticaret A.S company has been secured for the manufacture and supply of a batch of AI-450T engines, as well as the author's design support for the adapting the engines to the aircraft, which on December 6, 2019 performed the first flight and started flight tests. The evidentiary documentation required for AI-450T engine certification is developed. The AI-450C No.04 engine service life tests for 1,500 hours before the first overhaul for the most loaded AI-450CP model are carried out.

A set of special bench tests to ensure the start of flight tests of the AI-450CP-2 engine integrated in the TA-20 aircraft has been completed. The equivalent-cyclic tests of the AI-450CP-2 No.02 engine for the initial service life of 300 hours are carried out. The first AI-450CP-2 No.01 engine for ground and flight tests as part of the TA-20 aircraft was delivered under a contract with Wuhu Zhongke (PRC). The second AI-450CP-2 No.04 engine has successfully passed acceptance tests and is ready for delivery to the Customer for the aircraft flight tests. In accordance with the contract, Wuhu Zhongke was supplied with a set of design documentation to ensure the assembling and testing the AI-450CP-2 engine.

AI-222K-25F engines powering the L-15 aircraft gave to the aircraft an opportunity to fly with a supersonic speed. This is the first supersonic speed event achieved with the engines developed by Ivchenko-Progress SE.

Contractual works on delivery of AI-322F engines to the Foreign Customer are being performed. At MOTOR SICH JSC the preparation of production for the manufacture of hardware for AI-322FK engines has begun. The stage of the detailed design and release of the design documentation for the manufacture of AI-322-30 engines has been completed.

Research activity on the development of ramjet is underway.

Work to update the high-altitude chamber is carried out in the Experimental and Research Complex to ensure verification of the turbojet engine performance when simulating a flight altitude of 8,000 m and a flight speed of $M = 0.9$.

A test bench was delivered to the Customer to check the start and serviceability of small-size engines. Two small-size engines for UAV were delivered to the Foreign Customer.

To verify the engine's compliance with the requirements of the international standards and to confirm the altitude-airspeed performance the tests have been started in the high-altitude chamber at Ivchenko-Progress's. Engines are manufactured for flight development tests at the Customer's.

Development of an advanced auxiliary power plant for aircraft and helicopters has commenced.

The BP-17MS main gearbox, designed for updating Mi-8 / Mi-17 helicopters, passed long-term tests, a set of special tests, and was authorized to start flight development tests with an initial service life of 50 hours as integrated in the updated helicopter. Bench tests of the gearbox for further extending its service life are in progress.

Works on production of spare parts and repair of hardware for aircraft repair bases of Ukraine for the purpose of airworthiness support of the equipment used in the state aviation are carried out.

Technological preparation of production for manufacture of parts and assembly units of the AI-28 engine is executed, preparation of the test bench No.15 for testing the gas generator is carried out. The design of the fan blade made of composite material and the process of its manufacture is being tested. The specialists from the Department of the Chief Physical Metallurgist are involved in the development of a method of testing the locking part of the composite blade.

Testing of process of INCONEL 718 welding with M50NIL for the manufacture of the HPT rotor rear bearing support trunnion continues.

Today, work is underway to introduce the process of manufacturing turbine blades and vanes using Sarix electro-discharge drilling, which will allow to obtain holes of various configurations on the curved surfaces of heat-resistant alloy parts, expand design capabilities to improve the cooling efficiency of the blade, and help to improve the engine efficiency and decrease a fuel consumption.

Laser processing technology has been developed. The Acdis laser beam machine allowed to perform cutting at increased speeds of components of up to 4 mm thickness, which significantly reduced the production time of parts, today a laser welding process has been successfully implemented for earlier mastered thin-walled parts and welding of thick-walled parts (up to 2 mm). Work is underway to

use the laser welding process as a method of repairing parts and restoring complex curved surfaces of parts for GTEs. Successfully restored by using a wire ($\varnothing 0.5$ mm) the surfaces of the rakes of a sealing rear disk sample made of nickel-base alloy (low weldability material), also successfully performed a copper wire building-up welding to the blade tips, as an abradable material.

As part of the tasks in the AMVES R&D project, the specialists of the Design R&D Complex developed drawings of a test installation for research of the bearing chamber (turbine) in a hot environment.

In April 2021, the Experimental and Research Complex successfully launched the installation and conducted check tests of the bearing chamber

Research work on engine updating for a foreign Customer has been performed.

Ivchenko-Progress SE has developed and manufactured a tractor five-bladed AI-P500V5 propeller of feathering and reversing type of an automatically variable pitch with blades made of polymer-composite material for AI-450T turboprop engine of 500 hp power. Tests of the specified propeller are started. Preliminary tests have shown that the propulsion performance of AI-P500V5 propeller in the test bench conditions exceeded at least by 25 kgf the propulsion performance of the similar MTV-5-E-C-F-R (M)/CFR210-56 propeller developed by the MT-Propeller company.

Developed and tested ideas, production processes and materials introduced by Ivchenko-Progress SE not only into new advanced engines, but also into updating the existing production gas turbine engines, offer new possibilities and improvement of the aircraft performance quality. Work is continuously underway to improve consumer properties, further extending service life and reliability of production engines. As part of the work on the AI-25TLT and AI-25C engines, the electric start of these engines was tested.

Ivchenko-Progress SE successfully implements all its projects in close cooperation with Antonov SE, MOTOR SICH JSC, FED JSC, POLISVIT NT SKB, Element JSC, HAKB SE, HMZ FED SE, with scientific and research institutes of the NAS of Ukraine and higher educational institutions.

The enterprise has a many year experience in design of gas turbine engines for various applications, a modern scientific and production base, one of the largest experimental and research complex in Europe. Ivchenko-Progress SE is included in the Register of Scientific Organizations of Ukraine, it has many international and state awards and is considered a world-class enterprise in the aviation industry sector. The enterprise has more than 35 awards of international public recognition, including diplomas and awards for quality products and services.

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ГП Ивченко-Прогресс состояние и перспективы развития предприятия

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Анотация. ГП “Ивченко-Прогресс” – состояние и перспективы развития предприятия. Сентябрь 2021.
ГП “Ивченко Прогресс” исполнилась 76-я годовщина от дня создания Государственного предприятия “Запорожское машиностроительное бюро “Прогресс” имени академика А. Г. Ивченка.
Сотрудничество ГП “Прогресс” с учреждениями НАН Украины постоянно расширяется.
Ключевые слова: Ивченко-Прогресс.

ДП “Івченко-Прогрес” стан і перспективи розвитку підприємства

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Анотація. ДП “ІВЧЕНКО-ПРОГРЕС” – стан та перспективи розвитку підприємства. Вересень 2021.
ДП “Івченко-Прогрес” виповнилася 76-а річниця від дня заснування Державного підприємства «Запорізьке машинобудівне конструкторське бюро “Прогрес” імені академіка О.Г. Івченка.
Співробітництво ДП “Івченко-Прогрес” з установами НАН України постійно розширюється
Ключові слова: Івченко-Прогрес.