

REPUBLIC OF BELARUS STATE COMMITTEE ON
SCIENCE AND TECHNOLOGIES

SCIENTIFIC INNOVATION ASSOCIATION «INPROMTECH»

CATALOGUE

of innovation projects and elaboration

ISSUE 13

*ON RESULTS OF COMPLETION OF STATE SCIENTIFIC AND TECHNICAL
PROGRAMS AND INNOVATION PROJECTS ON SOCIAL PROBLEMS AND
CREATION OF INNOVATIVE TECHNOLOGICAL MACHINES AND MATERIALS*

MINSK
2007

UDC 001. 895(476)

V.M. Anischik
A.V. Bely

E.F. Krasnikov
O.V. Roman

Edit group:

Candidate of Technical Sciences
Corresponding Member of Belarus Na-
tional Academy of Sciences

Academician

Edited by

Doctor of Technical Sciences
Matjushkov V.E.

Prepared on basis of materials presented by, Republic of Belar-
us State Committee on Science and Technologies.

Additional information is presented by Scientific Innovation
Association «INPROMTECH».

220072, Minsk, Grekov St. 6-18.

Tel., (+375 17) 231-25-15, e-mail: inpromteh@tut.by

CONTENTS

№	CHARPTEP	P.
I.	ELECTRONICS. INFORMATION TECHNOLOGIES	7
II.	LASER TECHNOLOGIES	27
III.	NEW MATERIALS	47
IV.	COATINGS	63
V.	MACHINE-BUILDING. METALLURGY	79
VI	AUTOMOBILE AND TRACTOR BUILDING	109
VII.	INSTRUMENT ENGINEERING	137
VIII.	TOOLS	153
IX.	CHEMICAL INDUSTRY. BIOTECHNOLOGIES	161
	Developer List	178

I. ELECTRONICS. INFORMATION TECHNOLOGIES

№	Project name	P.
I-1	Automated information-analytical systems for medicine	9
I-2	Automatic telephone digital station «Beta M 12»	10
I-3	Automatic telephone digital station «Beta M 4»	11
I-4	Facility to control flatness deviation of semiconductor plates EM-6319	12
I-5	Hybrid- neuronet- model-based information technology to analyze data: software complex «Hybrid»	13
I-6	Operator's controller	14
I-7	Polaroids for optoelectronics and protective technologies	15
I-8	Porous powder material to obtain mini flat heat pipes capillary structures	16
I-9	Programmed numerical control universal system UPNC TAIS.421415.007	17
I-10	Protected PC BM2002	19
I-11	Software-driven system CAD "AutoKroy-D"	21
I-12	System of cartographic expressions automated digitizing and editing	23
I-13	System to process earth surface images	24
I-14	Tensor-sensor systems controller «SGC-2»	25

I-1 Automated information-analytical systems for medicine

Range of application Medicine. Patients' classification and registration facility as well as therapy end result prediction.

Description The automated system includes several subsystems.

- subsystems «Admission room», including 2 automation-equipped working places;
- subsystems «Reception office», consisting of 1 recorder. automation-equipped working place;
- subsystems «Narrow specialists», Including 2 automation-equipped working place for cardio-surgeons of admission- and- consulting unit;
- subsystems «Cardiac surgery», consisting of 13 automation-equipped working place;
- subsystems «Resuscitation unit», making 6 automation-equipped working place for experts in resuscitation;
- subsystems «Surgery unit», amounting 3 automation-equipped working places;
- subsystems «Ray examination», making 3 automation-equipped working places for diagnosticians;
- subsystems «Functional diagnostics», amounting 2 automation-equipped working places for diagnosticians;
- subsystems «Clinico-laboratory diagnostics», making 3 automation-equipped working places for laboratory doctors;
- subsystems «Medical Statistics», making 1 automation-equipped working place;
- subsystems «AIAS Administrator», making 1 automation-equipped working place for automatic control system administrator.

Expectancy The implementation of the systems will improve medical service and facilitate medical workers performance.

Realization *The contractor offers delivery and installation of the system as well as help in training the medical personnel.*

Developer *Public Research Institution «United Institute of Informatics Problems of Belarus National Academy of Sciences»*



Range of application Digital ATS «Beta M12» is designed for operation in rural telephone networks (RTN) in Republic of Belarus and CIS countries. The ATS is an up-to-day multimodule commutation system with distributed control. Therefore, at RTN it is a central, base and terminated exchange. It can also be applied as communication center of rural-urban communication providing high quality wire and radio communication.

Description ATS «Beta M12» basic parameters:

- wire subscriber lines count — 9000;
- radio subscriber lines count — 1000;
- connecting circuits count — 2160;
- rural-urban communication connecting circuits count — 3780;
- maximal station load in Peak hours — 3000 Erl;
- maximal calls count in Peak hours — 150000.

Expectancy Reduction costs, labour saving.
The use of software-hardware complex makes it possible to expand the capacity of central rural ATS providing on-line control and modernization of local telephone networks.

Interface and access protocols realization in accordance with International Telecommunications Union (ITU) principal provisions and normative documents of CIS countries enable compatibility of ATS with any types of current and newly-install equipment and availability of its integration into international networks.

A large choice of ATS configurations is available. It enables to apply it for modernization of analog and development of digital networks at RTN.

Realization *Finished product delivery.*

Developer *Joint Stock Company «Minsk Production Enterprise of Computing Technics»*

I-3 Automatic telephone digital station «Beta M 4»



Range of application

Digital ATS «Beta M 4» is designed for operation at corporate and local telephone networks.

Description

The ATS is an up-to-day multimodule commutation system with distributed control. It provides high quality wire and radio communication and can be applied as:

- corporate networks base and central ATS;
- organization network terminating and transit change;
- organization- private automatic exchange;
- rural telephone lines terminal exchange autoswitching center;
- city exchange substation.

Interface and access protocols realization in accordance with International Telecommunications Union (ITU) principal provisions and normative documents of CIS countries enable compatibility of ATS with any types of current and newly-install equipment and availability of its integration into international networks.

A large choice of ATS configurations is available. It enables to apply it for modernization of analog and development of digital networks including development of wireless communication.

«Beta M 4» key parameters:

- wire subscriber lines count — 4000;
- radio subscriber lines count — 1000;
- connecting circuits count in the mode of terminal exchange — 1800;
- connecting circuits count in the mode of rural –urban terminal exchange — 3780;
- maximal station load in Peak hours — 3000 Erl;
- maximal calls count in Peak hours — 150000;
- power consumption — not more than 0,8 Wt/port;

Full-scale production is in progress.

Expectancy

Increment in profit, reduction costs, labour saving.

The use of software-hardware complex makes it possible to expand the ATS capacity.

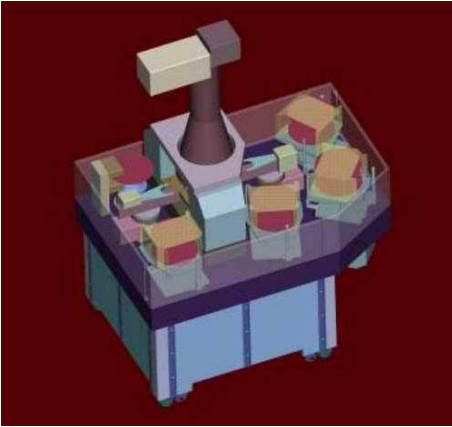
Realization

Finished product delivery.

Developer

Joint Stock Company «Minsk Production Enterprise of Computing Technics»

I-4 Facility to control flatness deviation of semiconductor plates EM-6319



Range of application

To control flatness deviation of semiconductor plates which are in «erect» state.

The facility uses the method of multichannel interferometer.

Description

The facility can be used electronics enterprises in both the process of making semiconductor silicon plates and substrates and substrates from gallium arsenide, sapphire and sapphire silicon, and in the process of their sorting into three sorts under the assigned by operator parameters directly prior photolithographic step.

The developed facility enables interferometric measurement flatness deviation from silicon semiconductor plates and substrates work area flatness.

- controlled plates diameter — 100; 150; 200 mm;
- flatness deviation measurement error — 50 nm;
- measurement random component standard deviation — 20 nm
- palter surface relief maximum elevation difference at the length of 10 mm — not more than 7 μ
- kinematical capacity, plates/h:

— for plates with diameter of 100 mm — 90

— for plates with diameter of 150 mm — 75

— for plates with diameter of 200 m — 60.

In its main technical parameters the developed facility ranks over the only home sample EM-6019A and is in appliance with the best world's sample by the company ADE, standing out in price. The pilot batch has been manufactured. The application of the facility will enable to decrease the chip's spoilage percent.

Expectancy

The use of the facility will reduce the defect ratio of the manufactured chips since the topological picture with submicron elements is shaped in photo resist layer with the help of the projecting lenses having several-micron focusing depth which does not allow to obtain qualitative chips on wavers with the same work surface curvature, owing to the image defocusing.

Realization

Finished product delivery.

Developer

R&D and manufacturing company «Design Office for Precision Electronic Engineering — optomechanical equipment» («KBTEM-OMO»)

I-5 Hybrid- neuronet- model-based information technology to analyze data: software complex «Hybrid»

Range of application In medical establishments to solve different tasks of patients classification and therapy end result prediction. In other spheres to facilitate the tasks of prediction classification where it is necessary to obtain not only accurate but interpretable solutions. It is used for analysis of laboratory, clinical, epidemiological and other medical data about patients.

Description The software complex is created on the basis of information technology. Its key function is to support the decision made by a medical worker about the group of risk of an acute leukemia patient and to predict his bringing into remission before the course of inductive therapy has been completed. The technology enables a doctor to extract efficient and easily interpreted set of decisive rules to fulfill the tasks of classification by group of risk and to predict the result of therapy in infantile leucozoology.

The software complex «Hybrid» provides medical data analysis based on hybrid neuronet models (HNM) for classification and prediction tasks in infantile leucozoology with obtaining the solution in the form of a set of interpretable, non-esoteric linguistic rules which could be easily grasped by medical workers. Home analogues are nowhere in evidence.

The developed software product compiles with world's level. The advantage of the information technology actualized in the form of the software complex «Hybrid» is integrated use of neuronets methodologies, fuzzy logic, fuzzy clusterization enabling quick and effective analysis medical data with getting fairly simple and easily interpretable results.

The software complex «Hybrid» has been tested and transferred to Ministry of Health Protection of Belarus to automated control system department for practical application.

Expectancy The use HNM in clinical practice enables medical workers to classify patients under risk groups on the basis of their individual profile and to choose the most grounded inductive therapy course.

Realization *The software complex «Hybrid is supposed to be donated to specialized children's oncohematological clinics of Belarus. For all other applications the software complex «Hybrid needs adaptation which requires certain amounts of money depending on complexity of adaptation.*

Developer *Public Research Institution «United Institute of Informatics Problems of Belarus National Academy of Sciences»*

I-6 Operator's controller



Range of application

To control the processes of various materials weighing and dozing in industrial and agricultural enterprises. Materials consumption, laded products listing database support.

Description

Operator's controller is a group control reprogrammable device used in automation of weighing and dozing processes. 16 local controllers of the type TSC-2 or any others having channels in series can be connected to it.

Capacity:

- control with the help of connected dose-meters in a single cycle;
- storing up to 50 recipes amounting 10 components;
- various options of laded materials listing;
- flexible readjust system to control dozing cycle;
- two channels in series (RS 485 and/or RS 232C) to connect peripheral units;
- connection with external PC;
- owing to a data processing built-in unit the controller can be used for a direct control of a dose-meter;
- operator's controller multifunctional performance and high communication properties make it possible to connect it to different types control devices such as operator's control panel, for example;
- built-in-calendar clock.

Technical features:

- energy-dependent ROM capacity – 32 Kb;
- 32-bit matrix LC-indicator;
- supply voltage — 8—12 V;
- operating-temperature range – from -10 to+40°C;
- Protection class under national Standard 14254 – IP54;
- overall dimension – 180x110x40 mm.

Expectancy

Final product quality improvement as a result of dosing accuracy increase and exact keeping to recipe. Increase in reliability and capacity of the equipment. Production control. Simplification. Detailed listing of materials consumption and manufactured product amount.

Realization

The contractor offers the controllers delivery and putting them into production.

Developer

Belarusian National Technical University

I-7 Polaroids for optoelectronics and protective technologies

Range of application Polaroid films of transmitting, reflective and semi-luminal types are used in LC data display devices, latent image control devices, as well as polaroid filters to manufacture optical and laser equipment etc.

Description Polaroid films of transmitting, reflective and transmitting-reflective (semi-luminal) types with expanded range of service temperatures as well as the technology of their manufacture and coatication have been developed. The polaroids have high indices in spectrum visible area:

- light transmission >44,5%,
- polarity effect >99,9%,
- dichroic factor >500.

The polaroid films in their characteristic are in appliance with the best world manufactures like «Nitto Denko» and «Ace Digi-tech» (catalogues, JP20030115650, JP2004341503), and in polarizing capacity surpass some of the foreign analogues. 3 RB patents protect the technology.

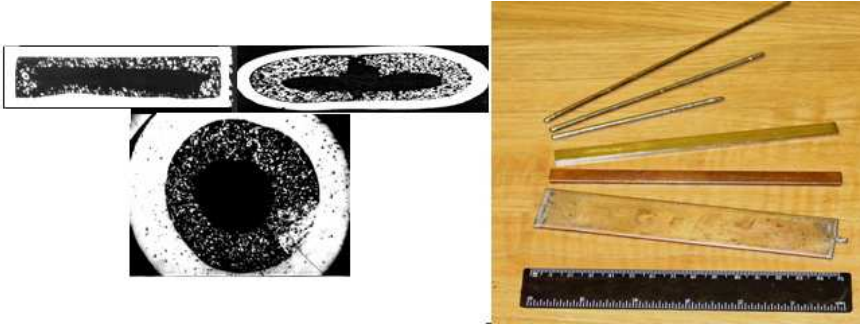
A pilot line to manufacture various types polaroids with annual capacity of 120-150 m² has been created. Polaroid manufacturing procedure has been mastered and pilot development batches has been manufactured.

Expectancy Import-substituting products. Expanding the capacity of optical, laser instrument making.

Realization *License agreement, technology and finished product sale. The technology implementation into full scale production and satisfaction of home consumers needs in polaroids of the given type require additional government expenditure making 150 000 USD for 3 year-period.*

Developer *Public Research Institution «Institute of Chemistry of New Materials NAS of Belarus»*

I-8 Porous powder material to obtain mini flat heat pipes capillary structures



Range of application Electronics, personal computers.

Description Porous powder materials to be used as high-efficiency mini flat heat pipes capillary structures have been developed. When the heat pipe thickness, width and length make respectively 2 mm, 6 mm and 180 mm, maximal transmitted power reaches 30 Wt; heat-transfer resistance makes 0, 3 K/Wt. Compared to currently available mini flat heat pipes with those developed the latter have a higher heat-transmitting capacity and a lower thermal resistance having the same size and weight. In comparison to the best world analogues prices the developed tiny flat heat pipes are 1,5 times cheaper. The experimental batch tests of the mini flat heat pipes have been carried out, operational procedures to obtain mini flat heat pipes with powder capillary structure have been developed.

Expectancy The results can be used in developing electronic equipment and PC components cooling system.

Realization *The contracture offers the technology and finished-product supply.*

Developer *Public Research Institution «Institute of Powder Metallurgy of Belarus National Academy of Sciences»*

**I-9 Programmed numerical control universal system
UPNC TAIS.421415.007**



Range of application

Industrial enterprises.

Description

UPNC provides control over the lather of miller metal working machines, as well as machines compatible with them in operational mode (drilling, boring, and grinding) with adaptation to each machine model under customer's requirements both in the software and the hardware.

UPNC provides:

- at least four positioning axes ;
- performance of two technological programs;
- linear, circular, helical and spline interpolation; up to 6 axes of interpolation, 4 simultaneously controlled interpolation axes;
- spindle positioning; up to 2 controlled spindles;
- axes systematic error program compensation;
- radius calculation;
- dead stroke program compensation;
- instrument automatic reset;
- assignment of the size with numeric or alphabetic access.

UPNC supports the function «Preset».

UPNC provides:

- equipment operational parameters digital indication;
- floating zero and positioning point assignment ;
- work area restraint;
- assignment of parameters in millimeters and inches ;
- aim distance indication ;
- transformation "degrees - minutes - seconds and " orthogonal – rotational coordinates ".

ELECTRONICS. RADIO ENGINEERING

The values of the key parameters :

- Maximal direct current of output signals of the channels without additional amplifiers – up to 60 mA at output voltage 24 V.
 - Maximal direct current of output signals of the channels with additional amplifiers or decoupling – at least 2 A at output voltage 24 V
 - Maximal current of channels relay output signals - at least 2 A when 50 Hz AC current is supplied with 250V nominal voltage
 - Analog inputs, at least four in the range of direct voltage – from - 10 to + 10 V.
 - Analog inputs transformation discreteness – at least 12 bit.
 - Amount of impulses per engine revolution when receiving signals from incremental encoder with TTL - levels – at least 1024.
 - Channels to support the operation of manual impulses generator – not more than three.
 - Entered control programs, parameters and corrections are stored in UPNC storing device when power supply is disabled , at least 4400 h
 - UPNC in electric safety corresponds to class I under National Standards 12.2.007.0.
 - UPNC power supply from AC network (50 ± 1) Hz with nominal voltage 230 V.
 - interpolation axes - 6
 - simultaneously interpolated axes - 4
 - control contours - 2
 - discrete inputs/outputs-256/256
- Program compensation of systematic error in axes-available

UPNC is in compliance with the analogue M64S, Japan

The system operates in the complex with PC and Windows2000.

UPNC operation is actualized via a specialized controller installed in a PC.

Negative consequences in the form of emergencies, ecological pollution and others in the process of the project actualization haven't been detected.

Pre-production is in progress.

Expectancy

UPNC is a kit of: drives, motors, input/output modules , power units, control boards — sufficient to equip 95% metalwork machines manufactured in Belarus.

Realization

Project payback period — 5 years. By customer's request UPNC can be adapted to each model of a machine by both the software and the hardware.

Developer

Joint Stock Company «Minsk Production Association of Computer Machines»

I-10 Protected PC BM2002

Range of application

PCs BM2002 are oriented as means of automation in different areas of professional, intellectual activities. It means to organize scientific, engineering and economic calculations and researches, to organize measurement, registration and information retrieval systems, in education and leisure.

Description

Universal PCs are designed to solve a wide range of tasks in different spheres of activity. Depending on configuration the PCs of the given class represent:

	initial level	high performance
processor	Intel Celeron	Intel Pentium IV
RAM	128Mб SDRAM	256 Mб DDR RAM
disk drive (FDD) 3,5"	1,44 MB	1,44 Mб
hard diskst (HDD)	40 GB. (at least), IDE, UDMA 66, 5400 rpm	80 Гб (не менее), IDE, UDMA 100, 7200 rpm
CD-ROM	52x speed, IDE	CD-RW/CD-ROM IDE
network adapter built-into motherboard	Ethernet 10/100 Mbit, UT/BNC,	Ethernet 10/100 Mbit, UTP
graphic adapter	built-into a motherboard, videomemory 8 MB	external, videomemory 64 MB
screen	15" CRT/LCD	17", 19" CRT
case	MidiTower 250 Бт	MidiTower, 300 Бт
software	Windows'95/98/ME, Windows 2000/XP, LINUX	

Workstations are high-performance systems for modern applications. The computers of this class are used as a personal workstation or in the system "client-server" and suppose a high-level user's work. This is an ideal solution for specialists requiring high computational power and who work in CAD/CAM.

- Processor Intel Pentium IV
- RAM 512 Mb, DDR RAM (at least)
- Drive (FDD) 3,5" 1,44 Mb
- Hard disk (HDD) 806,4 GB, SCSI/IDE, 7200/10000 rpm
- CD-RW/CD-ROM SCSI/IDE
- External network adapter, video memory 128 Mb (at least)
- graphic adapter Ethernet 100 Mbit, UTP, built-in or external
- Screen 17", 19", 22"
- MidiTower/Full Tower
- Software Windows 2000/XP

Servers , made by our enterprise (base on Pentium IV), are designed for different level users. We will find optimadl solution when choosing server for a small LAN and servers mainatning coporate or global networks.

ELECTRONICS. RADIO ENGINEERING

Multimedia PCs are oriented for the users in home conditions (home PC). PC data are provided with developed multimedia which enables work and play using modern multimedia applications and computer

Special-purpose personal computers are designed to transmit and process limitedly-spread information (i.e. private information) to provide informational security of governmental institutions. The PC includes hardware-software facilities of protection from unauthorised access to hardware and data, crypto and digital signature protection means.

Expectancy Import substitution.

Realization *The delivery is carried out as a set with any peripheral devices. The PC BM2002 have RB and RF conformance certificates. The technical characteristics and configurations of the suggested computers are base only. The user can choose the final configuration, or select the most optimal option.*

Developer *Joint Stock Company «Minsk Production Association of Computer Machines»*

I-11 Software-driven system CAD «AutoKroy-D»



**Range of application
Description**

Children-wear sewing enterprises.

The software-driven system is aimed to automate the process of development of children-wear basic design. It represents the designer's instrument guaranteeing high quality of the design without restraints of creativity of the customer. It enables developing of new models of children's clothes tight schedule providing, at the same time, high accuracy of calculations and building details of clothes' design taking into account textile technological properties. Program package (software CAD "AutoKroy-D"), entering the system is designed to organize interactive operating mode with the system to input source data about the design, technological widening and dimensional allowances, design automatic calculation and output to a plotting device the details of base designs (BD) for children's garment (trousers, a waistcoat, a jacket, a shirt, a coat, a skirt, a blouse, a dress, jumpers, a jump suit).

CAD "AutoKroy-D" has been designed for specialists of any skills therefore the quality of the developed in the system designs in a less degree depends on the experience of the customers which enable to increase the competitiveness of the product.

ELECTRONICS. RADIO ENGINEERING

Children's sewing clothes CAD software consists of a dialog subsystem, subsystem to make BD of shoulder clothes (jacket, vest, coat, overcoat, and blouse), subsystem to make BD of waist clothes (trousers, skirt), subsystem of technical multiplication of curves for all sizes and heights and fattiness groups and subsystems of output.

Output subsystem enters inquiry information (design characteristic, calculation of key parameters and additions), tables of calculation of basic design patches with the data on each design section, drawings (true to scale) to the printer and output of drawings and strips in actual size to the plotting device.

In technical characteristics the product is in appliance with the best foreign analogues and in price and functionality surpasses them. The product is awarded with Diplomas at specialized exhibitions Дипломы: Kiev-2002., Kharkov - 2003r. Minsk «Bellegmash» -2004 and 2005.

No home analogues. Unlike Russian analogues (companies «Assol», «Kom-tens») and Ukrainian samples («SAPRLegProm», «Gracà»), the created system has clothes design solutions on a qualitatively new level.

In technical level of both technical and software characteristics, functionality, quality and prices the product corresponds to the world's level of analogues products made by Herber (USA), Lectra System (France) and others.

Acceptance tests have been carried out and pilot batch has been manufactured.

Expectancy

Autokroy-D provides

- curves high accuracy;
- labour intensity reduction in tens times compared to standard graduation;
- quality adequacy of a design of any standard size to the quality of base size-height design;
- possibility of quick changeability of clothes models which enables adequate response to market demands ;
- possibility of automatic curves making for other types of textile or with other design additions.
- calculation accuracy of base and model designs for standard patterns of all sizes and heights — 0,1 — 0,5 mm.
- material saving, 5—10 %

Import substitution. CIS countries sale is possible.

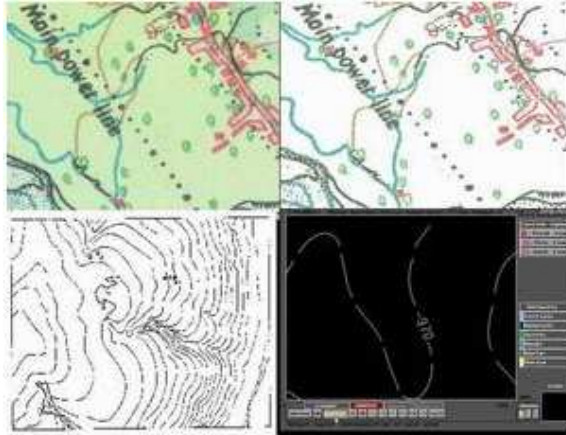
Realization

Project payback period makes 2, 3 years. The contractor offers technical documentation and help in implementing the product.

Developer

Scientific and production Limited Company (SP, LTD) «Lakshmi»

I-12 System of cartographic expressions automated digitizing and editing



Range of application The system is designed for automated creation of digital maps using cartographic materials. Creation and editing of digital maps and location plans , city cadasters.

Description The system performs three groups of functions:

- Color separation of raster images of originals;
- Automated vectorization of originals ;
- Interactive detection of objects maps and digital map formation in format F20S.

Pilot samples of the software are available. The system's possible application in cartography is being negotiated.

Expectancy The system considerably widens the possibilities of operative creation of location digital maps. It enables to increase productivity and accuracy of input and creation of digital maps.

Realization *Cooperation agreement.*

Developer *Public Research Institution «United Institute of Informatics Problems of Belarus National Academy of Sciences»*

I-13 System to process earth surface images



Range of application To process earth surface photographs and renew digital location maps.

Description The system performs the following groups of functions:

- functions of special transformations of image solving the problems of image transformation to change its geometrical parameters or to remove geometric distortions;
- functions of interactive processing of digital shot (DS), solving the problem of viewing half-tone image using various modes, interactive selection of part of an image for its sequential processing , performance of transformation of image brightness characteristics, improvement of brightness of the selected objects;
- decoding function enabling to select on DS lengthy objects belonging the class «road net»;
- processing and renewing of digital models of locality using prepared shots of earth surface, DS and digital models of locality gridding by control survey points,
- digital models of locality auxiliary file formation for automated decoding of DS images in contour objects — possibility to compare the results of DS images decoding and digital models of locality objects changes selection , making measurements of geometrical forms of objects on DS (digital models of locality) images , determining their geodesic and rectangular coordinates and their deviations in the process of comparison , editing of objects of digital models of locality by selected changes.

The software pilot samples are available.

Expectancy The system considerably widens the possibilities of currently available systems of earth surface aero and space photographs

Realization Cooperation agreement.

Developer *Public Research Institution «United Institute of Informatics Problems of Belarus National Academy of Sciences»*

I-14 Tensor-sensor systems controller «SGC-2»



Range of application To control the processes of various materials weighing and dosing in industrial and agricultural enterprises.

Description Tensor-sensor controller TSC-2 is a special-purpose control device to fulfill the following tasks:

- reception and processing of information from one or several tensor-sensors (up to 6 with parallel connection);
- dosing processes control.

Capacity:

- successive dosing of 4-components.
- long-term storage of one recipe.
- Automatic correction of dosing limits (material under-fill metering).
- quick operating sigma-delta ADC (data processing frequency up to 5 kHz).
- availability of software dynamic filter providing stability in mass reading
- availability of serial link RS 232C or RS 485.
- PC or any other control unit (particularly operator's controller).
- 5 discrete channels of inputs/outputs (24V, 2A or 220V, 120mA).

ELECTRONICS. RADIO ENGINEERING

- availability of various software versions depending on the tasks: static weighing, discrete dosing (continuous dosing), quick-operating processes.

Technical features:

- ADC bits — 24.
- signals measuring from sensors — up to 80 mV.
- tensor-sensor voltage supply — 5 V.
- power consumption, not more than 8 Wt.
- indication — LED, 6 bits.
- operating temperatures range — from -10 to +40°C.
- protection class under National Standard 14254 — IP54.
- size — 130x95x60 mm.

Expectancy

Final product quality improvement as a result of dosing accuracy increase and exact keeping to recipe. Increase in reliability and capacity of the equipment. Production control. Simplification. Detailed listing of materials consumption and manufactured product amount.

Realization

To control the processes of various materials weighing and dosing in industrial and agricultural enterprises.

II. LASER TECHNOLOGIES

№	Project name	P.
II-15	A facility to measure parameters of laser radiation reducers (MPLRR)	29
II-16	Continuous diode-pumping two-frequency laser sources	30
II-17	Diode laser surgical apparatus DIOLAS-810	31
II-18	Diode-pumped pulse microchip lasers with intracavity Raman-transformation	32
II-19	Facility to cut metals with laser	33
II-20	Facility to measure average power of continuous laser radiation and average power measurement tools verification	34
II-21	Facility to measure continuous laser radiation power stability	35
II-22	Facility to measure LR pulse energy and verification of tools to measure LR energy	36
II-23	Facility to measure the stability of pulse energy of pulse laser radiation	37
II-24	Laser scanning marking facility	38
II-25	Laser spectral analyser (LSA)	39
II-26	Medical-and-technical universal laser module for complex ophthalmology diagnostics and rehabilitation	40
II-27	Powder laser stereolithography facility	41
II-28	Pulse radiation multifrequency transmitters	42
II-29	Stomatological laser «Optima»	43
II-30	Technology of unification into a system of array ICs on silicon wafer	44
II-31	Type-series of secure for visual organs pulse radiation sources based on Raman Effect in chips	46

II-15 A facility to measure parameters of laser radiation reducers (MPLRR)



Range of application

Certification, metrology. Measurement of attenuation coefficient of laser reducers and their calibration.

Description

The facility is designed to measure the attenuation coefficients of metrical reducers of laser radiation of two types:

- dynamic— mechanical reducers with rotating sector;
- static — absorption reducers.

The facility can be used in the process of metrical reducers calibration included into a set of laser radiation power measurement tools.

Characteristics:

- attenuation coefficients dynamic range— 1,0— 100;
- spectral range — 0,4— 1,1 μ ;
- maximal slope angle — 1,5 degrees;
- attenuation coefficients measurement basic relative error , not more than — 3,0%;
- size — 1500x500x600 mm;
- weight — 30 kg..

Expectancy

The unique facility is a necessary constituent of technical basis of laser equipment metrological support.

Realization

Metrological support.

Developer

Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»

II-16 Continuous diode-pumping two-frequency laser sources



Range of application Spectroscopy, environmental protection, range finding. The sources are supposed to be used research and in ecological systems.

Description Laser sources are based on intracavity Raman-transformation of radiation of diode-pumped mini-lasers. Crystals of nitrates, wolframates, vanadates are used as scattering media.

Characteristics:

- laser diode power — up to 3 Wt;
- generation waves count in the area of 1,06—1,2—2 μ ;
- output —up to 200 mWt;
- laser beams quality parameter — < 1,7 M2.

A laboratory sample is available.

Expectancy Simultaneous generation of two wavelengths, generation in a new spectral range.

Realization Joint development and full-scale production output, sale of licenses (protective documents are available).

Developer *Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»*

II-17 Diode laser surgical apparatus DIOLAS-810



Range of application

The product is designed to make surgical aggregations in different fields of surgery and dermatology to stop bleeding in urgent, endoscopic and "open" surgery including photodestruction of nonmalignant and malignant skin and mucous membrane neoplasms.

Description

Photothermic effect on skin, mucous membranes and bleeding vessels is achieved.

Technical features:

- Laser radiation wavelength — 810 nm;
- Laser radiation power at light guide output adjusted in the range— 1—40 Wt;
- Target laser power — 0,5—2 mWt;
- Laser radiation power irregularity, not more than 20 %;
- Pulse, pulse periodic, continuous operation;
- Light guide diameter to transport laser radiation — 600 μ ;
- pulse recurrence frequency — 0,5—10 Hz;
- AC power supply with voltage — (220 \pm 20) V, (50 \pm 5) Hz;
- Power consumption — Wt 400;
- Operating time : 40 minutes, 20 minutes break — 6 hours;
- Overall size — 460x435x200 mm;
- Operating mode setup time, not more than 2 minutes.

The product has indisputable advantage over currently available products of the same kind.

Expectancy

Tissues dissection, especially those of hollow organs, is actually asanguinous. The product provides dosed effect on abnormal locus depending on radiation mode, pulse duration as well as other parameters. Tissue surrounding abnormal locus is subjected to minimal thermic affect.

Realization

The contractor can sell technical documentation and render assistance in coping with the product.

Developer

Unitarian Enterprise «Lasers in ecology, medicine and technology»

II-18 Diode-pumped pulse microchip lasers with intracavity Raman-transformation



Range of application

Precise range finding, ecology, medicine, spectroscopy, photochemistry.

Description

Diode-pumped pulse microchip lasers with intracavity Raman-transformation are miniature (laser head within 1 cm case) are totally solid lasers generating high spacing frequency light pulses (duration amounts less than 10⁻⁹ s). To obtain radiations at a number of frequencies in the range of 300—600 nm additional non-linear elements can be installed at the output of such lasers. Laser pumping is achieved with the help of standard diode laser with output power up to 1 Wt.

Micro-chip-laser in standard performance:

- wavelength — 1,06 and 1,18 μ ;
- maximum output up to 25 mWt,
- pulse duration 200 picoseconds;
- pulse frequency 5—10 kHz.

Compared to a standard micro-chip-laser the suggested product has a shorter pulse duration a higher maximum output at small pump powers and availability of generation on two wavelengths.

A laboratory sample is available.

Expectancy

Extension of capacities in development and production of laser instruments and laser equipment for various branches of industry.

Realization

License agreement (national and international patents are available), development and creation of a breadboard model, joint mastering in production and full-scale production. Laser and Raman mediums can be selected by the customer.

Developer

Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»

II-19 Facility to cut metals with laser



Range of application

Machinebuilding, instrument making, metalworking. Cutting ferrous and non-ferrous metals workpieces as well as plastics and other materials in plant conditions of machinebuilding, instrument making, metalworking enterprises.

Description

Technical specifications:

- workpiece vertical and horizontal rotation nodes :
 - axial rotation — 360 degrees
 - circular pitch (at trajectory diameter 200 mm) — 50 μ
- light guide attachment to transport laser radiation:
 - light guides diameter — 400, 600 μ ;
 - light guides power — 200 Wt
- visual control unit with video camera;
- cutting metal width (for steel) — up to 5 mm;
- workpiece weight— up to 10 kg;
- radiation wavelength — 1,064 μ ;
- laser radiation power — up to 150 Wt;
- laser mode — pulse;
- 3-coordinate table:
 - traverse speed — up to 30 mm /s,
 - linear movement by X-Y — 500 mm,
 - positional accuracy by X-Y — 20 μ ,
 - linear movement by Z — 100 mm,
 - positional accuracy by Z — 50 μ ;
- Computer-aided control, PC of Pentium type;
- Software DOS, Windows 98;
- size — 2400x1400x1600 mm;
- weight — 550 kg;
- power-line supply — 380 B, 50 Hz;
- power consumption — 12 kWt.

A laboratory sample for industrial applications is available.

Expectancy

Relatively low cost.

Realization

Finished product sale.

Developer

Pilot-design Unitarian Enterprise «Aksicon» of Belarus National Academy of Sciences

II-20 Facility to measure average power of continuous laser radiation and average power measurement tools verification



Range of application

Certification, metrology. The certification of lasers and calibration of laser radiation power measurement tools have been carried out.

Description

The facility is a complex including lasers, measurement tools, optical schematic elements and a PC. The facility is designed to measure the average power of continuous and pulse-periodical laser radiation when carrying out metrological certification of different types of continuous radiation lasers and to calibrate measurement tools to measure medium-powered laser radiation.

Characteristics:

- dynamic range in the mode of reproduction of average power measurement unit — $1 \cdot 10^3$ –5 Wt;
- dynamic range in the mode of LR average power measurement — 1–10–3–100 Wt;
- spectral range LR in the mode of LR average power measurement — 0,4— 2,0 μ ;
- fixed wavelengths in the mode of reproduction of average power measurement unit — 0,532; 0,975; 10,6 μ ;
- LR average power relative standard uncertainty in measurement— 1,4— 3,0%;
- relative standard uncertainty in measurement of reproduction of LR average power measuring unit amount — 1,5— 3,0%;
- size — 3000x1300x1400 mm;
- weight— 450 kg.

Expectancy

The unique facility is a necessary constituent of technical basis of laser equipment metrological support.

Realization

Metrological support.

Developer

Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»

II-21 Facility to measure continuous laser radiation power stability



Range of application

Carrying out of certification of lasers in radiation power stability. Certification, metrology.

Description

The facility is designed to measure the stability of laser radiation power when carrying out certification of different types of lasers having continuous generation mode under the requirements of standard STB ISO11554-2004. Computer aided data processing.

Characteristics:

- dynamic range of controlled level of LR average power — 10⁻²—0,5 Wt
 - spectral range — 0,4—1,1 μ
 - threshold sensitivity when measuring LR power stability, %
- average time (measurement 1 min) — 0,04
— long-termed (measurement 1 h) — 0,08
- extended relative uncertainty in measurement of LR power stability (k=2, P=0,95), not more than 10%
 - size — 1500x300x400 mm
 - weight— 30 kg

Expectancy

The unique facility is a necessary constituent of technical basis of laser equipment metrological support..

Realization

Metrological support.

Developer

Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»

II-22 Facility to measure LR pulse energy and verification of tools to measure LR energy



Range of application Description

Certification, metrology. Carrying out of certification of lasers and calibration of laser radiation pulse energy.

The facility is a complex including lasers, measurement tools, optical schematic elements and a PC. The facility is designed to measure laser radiation pulse energy when carrying out metrological certification of different types of pulse lasers and to calibrate measurement tools to measure laser radiation pulse energy.

Characteristics:

- dynamic range of reproduction of energy unit — $5 \times 10^{-3} - 1$ J
- dynamic range of measured energy — $5 \cdot 10^{-3} - 100$ J
- spectral range in the mode of energy measurement — $0,4 - 10,6 \mu$
- fixed wavelengths in the mode of energy unit reproduction — $0,532; 0,69; 1,064 \mu$
- relative standard uncertainty in measurement of LR energy — $1,6 - 4,3\%$
- relative standard uncertainty in reproduction of LR energy measurement unit — $1,7 - 2,7\%$
- size — $2500 \times 1300 \times 1400$ mm
- weight — 400 kg.

Expectancy

The unique facility is a necessary constituent of technical basis of laser equipment metrological support.

Realization

Metrological support.

Developer

Public Research Institution «Institute of Physics named after B.I. Stepanov of Belarus National Academy of Sciences»

II-23 Facility to measure the stability of pulse energy of pulse laser radiation



Range of application

Carrying out of certification of lasers in radiation pulse energy stability. Certification, metrology.

Description

The facility is designed to measure the stability of laser radiation pulse energy when carrying out certification of different types of pulse lasers under the requirements of standard STB ISO11554-2004. Computer aided data processing.

Characteristics:

- dynamic ranged of controlled level of pulse energy — 10⁻²—0,5 J;
- spectral range — 0,4-1,1 μ ;
- threshold sensitivity when measuring LR energy mobility — 0,09%;
- extended relative uncertainty in measurement of LR power stability (k=2, P=0,95), not more than 10%;
- size — 1500x300x400 mm;
- weight — 30 kg.

Expectancy

The unique facility is a necessary constituent of technical basis of laser equipment metrological support.

Realization

Metrological support.

Developer

Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»

II-24 Laser scanning marking facility



Range of application

The facility can be used in plant conditions of machine-building, instrument making, metalworking enterprises.

Description

Engraving on piece surface possibilities:

- by conveying the object on the coordinate table with the field 500x500 mm (up to 1600x1200 mm) with positioning accuracy 0,02 mm , the executor remains stationary, conveyance speed up to 20 mm /s;
- by laser beam scanning with the help of a galvanic-type drive and a wide-angle small-aberration optical objective with the field 50x50 mm with the possibility of positioning from 300 to 2000 points; at the same time the objective and the executor remain stationary; beam conveyance speed ; — up to 300 mm /s;
- with the help of a galvanic-type drive, placed on two-axis table, the objective remains stationary; beam inter-shot conveyance speed — up to 300 mm /s; shot change speed— 20 mm /s.

Characteristics:

- engraved signs depth — from 0,6 mm;
- lines average width — 0,05 mm;
- laser wavelength — 1,06 μ ;
- size — 1900x900x1200 mm;
- weight — 250 kg;
- power supply — 380V, 50 Hz;
- power consumption — 4 KWt.

The cost is considerably lower that that of manufacturers of analogous products. The introduction of the product is progress.

Expectancy

Marking and engraving of metallic, plastic articles and other materials. Marking of surfaces with paint and galvanic or any other coating is possible.

Realization

Finished product sale.

Developer

Pilot-design Unitarian Enterprise «Aksicon» of Belarus National Academy of Sciences

II-25 Laser spectral analyser (LSA)



Range of application

Research, evaluation of chemical composition of any solids by emission atomic plasma spectrums. Evaluation of chemical composition of any solids by emission atomic plasma spectrums, shaped under the impact of focused laser radiation on sample surface.

Description

LSA includes two-pulse laser with Q-factor modulation, optical-and-mechanical unit with a microscope, videocamera and software-controlled objective table, optical multichannel analyzer, software.

Characteristics:

- measured concentration of chemical elements in solid samples (error 3—7%) — 0,001% and more;
- automated pulse laser source operation mode —periodic 1—10 Hz;
- laser pulses—double;
- measured time between pulses —.from 0 to140 μ ;
- each pulse duration — 10—12 ns;
- energy— 1064 mJ;
- laser effect area visualization accuracy and accuracy of its positioning—0,01 μ
- power consumption, not more than 750 Wt.

Expectancy

Laser analyzer enables making analysis of both conductive and non-conductive materials without preliminary preparation of the sample. It also helps in solving the tasks of local and layer-by-layer analysis. The analyzer favors to studying toxic and gyroscopic materials placed into closed transparent vessels.

Realization Developer

Contracts.

Public Research Institution «Institute of Molecular and Atomic Physics of Belarus National Academy of Sciences»

LASER TECHNOLOGIES

II-26 Medical-and-technical universal laser module for complex ophthalmology diagnostics and rehabilitation



Range of application Ophthalmologic disease treatment and diagnostics.

Description The module is designed in the form a removable device with the following units:

- operative microscope with video camera;
- step-type drive control system;
- module control system;
- laser power supply;
- laser head;
- control pedal;
- radiation transformation fiber optic systems

Module's non-stop operation time — 8 hours;

- module overall dimensions — 2300x2000x1620 mm;
- PC system overall dimensions — 780x1000 mm;
- module's weight — 350 kg.

Expectancy The proposed product will favor to curing different ophthalmologic diseases, reduce treatment time and consequently incapacity to work time. Putting the laser module into full-scale production will help in reduction of currency expenses to purchase and maintenance of medical equipment; create new job places and master new high-end technologies.

ually *Payback period: 3,2 years. The contractor can offer technical documentation and assistance in the product setup.*

Developer *F. Skoryna Gomel State University*

II-27 Powder laser stereolithography facility

Range of application Powder metallurgy, medicine, machinebuilding.

Description The facility is designed to obtain individual medical implants from composition titan for prosthetics in orthopedy and oncology by successive formation and baking with the help of laser radiation configurationally-shaped powder layers and their consequent baking to each other. It enables to obtain composite compact-porous volumetric articles having complex geometry of the surface. It can be used in other branches when creating complex articles, models and parts prototypes in the process of design and manufacture. In this case, the facility will make it possible to reduce the manufacture time of such articles in several times owing to fast and economic transformation of the results of the automated design into articles.

Technical specifications:

- radiation wavelength — 1,06 μ ;
- pulse frequency — 50 Hz;
- laser average power — 150 Wt;
- pulse duration — 3—6 ms;
- work area of workpiece conveyance — 200x200x50 mm;
- objective conveyance speed—100—1000 mm/min;
- positioning accuracy — 20 μ .

Home analogues are unavailable. In its technical characteristics the product is in appliance with foreign analogues. Pilot sample acceptance tests have been carried out. Implants pilot batches have been manufactured.

Expectancy It will give 10-fold reduction in mastering new types of products owing to quick and economic transformation of the results of the automated design into complex articles, machines and equipment, models and prototypes of parts which are labor-consuming in manufacture.

Realization *The cost of one facility depending on completion makes up to 70 thousand USD. The contractors can manufacture up to two facilities annually..*

Developer *Separate self-supporting enterprise «Research Design-and-Technological Institute of Welding with Pilot Production (SSE RDTI with PP)*

VII-28 Pulse radiation multifrequency transmitters



Range of application Lidar complexes, ecology, range finding. For use in lidar complexes to solve ecological problems and other application.

Description A multifrequency transmitter includes pulse YAG: Nd-laser with second harmonic generator and a set of Raman –lasers on barium nitrate crystals. It enables, depending on YAG: Nd-lasers and types of Raman crystals, to generate 5 wavelengths (0,53; 1,06; 1,2; 1,4 1,6 μ).

Features:

At output energy of YAG: Nd-laser pulses at the wavelength of 1,06 μ «1 J provides on wavelengths 0,53; 1,2; 1,4 and 1,6 μ radiation with the pulse energy up to 100 mJ at frequency of the repetition 10 Hz
A laboratory sample is available.

Expectancy Non-linear optical transformation high-performance, solid-state approach, compactness.

Realization Co-developing and commercialization.

Developer *Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»*

II-29 Stomatological laser «Optima»



Range of application

For operative treatment of paraplasm of mouth cavity and skin of maxillo-facial area, including parodontosis. Treatment procedures and operations in mouth cavity: non-contact impact on dental tissue.

Description

A facility with three-wave radiation.

Performance specifications:

- pulse frequency — 1—50, 1—50, 1—30 Hz;
- pulse energy change range — 50—700, 50—500, 50—300 mJ;
- maximal pulse duration — 0—300, 150—300, 50—300 μ s;
- way of transportation of radiation to work area, Quartz:
 - Quartz light guide
 - Sapphire light guide
- maximal radiation average power — 30, 20, 40;
- nozzle type: contact, non-contact, aerosol, air-water;
- target laser type, Red — 630 nm;
- main laser radiation generation pulse time— 150—300 μ s;
- power consumption from AC network at nominal voltage of less than 3,5 KWt;

- water-air cooling system;
- control— microprocessor , adjusting;
- size— 600x325x940 mm;
- weight — 100 kg.

Pilot sample acceptance medical tests have been carried out. Pre-production stage has been actualized.

Expectancy

The facility opens new horizons in present-day stomatological practice and can be used not only in stomatology but other surgical and cosmetology applications. Radiations with wavelengths 1064 and 1320 nm provide minimal zone of coagulation necrosis at dissection and coagulation of tissue giving good therapeutic and cosmetology effect, accelerating wounds healing, making it possible to do operations in ambulatory conditions. Radiations with wavelength 2940 nm are applied when treating dental tissue (caries, odontolith etc.) and bony tissue with minimal pain and absence of vibration.

Realization

Sale of finished equipment.

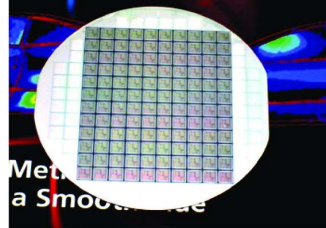
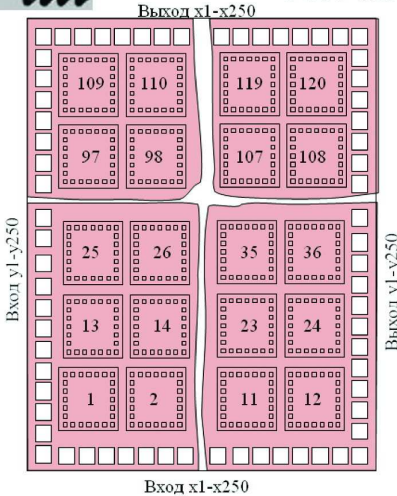
Developer

Unitarian Enterprise «Lasers in ecology, medicine and technology»

II-30 Technology of unification into a system of array ICs on silicon wafer



SoW на БМК K1574XM11



Входные данные
Диаметр пластины: 102 mm
Размер кристалла: 6.3×6.3 mm
Количество кристаллов: 150
Число затворов (вентилей): 75K (300K)

программирование БМК
I слой – контакты к ячейкам
II слой – первый металл
III слой – межуровневые контакты
IV слой – второй металл
программирование SoW
I слой – пассивация, контакты к площадкам
II слой – межсоединения первого уровня
III слой – межуровневые контакты
IV слой – межсоединения второго уровня

SoW Спецификации:

Размер: 78-68 mm
Число функциональных блоков БМК: 120
Число вентилей(затворов): 9M (36M)
Число вводов/выводов: 1000

Range of application Microelectronics, multiprocessor homogeneous computing environments (HCE), super-, neurocomputers, neuronets.

Description The developed minifactory of customized integrated chips and waver systems (minifab ASICs and SoW) is oriented to customized devices: ASIC, SoC, SoW, IP-blocks.

Minifactory key principles :

- non-integrated works –only interconnect connections formation
- wafers individual treatment : each wafer is a production batch
- interconnection elements direct laser recording
- superclean room minimal size
- automated equipment
- equipment united into a single conveyor

Minifactory advantages:

- Minimal amount and low cost of the equipment units
- Minimal service-personnel
- Short term of programming (< 3 hours 1 layer)
- Images laser generator, realizing non-template technology provides:
- Minimal size of the element , ≈ 0.5 mm;
- Maximal exposure area 300×300 mm²;
- Accuracy beam positioning < 0.1 mm;
- Individual programming of each chip on the wafer;
- Development time and material costs reduction and manufacture of SoW and transition from one type to another.
- Absence of limitation on exposed chip size; SoW, up to ≈ 300 mm.
- On-line introduction of changes into manufactured SoW.
- Faulty components disabling and spare components enabling to the extent of a separate cell.

The developed technology SoW is in compliance with the world's analogues.

The manufacturing method is aimed at being used in production at minifactories, in perspective in closed production cycle The technological process is based on cluster technologies thus nullifying environmental pollution.

Processes technological rout maps have been developed.

SoW test structures have been developed and manufactured.

Expectancy

The product provides economic expediency at production volumes up to one-of-a-kind item, owing to quick development and manufacture of the systems with minimal costs. SoW manufacture on wafers exclude 90% of expenditures on expensive operations on assembling into a case of each entering it IC, reduces system's cost, and increases their running speed and reliability.

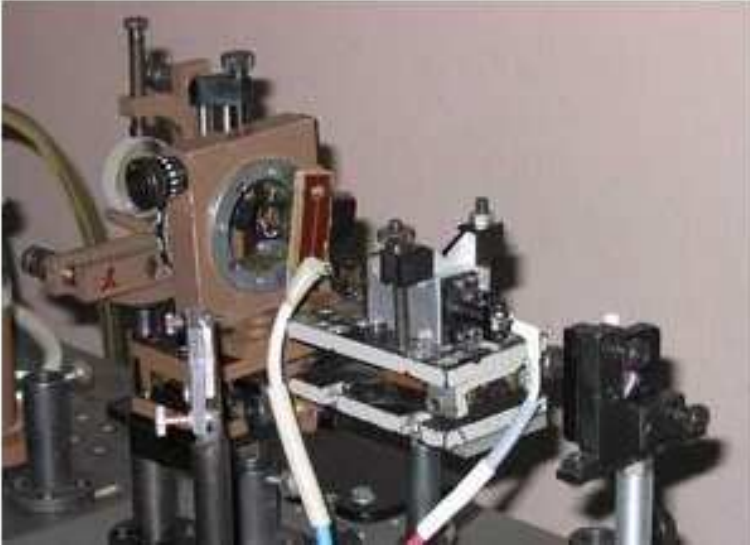
Realization

Joint production and development of SoW, is possible as well as sale of the SoW technology and its separate processes. A new methodology of wafer-based system development and manufacture has been proposed. It involves close cooperation of Customer , system-level design center , chip-level design centers and laser programming minifactory

Developer

Belarusian State University of Informatics and Radioelectronics

II-31 Type-series of secure for visual organs pulse radiation sources based on Raman Effect in chips



Range of application Ecology, geodesy, range finding. To be used in ecological, geodetic surveying and range finding systems.

Description The type-series of secure for visual organs radiation sources (wavelength in the area 1,5—1,6 μ), based on Raman transformation (including Raman self-transformation) of radiation of pulse Nd-containing lasers pumped with the help of laser diodes or flash lamps.

Characteristics:

- Pulse frequency — 10— 10 000 Hz;
- Energy in pulse — 10-6— 10-1 J;
- divergence — 3— 5 mrad.

Compared to the currently available analogues the proposed products provide higher efficiency, have smaller size and are noted for unified approach to creation the sources with different output parameters.

A laboratory sample is available.

Expectancy Extension of possibilities in the development and manufacture of laser devices and laser equipment for different branches of industry.

Realization *Co developing and off-the-shelf production, license sale (protective documents are available).*

Developer *Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»*

III.
NEW MATERIALS

№	Project name	P.
III-32	Aluminum oxide-based thermoresistant ceramic material	49
III-33	Alumosilicates-based composite material and filtering element from it. Manufacturing method	50
III-34	Ceramic materials and UHF-range antenna elements made from them. Hot casting facility for antenna ceramic elements	51
III-35	Complex graphitizing modifying agent for iron casting MIG	52
III-36	Constructional –heat insulating board on the basis of a dolomite binding agent and a wood filler	53
III-37	Extrusion profile manufactures, technology of their obtaining	54
III-38	Gypsum- binding- agent- based materials	55
III-39	High-temperature and corrosive medium resistant composite materials. The engineering procedure to make manufactures from them	56
III-40	High-temperature ceramic material and two-layer non-swirl nozzles from it	57
III-41	Light-weight keramzites manufacturing method. Manufacture of effective expanded-clay concrete blocks for exterior and interior walls	58
III-42	Material to manufacture soil pumps working in the conditions intensive hydro-abrasive wear	59
III-43	Thermodynamically- incompatible- thermoplastics- based -composite material	60
III-44	Wear-resistant composite material on polymeric matrix. Technological process of applying coatings from the composite material	62

III-32 Aluminum oxide-based thermoresistant ceramic material



Range of application

Electrical industry, metallurgy, machine building.

Description

We developed a thermoresistant material on the basis of aluminum oxide with a high level of physical-mechanical, electrophysical and thermal properties for welding apparatus power supply units. The equipment, the workflow and specifications to make ceramic insulating bushes and other thermoresistant manufactures.

Features:

- ultimate compression strength, — 1200—1600 MPa;
- crack resistance factor — 3,0—4,0 MPa*m^{1/2};
- breakdown voltage, —10—15 kWmm;
- The cost of insulating bushes made from the developed material makes 5—7 USD per 1 kg.

In its physical-mechanical, electrophysical and thermal properties the material approaches west-European analogues. However the cost is 1, 3—2, 1 times lower than that of EU countries (for example «CeramTec» (Sweden). The material and the technology are in appliance with the best analogues of CIS and Baltic states. RB patent.

The technological process to manufacture ceramic insulation bushes is environmentally friendly.

Pilot batches production has been mastered and the output of ceramic insulating bushes for welding apparatus power supply units.

Expectancy

3—2, 1 fold cost reduction. The developed equipment, technological process and material enable to obtain thermoresistant manufactures with a high level of physical-mechanical, electrophysical and thermal properties, which will allow saving currency to import the product increasing the efficiency of welding apparatus power supply units and proving Belarusian marked with thermoresistant manufactures of various assortment.

Realization

The required sum of money for industrial production makes 4 thousand USD. 3-year project payback period. Sale of technology, documentation and assistance is also possible.

Developer

Public Research Institution «Institute of Powder Metallurgy of Belarus National Academy of Sciences»

III-33 Alumosilicates-based composite material and filtering element from it. Manufacturing method



Range of application For filter elements used in recycling water purification systems, and air in pneumatic systems.

Description We created a porous composite material based on high-strength alumosilicates powders and filtering elements on its basis enabling to manufacture local devices to purify from mechanical impurities recycling water and pneumatic actuators. It allows to purify the systems from colloid iron to MPC level. It will favor to increasing the life time of systems using recycling water and compressed air in 2—2,5 times. The product surpasses analogues filtering elements in durability (50%) and efficiency (70%). It is in appliance with the best world's samples.. Full scale production has been organized. Acceptance tests have been carried out.

Expectancy Boiler service life increase due to the installation of local systems purification filters and use of filtering elements from the developed high-strength material

Realization *Project payback period: 4, 5 years. Import substitution. The contractor can offer technical documentation and assistance in implementation.*

Developer *Public Research Institution «Institute of General and Inorganic Chemistry of Belarus National Academy of Sciences»*

III-34 Ceramic materials and UHF-range antenna elements made from them. Hot casting facility for antenna ceramic elements



Range of application

Telecommunication and navigation systems.

Description

Ceramic dielectric material has been developed as well as the technology to make ceramic elements for antenna dielectric ceramic elements. The developer also offers a hot casting facility for antenna ceramic elements, resonance frequency fitting, metallization and control of electric parameters of ceramic antennas elements.

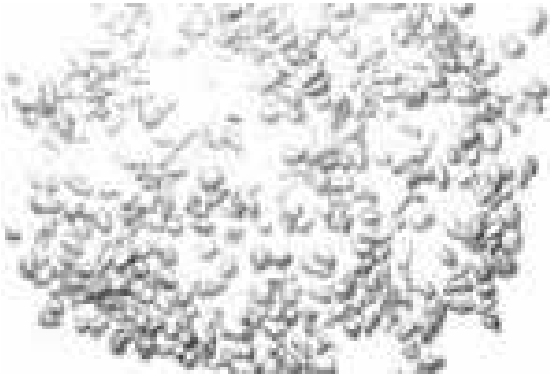
- Relative dielectric constant — 20;
- resonance frequency and dielectric constant approximate zero;
- dielectric dissipation is less than 0.0005.

The developed technological process and equipment enable to obtain ceramic elements with a higher service characteristics and material consumption double reduction. Antenna ceramic elements metallization process is free from precious metals. Resonance elements Q-factor 1.2 increase has been provided. UHF-antennas ceramic elements develop surpass the best world analogues in the total of technical and technological. The technological process is environmentally friendly.

Scientific and technical documentation has been developed and pilot production has been arranged. Pilot batch has been manufactured. Hot casting facility for antenna ceramic elements, facility to fit resonance frequency, metallization electro parameters control have been put into service.

Expectancy	20%-cost reduction. Free from precious materials metallization. 1.2-increase in electrophysical characteristics of elements.
Realization	<i>The contractor can sell technical documentation and render assistance in implementation.</i>
Developer	<i>Public Research Institution «Joint Institute of Solid-State Physics and Semiconductors of Belarus National Academy of Sciences»</i>

III-35 Complex graphitizing modifying agent for iron casting MIG



Range of application For late graphitizing inoculation of grey and high-quality cast iron independent of smelting method, chemical composition and temperature of source melt.

Description Composition: foundation — aluminum, active components — silicon, calcium, magnesium, rare-earth metals.

Technological parameters:

- cast iron source melt temperature — from 1300 °C,
- modifying agent consumption — 0.05—0.15%,
- method of adding to cast iron — any of the known methods including via automatic dosing mechanisms.
- granulating,
- fraction — 1—5 mm and 3—10 mm, bar,
- weighing— 0.5— 10 kg,
- inserted pieces — by customer's request,
- packing — 50 kg sacks.

Restraints to use – sand molding with humidity making more than 3% is not recommended.

Expectancy Die castings rigid graying with the wall width up to 3 mm, casted from cold cupola irons. vermicular and spheroid graphite structure in modular and refined cast iron is provided. Deoxidizing agent for carbon and special steels, increasing density, hot cracks resistance, impact hardness. The best modifying agent of wear resistant special cast irons of the type ITCH28N2.

Realization *Developed industrial production is available. The customer can use his raw materials. Delivery terms make 2— 3 weeks from the moment of the contract validity. Minimal batch amounts 500 kg. Modifying agent chemical composition can be adapted to the current technological process.*

Developer *Belarusian National Technical University*

III-36 **Constructional –heat insulating board on the basis of a dolomite binding agent and a wood filler**

Range of application Paper-pulp industry. Wood boards production. Building. Cheap efficient materials for building branches: civil engineering and house construction.

Description The technology has been designed and proof tests of the composites on soft-wood wastes and low-energy dolomite binding agent have been carried out. The use of low-energy dolomite binding agent will enable 20% reduction of the prime cost of the given production compared to the analogue on the basis of portland cement and utilize up to 12 thousand m³ of soft wood wastes annually.

Wood mineral composite material and magnesium binding agent obtained from dolomite compositions have been designed. Material's pilot batch has been output.

Physical and mechanical characteristics:

- density — 450—750 kg/m³;
- compressive strength — 2,0—2,5 MPa;
- bending strength — 0,7—1,0 MPa;
- coefficient of heat conductivity — 0,08—0,30 Wt/m·K

No home analogues. In appliance with foreign analogues. The technology is environmentally friendly. The technology has been developed and approbated.

Expectancy The developed technoly will help utilize soft wood wastes on wood processing factories. The designed material is similar to a wood concrete, on dolomite binding agent will be 20—30% cheaper.

Realization *Sale of the technology is possible including sale of technical documentation and rendering assistance in putting the technology into effect.*

Developer *Belarusian State Technological University*

III-37 Extrusion profile manufactures, technology of their obtaining

Range of application Construction, auto-tractor- and machine building, furniture industry. Substitution of analogues profile manufactures from wood, polymer and metal.

Description The manufactures are obtained from the materials reasonably combining in their structure wood wastes (up to 60—70 weight. %), polyvinyl chloride and special-purpose additives. Compared to the analogues to be substituted they possess high processing characteristics and availability of non-deficit raw materials and waste.

Characteristics:

density, kg/m ³	1100—1250	1200—1350	1340
strength, MPa			
bending	15—30	30—50	50—60
pressing	25—30	40—52	55—65
impact elasticity, kJ/m ²	4-16	5-16	7-8
water absorption for 24 h, %	10—22	4—6	1—2

Non-combustible.

In the stage of application to production.

Expectancy Unlike conventional labor and energy intensive methods to obtain moulded manufactures and composites the developed technology is actualized on industrial equipment completed with simple and reliable accessories.

Realization *Joint production, co-works.*

Developer *Public Research Institution «Institute of Mechanics of Metal Polymeric Systems named after V.A. Belyi of Belarus National Academy of Sciences»*

III-38 Gypsum- binding- agent- based materials

Range of application Interior decoration of buildings and constructions.

Description The material on gypsum binding agent has been developed: assembly adhesive to cement gypsum-fiber boards, thin bonding plaster, pore filler.

Characteristics:

- initial setting time — 40— 60 min;
- adhesion strength — 0,4— 1,1 MPa;
- ultimate compression strength — 4,3— 11,6 MPa (7 days).

Ranks over the analogues products. In appliance with the best foreign analogues.

Ecologically clean product.

A pilot batch of gypsum materials has been manufactured and acceptance tests have been carried out. The product's practical application is in progress.

Expectancy Use of the developed materials will increase the level and quality of works; reduce analogues products import.

Realization *Project payback period: 2—3 years. The contractor can offer technical documentation and render assistance in putting the technology into effect.*

Developer *Research Experimental Design Republican Unitarian Enterprise «Institute BelNIIS» Minstroyarkhetcturi RB*

III-39 High-temperature and corrosive medium resistant composite materials. The engineering procedure to make manufactures from them



Range of application

Tractor-machine building. The materials are used to make sleeves for internal-combustion engines.

Description

Aggressive-media and high-temperatures resistant composites have been developed and the parts from the machinebuilding. The technological process to make thermoresistant moulded fabricated rubber products (sealers).

Produced on the basis special purpose rubber resins

Elastomeric composition physical-mechanical indices:

- conditioned hardness – 21,4 MPa;
- elongation per unit length – 350%;
- Shore hardness A– 72 units Shre A;
- ISO hardness – 72 conventional units.

physical properties of a cup-type seal:

- Shore hardness A – 62 Shore units A;
- Change of weight after the impact of SZHR-1 at the temperature of 100°C during 72 hours – 3, 5 %.

There is no Analogous of the given product in Republic of Belarus. The product is in appliance with the best world analogues («Du Pont»). RB and RF patents. According to the conclusion of RB Ministry of Health Protection the technology is environmentally friendly.

Sleeves commercialization process has been initiated: front sealing and rear sealing; rings pilot batches have been manufactured and tested. The production of molded mechanicals has been put into operation.

Expectancy

Import substitution. Expanding the marked to CIS countries and bordering foreign countries.

Realization

Project payback period: 5 years. Off-shelf product sale.

Developer

Belarusian State Technological University

III-40

High-temperature ceramic material and two-layer nonswirl nozzles from it



Range of application

The developed nonswirl nozzles can be used in metallurgy.

Description

The high-temperature ceramic composite materials composition and two-layer nozzles manufacturing method have been developed.

Characteristic of materials:

- relative density — 4,5—5g/cm³;
- porosity — 7,5—11%;
- HRa hardness— 80—90.

The materials and the technology surpass the analogues of CIS countries. The materials in the complex of their mechanical and service properties are in appliance with West European analogues JUSTAL DS 1013. However, the price is 1,5—2,0 times lower.

3 RB patents are available.

The manufacturing procedure is environmentally friendly. The materials do not contain toxic substances and heavy metals salts.

Nonswirl nozzles pilot batch production has been arranged and their acceptance tests have been carried out.

Expectancy

Arrangement of nonswirl nozzles production in Belarus will help the republic replace imported nonswirl nozzles in work pieces continuous casting machines saving currency owing to the reduction of import.

Realization

The required funding amounts 12,5 million of rubles. Project payback period will make 3 years. The contractor can offer technical documentation and assistance in implementation.

Developer

Public Research Institution «RI of Pulse Processes with PP»

NEW MATERIALS

III-41 Light-weight keramzites manufacturing method. Manufacture of effective expanded-clay concrete blocks for exterior and interior walls

Range of application Residential and public building construction, construction of houses and cottages.

Description Energy-saving technology enables to obtain light-weight keramzite gravel economizing on natural gas and manufacture effective building blocks for exterior and interior walls.

- expanded-clay density — 200 kg/m³
- energy consumption per 1m³ of expanded-clay; — 65 kg.conventional tons.;
- bending strength — 2,5— 3,5 MPa;
- frost-resistance — 35— 50 cycles;
- heat conductivity — 0,12 Wt/m °C.

In compliance with the level of world's analogues. Provides industrial application of energy-saving technology to manufacture light-weight keramzite and manufacturing procedure for building blocks form expanded-clay concrete. No home analogues. The building blocks are 1,3 times cheaper than gas-silicate blocks.

The developed methods to obtain light-weight keramzite and manufacture building blocks form it are environmentally friendly.

The technology has been approbated.

Expectancy Energy saving.

Realization *Project payback period: 1 year. The contractor is ready to offer technical documentation and render assistance in technology application.*

Developer *Research Experimental and Designed Republican Unitarian Enterprise «Institute BelNIIS» Ministroiarkhtekturi RB, Belarusian National Technical University, Keramzite gravel Factory*

III-42 Material to manufacture soil pumps working in the conditions intensive hydro-abrasive wear



Range of application

In oil-refining and mine industries, auto-tractor building and other branches.

Description

The workflow to obtain cast boron-containing material to make soil pumps including charge make-up, preparation of the melting facility, charge loading, melting, control over the received alloy, casting preparation, casting, cast molds cooling.

The peculiarities of formation, structure and properties of iron-boron cast boron containing materials as part of the charge of ferroboration powder like components. Charge makeup, melting mode, control of chemical composition at melting, deoxidization stage, introduction of boron-containing material, melt modification, have worked out. The impact of the speed of cooling and heating temperature on the structure, hardness and cast phase has been studied. Technological documentation correction has been made.

A pilot batch of manufactures (rotor wheels for soil pumps) from cast boron-containing material has been made. The acceptance tests have been carried out. The manufacturing procedure has been mastered.

Expectancy

The results of mechanical test showed that the alloy deoxidized under the new method show high mechanical properties. The impact hardness values have 1, 5—2- fold dominance over the results of the analogues from cast steels casted under the conventional method. The results of rotor wheels pilot samples tests showed the appropriateness of application of the new material to make soil pumps operation in the conditions of intensive hydro abrasive wear.

Realization

The contractor can offer technical documentation and render assistance in putting the technology into effect.

Developer

Belarusian National Technical University

III-43 Thermodynamically- incompatible- thermoplastics- based -composite material



Range of application To manufacture drive shafts seal elements, stop valves seal elements to replace general mechanical rubber goods.

Description We created thermodynamically- incompatible- thermoplastics- based - composite material. Thermodynamically- incompatible thermoplastics are modified with ultrafine clusters of silicates, metals. The material used in manufacture of radial and end seals of cardan drives articulated links.

Physical and mechanical characteristics:

- yield point in elongation — 25 MPa;
- deformability, at least 10 mm;
- cracking resistance — 600 hours;
- brittle temperature, at least -40°C.

The composite materials have service characteristics comparable to those of the materials of the type «BASF», «Desmopan», «Vitur», «Rislan».

The manufacture of the composite material and manufactured articles on its basis is carried out at industrial equipment using fitting preventing from hazardous emissions, exceeding MPC.

The composite materials compositions have been proceed with patent application.

The technological procedure has been implemented. Acceptance tests have been carried out.

Expectancy

Cardan drives wear-resistance increases in 1,3—1,7 times. The cost price of the product diminishes in 1,5—2,1 times

New types of efficient composite hermetic materials on the basis of thermo-plastic elastomers, modified with ultrafine additives of silicates and metals. The composite material and the parts manufactured from them correspond to imported analogues. It enables to obtain parts to manufacture cardan drives which can compete with foreign analogues. The engineering procedure allows 1.1—1.3-fold reduction of technological cycle time to get parts from the composite material. The developed composite materials provide seal-elements increased wear-resistance, hygroscopic properties. It enables to replace imported analogues of the type «Desmopan». «Virtur». The material can change damping characteristics depending on actual operating conditions

Realization

To extend production the required amount of funding makes 0.07 million USD. 2-year- project payback period will take 2. The contractor offers technical documentation and implementation assistance.

Developer

Ja. Kupala Grodno State University. Research Institute of Material Science and Resource Saving Technologies

NEW MATERIALS

III-44 Wear-resistant composite material on polymeric matrix. Technological process of applying coatings from the composite material



Range of application

Machine building, metallurgy.

Description

The molding composition on the basis of epoxy resins and functional additives, technology of its obtaining and its coating on metal-working machinery friction assembly worn-out surfaces.

Belarus does not manufacture the material for the analogous purpose. In their main physical and mechanical properties the material surpasses those of UP-5-520 (Ukraine) and the material by «Kuhn. Reaktionsharz-Technic» (Germany). The development of the material is directed to solve import-substitution problem. The cost of the proposed material is 20—100% lower than that of applied foreign analogues.

The baked-on material is non-toxic and is environmentally friendly. The place where this material is manufactured and coated requires supply-and-exhaust ventilation and constant environmental control since inconsiderable escapes of epichlorhydrin from resin part and ammonia from hardening agent.

Laboratory, industrial and qualification acceptance tests of the developed material have been carried out. Material's industrial production has been organized. In production conditions a pilot batch of the material has been manufactured.

Expectancy

Increase in durability of metal-working machinery. The developed material can be used to repair machine tools instead of imported material to increase durability of metal-working equipment.

Realization

Purchase of new and more efficient mixing equipment requires additional funding. Payback period: 3—4 years. The contractor can offer technical documentation and assistance in implementation.

Developer

Public Research Institution «Institute of Mechanics of Metal Polymeric Systems named after V.A. Belyi of Belarus National Academy of Sciences»

IV.
COATINGS

№	Project name	P.
IV-45	Anticorrosion compositions with antistatic properties	65
IV-46	Ceramic-coated glass fabric filters	66
IV-47	Copper self-fluxing- alloys-based powder compositions and their coatication technology	67
IV-48	Frameless metal-fiber filtering elements	68
IV-49	Materials to shape thin-film coatings for enhanced wear-resistance devices crystals. Technique to shape silicon wafers thin-films	69
IV-50	Metal-polymeric belt from wear-resistant self-fluxing alloys	70
IV-51	Mine equipment high-wear parts manufacturing and reinstating procedure	71
IV-52	Nonleaded painter's enamel for glassware decoration	72
IV-53	Powder compositions with nitrogen-boron containing components, the manufacturing procedure to obtain and improve the manufactured articles with their help	73
IV-54	Powder polymeric paints	74
IV-55	Silicon-dioxide-based polishing suspension	75
IV-56	Technological process to increase holographic work matrixes wear resistance	76
IV-57	Technology and equipment to manufacture copper anodes using continuous horizontal casting	77
IV-58	The body with the applied DLC included into IR «Planics-T». Coating application engineering procedure	78

IV-45 Anticorrosion compositions with antistatic properties

Range of application Interior trim with enhanced requirements of accident prevention, to protect computer equipment.

Description Compositions on bitumen and epoxide-bitumen basis are designed to obtain coatings for various surfaces. Protect from corrosion, static electricity, electromagnetic radiation.

Features:

- spreading capacity — up to 200 g/m²;
- resistivity — 105 Ohm;
- electromagnetic radiation screening efficiency in frequency range — 8,5—7,0 GHz;
- at layer's width — 0,7—0,9 cm;
- reflection coefficient, — 23—44 dB;
- reflection, — 30—53%;
- absorption — 38—70%.

The products' manufacture application is in progress

Expectancy The use of the material will enable to increase computer equipment without additional expenses.

Realization License contract.

Developer Public Research Institution «Institute of General and Inorganic Chemistry of Belarus National Academy of Sciences»

COATINGS

IV-46 Ceramic-coated glass fabric filters

Range of application Fine filtration of metal in casting mold when manufacturing castings from high-strength and grey cast irons, some steels and non-ferrous alloys.

Description Ceramic-coated glass fabric filters are flat lattice with square cells with the following sizes: 1x1 mm, 1,5x1,5 mm, 2x2 mm and 2,5x2,5 mm depending on the viscosity type and the metal to be filtered
The shape and the geometry of filters may vary. The most common shapes are rectangulars and squares with the direction from 40 to 500 mm.
The filter width makes 1—2 mm, which enables in most cases to insert them into casting pattern without special signs device.
The filtering material is a cloth array of glass fibers corresponding to each type of the alloy to be filtered finished with special fire-proof composition.
Maximum allowable durable temperature of the mold when filtering makes 1450 °C, short-period temperature is up to 20—30 with – 1500 °C.

Expectancy To reduce spoilage in slag, nonmetallic inclusions and clogs; increase in the output of acceptable casting owing to the reduction of gating systems steel intensity; improvement of mechanical and structural properties

Realization *The filtering elements are delivered in finished form cut into the required sizes in water-proof package. Pilot batch production is available. The delivery terms make 2—4 weeks from the moment the contract has been signed*

Developer *Belarusian National Technical University*

IV-47 Copper self-fluxing- alloys-based powder compositions and their coating technology

Range of application The developed copper self-fluxing- alloys-based powder compositions and the technology of their application are used to obtain coatings on the surfaces of threaded connections working in the conditions of intensive wear and mechanical loading : track machines hubs and nuts, stop valves nuts, hydro- and pneumatic equipment hubs and nuts, lead and load nuts of machine-tool equipment , technological equipment and other equipment of machine building auto tractor-building , railway, sanitary engineering and other profiles.

Description The developed compositions and the workflow enable to obtain highly reliable parts with antifriction coatings on the surfaces of threaded connections corresponding in engineering-and-economical performance to the world's level.

Features:

- in «screw-nut» friction service life increase — 2,5—3 times
- friction factor — 0.06— 0.007,
- coating hardness — 175— 180 HRC
- material melting temperature — 900— 915°C.
- capacity — 12— 7 parts/h.
- ferrous alloys economy, up to 85%.

Ranks over home antifriction powder mixtures and their coating technology. Surpasses the manufactured items by «Hoganes» Sweden, «Metko» USA, NPK «Metalceramics» Bulgaria in «screw-nut» friction service life. RB patent. The powder mixtures composition and their application procedure and production accessories equipment are environmentally friendly
The powder mixtures and antifriction items workflow has been actualized, powder mixtures and antifriction coated parts manufacture has been put into operation.

Expectancy 1.5—2 –fold reduction in prime cost. Import substitution.1, 5—2- fold workflow productivity increase. 0, 85 copper alloys use efficiency increase to improve reliability of threaded connections working in the conditions of intensive wear and mechanical loading in whole

Realization *The required money to invest: 60000 thousand rubles. Project payback period: 2 years. Technical documentation sale.*

Developer *Public Research Institution «Institute of Mechanics and Reliability of Machines of Belarus National Academy of Sciences»*

COATINGS

IV-48 **Frameless metal-fiber filtering elements**

Range of application One-phase removable filtering elements for frame and frameless stationary and mobile filters in instrument making, electrical engineering, metallurgy, chemical industry, services sector, auto service and others.

Description The filtering elements are represented as a pressed mass from metallic fiber of the required geometry dressed with strengtheners or baked. Depending on the range of application the filtering elements can have.

Features:

- permissible pressure drop — up to 10 kg/cm²;
- relative porosity — 5— 98%;
- filter fineness — 10— 300 μ;
- operating temperature — from -100 to +300°C;
- fiber material — aluminum, zinc, copper, tin and their alloys;
- filtering mode — laminar, turbulent, transitional;

Expectancy Ion purification of enterprise sewages and spent solutions from precious and heavy metals; purification of wastewater from oil products; purification of exhaust gases from radioactive particles and salt sprays ; purification of organic and inorganic liquids (both with decreased viscosity and high-viscosity) from mechanical impurities.

Realization *The filtering elements are delivered in pilot batches under contracting prices. Laboratory equipment for manufacture is available. Development of pilot production in case of firm demand and in short terms is possible.*

Developer *Belarusian National Technical University*

IV-49 Materials to shape thin-film coatings for enhanced wear-resistance devices crystals. Technique to shape silicon wafers thin-films

Range of application For devices' crystals (Schottky diodes of SB series).

Description The developed technology of crystals planar metallization resistant to enhanced temperatures of devices assembly and maintenance — Schottky diodes of SB series — is noted for obtaining of acceptable films adhesion, up to 30 MPA, as well as for reduced level of residual mechanical stresses, which determine films stability in service conditions including thermocycling, and devices' reliability.

The tests of semiconductor devices crystals of SB series showed that the devices crystals endure, unlike the crystals manufactured before, the service temperature up to 150 °C, which is in appliance with the performance of the best foreign analogues.

Ranks over the technology to obtain thin-film coatings on silicon in maximum service temperature value Home analogues in manufacture the instruments of the given class are unavailable. In appliance with the manufacturing procedure of foreign analogues — crystals of Schottky diodes of SB series IOCTQI50, 10CTQ150S and others.

The technology has been put into operation.

Expectancy Manufactured articles service life prolongation.

The product is in appliance with present-day ecological requirements and its wide application will not cause ecological deterioration.

Realization *The required sum of investing money will be specified after the specification of the devices spectrum in which the designed nano-structural materials of thin-film coatings and procedure of their shaping are supposed to be used.*

Developer *Belarusian State University of Informatics and Radioelectronics;
Unitarian Enterprise «Plant«Transistor»*

IV-50 Metal-polymeric belt from wear-resistant self-fluxing alloys

Range of application The developed metal-polymeric belts on the basis of wear-resistant self-fluxing alloys and their coatication technological process are used to obtain coatings on work surfaces of parts working in the conditions of intensive determination and mechanical loading, of the following assortment: fodder harvester shredders cutting pairs wear resistant elements , soil cultivating machines working organs and other equipment of the enterprises of machine building, auto tractor, agricultural and other profiles.

Description We developed and manufactured metal-polymeric belts on the basis of wear-resistant self-fluxing alloys with polymeric binding agents. We also developed the procedure of application of wear-resistant coatings by welding these belts onto work surfaces of the parts working in the conditions of intensive deterioration and mechanical loading, including production tooling. The developed metal-polymeric belt and the engineering procedure enable to obtain highly reliable parts with wear-resistant coatings of the work-arears. It is in appliance to the best world's analogues in engineering-and-economical performance.

Obtained products parameters:

- service life prolongation — 2—3 times;
- hardness — 63—65 HRC;
- process capacity — 12—17 parts /h;
- doped alloys economy, up to 85%;
- prime cost reduction in 1,5—2 times.

Surpasses home made antifriction powder compositions and their coatication technology. Takes advantage over the articles of world's level by GUP FNPC «Pribor» Russia, «Metallwerke Planszee» Austria. RBpatent.

The powder compositions, their coatication technological process and equipment with technological outfit are environmentally friendly.

The workflow has been actualized and powder mixtures and wear-resistant parts manufacture has been put into effect.

Expectancy Import substitution, 1, 5—2-fold increase in process efficiency, doped alloys use factor increase up to 0.5. Increase in reliability of wear-resistant elements of cutting blades and executive devices of agricultural machines working in the conditions of intensive wear-and-tear and mechanical loading in whole.

Realization *The required sum of investments makes 60000 thousand rubles. Project pay-back period amounts 2 years. Finished products , technological documentation sale.*

Developer *Public Research Institution «Institute of Mechanics and Reliability of Machines of Belarus National Academy of Sciences»*

IV-51 Mine equipment high-wear parts manufacturing and reinstating procedure

Range of application Mineral resource industry, heavy engineering industry, power engineering, chemical and oil industries.

Description The technology can replace the process of mine equipment parts reinstating with the help of weld deposition under the flux layer for a more efficient and less expensive process of activated arc spraying

Technical features:

- part overall dimensions — 15 — 500 mm;
- applied wire material — 1,6— 2,0 mm;
- spraying capacity ~ 16,0 kg/h;
- stock utilization ratio — 0,7— 0,76;
- coating total thickness — 0,2— 8,0 mm;
- protective coating density — 95— 97 %;
- coating adhesion strength — 40 — 42 MPa;
- protective coating hardness — 37— 41 HRC;
- corrosion coefficient — 0,07— 0,12 Ka.

Home analogues are unavailable.

The developed technology in key parameters is on the level of the best world's samples (Sulzer Metco (USA), SNMI (France)).

The developed engineering procedure is environmentally friendly since it does not involve the use of toxic agents.

The engineering procedure has been put into effect.

Expectancy The technology can prolong service life in 2, 0—2, 5 times, reduce mine equipment parts manufacturing and reinstating by 30%. The engineering procedure is free from the use of toxic agents.

Realization *Project payback period: 1, 2 years. The contractor can offer technological documentation and assistance in mastering the technology.*

Developer *Public Research Institution «Institute of Mechanics and Reliability of Machines of Belarus National Academy of Sciences»*

COATINGS

IV-52 Nonleaded painter's enamel for glassware decoration

Range of application Glasswork industry.

Description New painter's enamels for glassware decoration have been developed. They are free from toxic lead-containing compounds; They are treated with a single burning; have a wide gamma of colors owing to mixing of different enamels ; low cost (up to 35 USD) compared to German manufacture enamels («Her-aeus» up to 70 USD.) and silicate paints of Dulev factory (50 USD.). With relation to the best home and world's samples: the developed enamels are free from lead, non-toxic and environmentally friendly which enables to create on their basis a new competitive product (glassware decoration) Ecologically safe production. The manufacture of enamels is in appliance with traditionally applied enamel production and glassware decoration. The requirements specification have been developed, a pilot batch of enamels have been produced and their pilot production have been organized.

Expectancy Double reduction of energy intensity. - 1, 5—2- fold reduction of the price. On the basis of the developed new painter's enamels we hope to obtain a new sort of production — environmentally friendly painter's and decorative glasswear

Realization *Project payback period: 3 years. Sale of finished items and technical documentation*

Developer *Public Research Institution «Institute of General and Inorganic Chemistry of Belarus National Academy of Sciences»*

IV-53 Powder compositions with nitrogen-boron containing components, the manufacturing procedure to obtain and improve the manufactured articles with their help

Range of application Machinebuilding , fuel-energy complex, instrumental industry and other branches of industry to increase alloy-steels manufactured articles service characteristics

Description We developed the compositions of powder mixtures containing carbon, nitrogen and boron for their consequent use in the process of thermo chemical low-temperature treatment of alloy-steels manufactured articles... The technological process to harden complex alloyed steels manufactures using nitrogen and boron-containing composites has been developed. It enabled to create surface areas with high wear resistance. It allows to prolong the service life of the manufactured articles in 3—5 times
In performance characteristics they rank over the materials used to make rapidly wearing parts of machines and machining attachments. In technical and engineering characteristics the product is in appliance with the world's level. RB patent.
The waste utilizations carried out through their reclamation as technological filler with new saturating mixtures production. No toxic agents in water and air. A pilot section of thermo chemical processing has been organized.

Expectancy Import substitution. The developed technology will increase the tool life time in 3-4 times. It will enable to substitute expensive imported high alloyed steels for less alloyed steels with coatings.
Power intensity decrease owing to preparation of saturating mixture using the method of out-of-furnace metalothermy, material economy in 3-5 times owing to increase of operational properties, double reduction in cost thanks to the substitution of expensive imported high alloyed steels.

Realization *Project payback period: 3 years. The contractor is ready to offer technical documentation and render assistance in technology application.*

Developer *Belarusian National Technical University*

COATINGS

IV-54 Powder polymeric paints

Range of application Chemical, transport and agricultural machine building, electronics, radio electronics, construction, oil-trunk pipes protection.

Description The material is used to shape protective and decorative coating on various metal ware to obtain protective electrical insulating coatings.

Features:

- adhesion strength — 1 steps;
- bending strength — 2—6 mm;
- temperature resistance — from -25 to +25 °C;
- enhance humidity — at $t = 40^{\circ}\text{C}$ humidity 100%;
- salt spray — at $t = 35 \pm 2^{\circ}\text{C}$, $\text{CNaCl} = 50 \pm 5 \text{ l/dm}^3$;
- solar radiation impact.

In appliance with the best world's analogues.

Laboratory samples are available.

Expectancy The application of the developed paint enables to substitute imported products. The main advantage lies in low temperature mode for coatings to harden, power inputs lowering, and productivity boosting when manufacturing protective and decorative items.

Realization *Technical documentation sale.*

Developer *Public Research Institution «Institute of General and Inorganic Chemistry of Belarus National Academy of Sciences»*

IV-55 Silicon-dioxide-based polishing suspension

Range of application Electronics. Pre-polishing of optical and electronic manufactures.

Description The concentrated silicon-dioxide-based polishing suspension has been developed for monocrystals silicon plates pre-polishing stage.

Features:

- density — 1,075—1,085 g/cm³;
- Contents SiO₂, weight. — 12,5 %;
- pH suspension at 20 °C — 11,8—12;
- SiO₂ particles size — 10—40 μ;
- Price for 1 l of suspension — 3,3—4,5 USD;
- appearance — milky liquid, free from mechanical inclusions;
- polishing suspension viscosity makes 1,25 MPa*s;
- suspension shelf life, at least 6 months.

Polishing suspension parameters are in appliance with the best world's analogues («Fudjimi» (Japan), Nalko (USA)). Pilot production has been organized.

Expectancy The use of the polishing suspense at the monocrystals silicon wafers pre-polishing stage will increase the manpower effort by 20—30 %. Import substitution.

Realization Sale by contracts. Project payback period 2—3 years.

Developer *F. Skoryna Gomel State University*

IV-56 Technological process to increase holographic work matrixes wear resistance



Range of application

The technological process (KMRI.25271.00149) is aimed at increasing holographic work matrixes wear resistance when impressing holographic products from, gaining impressing process efficiency, reducing of holographic products prime cost.

The process can be adapted to increase interacting parts wear resistance , to reduce the friction factor , to prolong service life

Description

Work matrixes wear resistance increase is based on the protection of their holographic micro relief with the finest super hard coating from diamond-like carbon which will not distort holographic products performance.

Protective carbon coating width does not exceed 100 nm. Process parameters assign the required coating width.

Work matrixes surface is coated with the help of plasma deposition.

The technological process can be actualized on off-the-shelf vacuum assemblies with minimal alterations under the process requirements.

The developers used vacuum assembly UVN-71P-3 after its appropriate modernization.

The technological process has no analogues. The coatication cost does not exceed 8—10 % of that of holographic work matrix the wear-resistance of which being double increased at the same time.

The process has been RB patent pended The coatication process is environmentally friendly.

Modified surface holographic work matrixes pilot batch has been manufactured.. Modified work matrixes manufacturing procedure has been actualized.

Expectancy

Holographic products prime cost reduction.

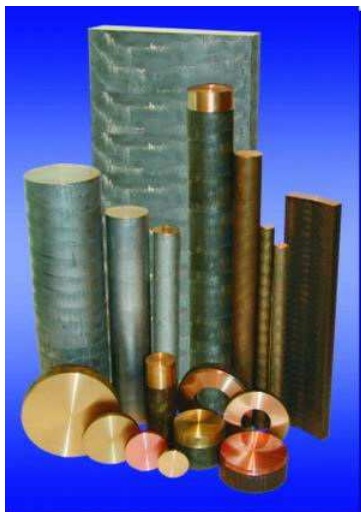
Realization

The contractor cam offer adaptation of technological process to increase holographic work matrixes wear-resistance and vacuum equipment to customer's requirements.

Developer

Engineering Center «Plasmoteg»

IV-57 Technology and equipment to manufacture copper anodes using continuous horizontal casting



Range of application

To apply galvanic coating when producing metal cord.

Description

The developed technology and equipment to obtain 12x80x500 mm copper anodes using continuous horizontal casting will enable reduction in copper anodes import. Copper anodes are applied as the material for galvanic coating when producing metal cord.

- The consumption of copper anodes per 1 ton of cord for general purpose use makes 4,95 kg;
- valid casted anodes output— 97— 98 %;
- chemical composition, %:
 - Cu , at least 99,975
 - impurities , not more than:
 - Bi 0,0005
 - Sb 0,001
 - As 0,001
 - Fe 0,001

- Ni 0,001
- Pb 0,002
- Sn 0,001
- S 0,002
- O 0,015
- Zn 0,001
- P 0,0005

Home samples are unavailable.

The developed technology and equipment to obtain copper anodes using continuous horizontal casting correspond to the best world's analogues in indices of chemical composition, copper anodes consumption per 1 ton of general-purpose cord.

The engineering procedure and equipment provide reduction of harmful effects with the level lower than that of maximum permissible concentration (MPC) The engineering procedure has been developed. The equipment has been manufactured and pilot batch manufacture of continuous copper anodes has been arranged.

Expectancy

Manufacturing application of the developed technological process and equipment to obtain copper anodes using continuous horizontal casting will enable to reduce copper anodes import thus saving enterprises currency.

Realization

Projects payback period: less than 1 year. The contractor can offer technological documentation and render assistance in technology manufacturing application.

Developer

Public Research Institution «Institute of Metals Technology of Belarus National Academy of Sciences»

IV-58 The body with the applied DLC included into IR «Planics-T». Coating application engineering procedure



Range of application

Medicine.

Description

Small-operational ecologically friendly technology of application of bio-compatible diamond-like coatings (DLC) is based upon the use of the process impulse vacuum-arc deposition of DLC on the basis of carbon when applying them on the bodies of artificial cardiac valves (ACV).

- synthesis temperature — 473 K,
- simultaneously coated area — 0,3 m;
- coating inhomogeneity in width — < 3 %;
- coating width, up to 3 μ
- thrombosis test index is not worse than 4,5 473K.

Home analogues are unavailable. Its parameters and properties of the resulting coating it corresponds to the best world's analogues (f.Sorin, Italy, f. SJM, USA). Coating of bio-compatible DLC is carried out at a lower synthesis temperature (473K) compared to that of the analogue. It allows preserving the surface structure free from deformations. The coating inhomogeneity in width and the thrombosis test index surpasses that of the analogue f Sorin, which reduces the risk of thrombosis formations which is proved with the patents.

The developed technology is ecologically clean and wasteless. The engineering procedure to obtain bio-compatible DLC application the bodies of Artificial satellites has been developed. The pilot batch has been manufactured and acceptance tests have been carried out.

Expectancy

The use of the developed product will help in ceasing the import of ACV. The implementation of the technology to obtain biologically competitive DLC, raising the quality to the level of world's standards, ecological safety. The use of the bell-jar fixture and implementation of the technical method will help to increase the output of production in 20% owing to the increase of DLC quality and increase the number of simultaneously coated manufactures; will lower the price cost in 10%.

Realization

15% increase in export. Import substitution. Payback period: 2, 2 years. Sale of finished product.

Developer

Engineering Center «Plasmoteg»

V. MACHINE-BUILDING.
METALLURGY.

№	Project name	P.
V-59	Alloyed steel casting technology using hot pressed cakes from bearing wastes.	82
V-60	Arc ignition insulator for catode art spraying facilities	83
V-61	Arc weld processes multiparameter control system by arc electric parameters and heat-affected zone thermal parameters	84
V-62	Bracket-milling machine with autochanger and NPC model. FSS500CNC	85
V-63	Compact drilling-milling machine SF-1	87
V-64	Complex resource saving technology to manufacture forgings of car front suspension cross bars and pins	88
V-65	Device to detect defects in polimeric pipes lap welds (SP-09)	89
V-66	Eddy-current defectoscope FD	90
V-67	Fast speed single-screw continous mixer to prepare short-life sand-resin mixtures model. S1SH3.	91
V-68	Hardening-cure casting	93
V-69	High-performance heaters	94
V-70	High-performance work pieces for piston and plunger rings from deformed cast iron	95
V-71	High-permeability ferrite elctromagnetic concentrators. Standard technological process opf their obtaining	97
V-72	PNC surface grinding semi-automated machine with a round rotary-axis table of the model OSH-641	98
V-73	Sheetbending hydraulic press with programmed numerical control intension 1000kN	100
V-74	Spin casting technology and standard equipment to manufacture iron-carbon alloy turned billets	101
V-75	Structural sheet metal-plastic	102
V-76	Technological process and equipment freeze crystallization casting of hopped-up diesel engine cylinder sleeve billets	103
V-77	Technology and design documentation for the equipment to obtained pipes from polymeric wastes.	105

Nº	Project name	P.
V-78	Technology and equipment to obtain billets using the method of electroslag remelting	106
V-79	Technology to obtain tubular billets form non-magnetic manganese steel for telemetric systems of horizontal and directed drilling	107
V-80	Universal lead-and-feed screw lathe SM1763	108

V-59 Alloyed steel casting technology using hot pressed cakes from bearing wastes

Range of application Enterprises of metallurgic industry the equipment of which include high-power arc steel-making furnaces.

Description The designed technology function is to smelt alloyed steel in the conditions of high-power arc steel-making furnaces using briquette from bearing production wastes. It enables to use briquettes from engineering plant production wastes as a burdening material which in its quality are the substitutes of lump alloyed scrap of category 6B1, currently imported.

The developed technology compared to base variant provides 5—15 % reduction of power consumption in smelting steel in blast furnaces. The quality of the product is in compliance with National Standard 4543-71.

- Output of metal products in the form of rounds of 0 80—150 mm from alloyed steels.
- Specific power consumption 400—420 KWt h/t.

Home analogues are unavailable. In compliance with the parameters of world's level technologies. Submitted to patent application.

Eco-friendly. Enables engineering plant production wastes utilization. The technology has been put into effect

Expectancy Lump alloyed scrap import reduction. Specific power consumption has reduced by 5—15 %.

Realization *Project payback period: from 1 to 2 years depending on processing efficiency. Technology transfer contract.*

Developer *Belarusian National Technical University*

V-60 Arc ignition insulator for cathode arc spraying facilities

Range of application Application of protective coatings using vacuum deposition.

Description We developed a material with the following properties:

- hardness — 95 HB,
- residual porosity, not more than 3%,
- destruction viscosity factor — 5,5 MPa*cm/2

including the technology of manufacturing arc ignition insulator. The economic effect is provided owing to the increase of insulator service parameters increase and due to technological temperatures reduction, (by 150—200 °C). In performance the product surpasses the performance of insulators used in cathode –arc deposition facilities. The temperature is reduced by 150 °C, which enables to save energy resources. The developed insulators are in appliance with the best foreign analogues. The use of our ceramic insulator reduces the dust level in building spaces. We've developed: the material, technologies to make arc ignition insulator from it. We also developed technological equipment, technological processes. Pilot batches of our insulators have been manufactured. Acceptance and performance tests have been carried out.

Expectancy 30 % cost reduction owing to temperatures reduction. The developed insulators have increased capacity in 1, 8—2 times when they are used in cathode-arc depositing facilities.

Realization *The required funding: 30000 thousand rubles annually. Project payback period: 2 years. The contractor can offer technologies, license agreement, finished product sale*

Developer *Public Research Institution «Institute of Powder Metallurgy of Belarus National Academy of Sciences»*

V-61 Arc weld processes multiparameter control system by arc electric parameters and heat-affected zone thermal parameters



Range of application The multiparameter control system can be used in technological processes where extraneous radiation sources (welding, rolling industry, flame spraying etc.) impact greatly on multiparameter control and can be adapted to other technological processes where the temperature control is of first-priority.

Description The system is designed for multiparameter control over welding process in real time in the process of automatic and semi- automatic arc welding in shielding gas environment. It provides registration and procession of data coming from welding apparatus sensors.

Features:

- welding arc voltage— 0—100 V
- welding arc current — 0—300 A.

Expectancy Control over all basic parameters of welding process including the temperature in two point in thermal impact area

Realization *Direct contracts, completion under the customer's requirements.*

Developer *Public Research Institution «Institute of Heat and Mass Transfer named after A.V. Lykov of Belarus National Academy of Sciences»*

V-62 Bracket-milling machine with autochanger and NPC model. FSS500CNC



Range of application

The Bracket-milling machine has been designed to treat parts by contour milling with linear and circular interpolation, drilling, core-drilling, coordinates hole boring, thread tapping.

Description

- Table work space size, mm:
length 1600, width 500
- Work piece maximal weight (with an attachment), 700 kg
- Travel capacity (by axes), mm:
longitudinal (X) 1000, transverse (Y) 500, vertical (Z) 500
- spindle taperISO50
- spindle rotational speed, 50–4500 rev/min
- spindle rotational speed steps number Stepless regulation
- carrying-in range, mm/min:
— longitudinal — 3—10000, transverse — 3—10000, vertical — 3— 5000
- fast traverse rate, m/min.:
longitudinal — 15000, transverse — 15000, vertical — 10000
- displacement resolution, μ 1
- instruments in the tool kit, items 20
- Instrument change time, from 10
- precision class under National Standard 8 P

MACHINE-BUILDING. METALLURGY

- bilateral positioning precision, μ :
— axis X— 30, axis Y— 20, axis Z— 20
- circular deviation at cylindrical surface contour milling, μ 0,03
- motor drives power, Wt:
— main motion — 11, table feeds — 4.8
- size — 3540x3350x3070 mm
- weight (with electrical equipment) — 6900 kg

In characteristics ranks over the home analogues. In functionality and quality ranks over the analogues mod.GF2171 ZeFS (Russia). Patent clearance in the following countries: Germany, Japan, France, Russia, England, USA. In compliance with the best world's analogues.

The advantages of the created design:

1. Advanced technical and technological facilities at the expense of the use of an auto-changer with a tool storage for NPC 20 instruments
2. Precision class P will enable to expand the assortment of treated parts, perform using the machine exact coordinates holes fine boring operations which are typical for vertical treating centers. Final polishing keeping to profile tolerances and location characteristic to general engineering parts becomes possible. At the same time, knee-type mill advantages are preserved: stationary arrangement of main drive gearbox, relatively low weight of the slider and as a result absence of weight balancing mechanisms, possibility to treat various-height parts owing to console setting motion. Spindle head stationary arrangement enables to execute more convenient auto-changer arrangement and to reduce instruments change time.
3. Table's upsizing and load capacity will enable to widen the dimensional and weight range of work pieces.
4. Design – the ergonomic solution of the machine will favor to fitting the modern tendencies of esthetic solution of millers's visual appearance to the best advantage
5. The application of newly mastered progressive component parts and materials with improved technical and economical parameters will enable to reduce the machine weight considerably.

The machine is eco-friendly.

The machine pilot sample manufacturing and testing is in progress.

Expectancy Machine building enterprise labor productivity increase. Import substitution.

Realization *The required funding sum amounts 135000 thousand rubles. The project pay-back period makes up 1, 7 years. Sale of the machine-tools.*

Developer *Republican Unitarian Enterprise «Homel machine-tool plant named after S.M.Kirov»*

V-63 Compact drilling-milling machine SF-1



Range of application

Small batch and piece-production in metal processing shops, cooperatives and individual production.

Description

Features:

- spindle driver power — 1,5 kWt
- spindle rotation speed — 100—3000 min⁻¹
- drilling maximum diameter — 23 mm
- milling cut maximum diameter — 76 mm
- maximum travel:
 - bed table — 260 mm
 - crossover table — 150 mm
 - vertical head — 280 mm
- table work areas size, mm:
 - length — 450
 - width — 180

- overall dimensions — 825x710x1005 mm
- weight — 200 kg
- price — 2450 USD
- precision class under the National Standard 8-82 N

In its performance the product is in compliance with the best world's analogues. With relation to the best home samples the product ranks them over in key parameters.

Eco-friendly technology.

Pilot sample tests have been carried out.

Expectancy

Substitution of out-of-date equipment, sales to SIC and non-CIS countries.

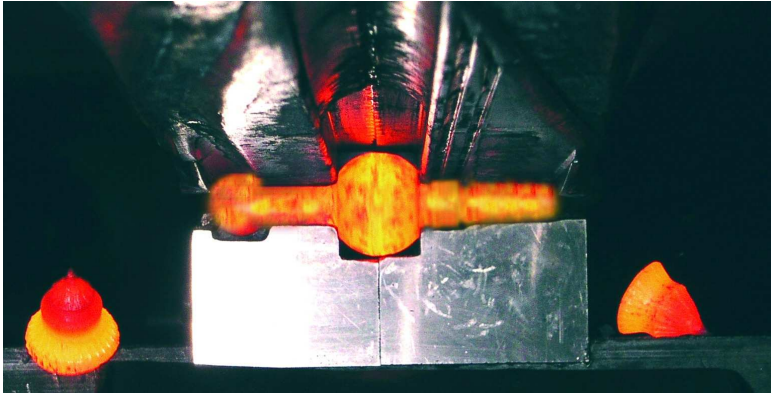
Realization

Payback: 3 years. The product's sale.

Developer

Republican Unitary Enterprise « Machine-Tool Plant «Krasni Bo-rets»

V-64 Complex resource saving technology to manufacture forgings of car front suspension cross bars and pins



Range of application Machine building, motor industry and auto service.

Description Variable cross-section forged piece complex resource saving manufacturing procedure has been developed. The forged pieces have been preliminarily profiled. We have also developed the technological process to manufacture trunnion crosses, car front suspension ball pins based on two operations of plastic forming: semifinished item cross-wedge rolling and forged piece close tolerance forging.

- metal recovery — 0,95;
- process capacity — 250 items/hour.

Features:

- metal recovery — 0,95;
- process capacity — 250 items/hour;
- cost reduction — by 15%;
- metal-roll annual saving — 989, 6 t.

Ranks over home analogues and is in appliance with the best world's samples. RB patent. The technology is eco-friendly. The technology has been applied into production.

Expectancy Manufactures prime cost reduction, forged pieces metal recovery increase. Manufacturing application of efficient complex technological processes to fabricate manufactures of two designations and six standard sizes. The technology with a few completions can be applied in production of a wide group of manufactured articles of analogous geometry and standard sizes.

Realization *Sale of the technology, joint production, sale of finished product, production accessories and deforming instrument is possible including the equipment and design documentation. The contractor can render assistance to apply the product to manufacture including help in making production accessories of the deforming instrument. The project payback period makes 0,3 years*

Developer *Public Research Institution «Physical and Technical Institute of Belarus National Academy of Sciences»*

V-65 Device to detect defects in polymeric pipes lap welds (SP-09)



Range of application

For ultrasonic control over the defects of polymeric pipes lap-welded union joints in the process of assembling the systems of cold and hot water supply and gas supply.

Description

The device consists of the following key assemblies: electronic block (control board, control unit, pulse generator, receiver-amplifier); transmitter; equipment for optimal arrangement of the transmitter in the process of control and ultrasonic effect protector.

Features:

- Pulse frequency, not more than 100 Hz;
- Generator impulse amplitude, at least 100 V;
- operating voltage — $12 \pm 1,3^*$ (direct current) V;
- controlled pipes diameter — 20—9 mm;
- weight, not more than 1,5 kg;
- Size, not more than 160x135x260 mm.

The control over lap-welded union joints of 40 mm polymeric pipes pilot batch using the device's pilot sample has been implemented. The methods of control have been developed.

Expectancy

Compactness, small size and low weight, convenient to be handled in assembling, requires no special training in adjustment and service, reliable and has a long service life, save in service (no need in high voltage power supply).

Realization

By customer's request the devices can be manufactured in the desired amount. Assistance in putting the devices into operation can be rendered.

Developer

*Public Research Institution «Research and Design and technological Institute of Welding and Protective Coatings with Pilot Production»;
Public Research Institution «Institute of Applied Physics of Belarus National Academy of Sciences»*

V-66 Eddy-current defectoscope FD



Range of application

FD can be used in workshop, laboratory conditions of industrial enterprises, repair work shops, in field conditions to detect defects in the form of cracks on the ferromagnetic items surface.

To detect defects in the form of cracks on the ferromagnetic items surface.

Description

It belongs to non-destructive testing. It consists of a small-size electronic unit which is connected with pencil-like eddy current detector. The principle of operation is based on the analysis of alternate voltage amplitude, directed in transducer magnetic test coil by eddy currents electromagnetic field which appears in a controlled device under the effect of alternate electromagnetic exciting field, created by the same transducer.

Defect detection takes place in the process of controlled surface scanning with the help of attachable transducer. The defect is displayed with light and sound warning.

Characteristics:

- minimal size of the detected defect for parts with roughness Ra making not more than 1,25 μ , mm:
 - width — 0,01
 - depth — 0,2
 - length — 5
- electron unit size , — not more than 200x100x40 mm
- accumulator power supply, continuous work non-recharge time , at least 12 hours
- weight, not more than 0,3 kg

Expectancy

Simple in service, no necessity in regulation in the process of operation , special training of the operator is not required. The applied method of signal electron processing essentially reduces the influence of negative factors such as nonuniformity of electric, magnetic characteristics of the material under control, controlled surface roughness. The attachable transducers are manufactured taking into account customer's requirements , for example, for control of flat and cylindrical surfaces, for wheels control etc.

Realization

Manufactured and delivered on the basis of a direct economic agreement of a contract.

Developer

Public Research Institution «Institute of Applied Physics of Belarus National Academy of Sciences»

V-67 Fast speed single-screw continuous mixer to prepare short-life sand-resin mixtures model. S1SH3



Range of application

Industrial enterprises having foundry with single-piece, serial and mass production of «rod» cast billets.

Description

The primary function of fast speed single-screw continuous mixers is to prepare short-life sand-resin mixtures used in cores manufacture by cold-hardening mixtures No-bake technologies. In base case the mixer has two contours of feeding and dosing of liquid binding agents. This provides the possibility of its use to prepare most available in present-day foundry types of sand-resin mixtures on the basis of two-component binding systems «resin + binding agent». When manufacturing cores on core-making machines the mixer can be mounted on the upper area of the machine and used to prepare sand-resin mixtures of hot and cold hardening with loading of prepared mixture directly into core-machine bunker.

Characteristic:

- mixer capacity — 1—3 t/h
- movable operating element number (screws) — 1.
- Mixing aggregate rotation angle — 180 degrees
- work range — 720 mm
- screw revolutions — 690 min⁻¹
- dosing pumps — 2.
- Installed power — 3,5 kWt
- Mixer size — 1375x420x1652 mm
- Mixer weight — 450 kg

MACHINE-BUILDING. METALLURGY

- price — 19 thousand USD

CIS countries do not manufacture fast speed single-screw continuous mixer to prepare short-life sand-resin mixtures. In main technical and economical characteristics S1SH-3 considerably ranks over those of two-screw mixer, mod. S2P1-1. S1SH-3 is in compliance with the best world's analogues by IMF (Italy), OMEGA (Great Britain). single-plunger pumps of ND type in acid-resistant design are used as dosing aggregates. These single-plunger pumps are widely represented in home market, have high dosing accuracy and considerable durability. To smooth liquid flow pulsation we use stainless steel air chambers (receivers).

Long serviceability of the pumps, dosing tuning accuracy and very high speed of response of liquid components feed for the beginning of mixture preparation is achieved owing to the use of looped (recurrent) scheme of binding agent feeding. The introduction of binding agent into the mixing chamber is carried out via the injectors continuously blown with compressed air. This provides the uniformity of binding agent distribution over the whole volume of prepared core mixture.

S1SH-3 distinguishing characteristic lies in design simplicity and reliability. The core mixture mixing takes place in mixing aggregate screw chamber having replaceable spades fixed on fast rotating shaft. A set of mixing chamber short length and screw high rotation speed provides quick and qualitative mixture preparation including complete purification from mixture residuals and the end of each work cycle.

Mixtures production is eco-friendly. S1SH-3 used present day core technologies which favors to improvement of sanitary and hygiene of cast billets manufacture at the stages of mixture preparation, core making and casts pouring. The mixer's pilot samples acceptance tests have been carried out. Pre-production stage has been completed.

Expectancy

Replacement of out-of-date models of low-sort mixtures and introduction of cold hardening mixtures No-bake technologies when manufacturing cores enabling considerable increase in quality of manufactured sand cores and the obtained casts. It will make possible to reduce their cost and improve ecology. The production of wide assortment of sand cores by modern technologies of short-life cold-hardening mixtures (furan-process, technology alpha-set and others).

Realization

Direct purchase contracts. Project payback period: 3 years.

Developer

Republican Unitarian Enterprise «Institute of BelNIIIit»

V-68 Hardening-cure casting



Range of application

The method can be used for silumins casting with nano-structural eutectic silicon; obtaining of deformed cast alloys, for example, silumins; casting of antifriction alloys with high performance and service characteristics ; considerable improvement of structural heredity of the billets from silumins and improvement of their mechanical properties.

Description

The alloy is poured into water-cooled metal chill, where initial 5—8 mm width casting skin is shaped. Then the billet is extracted and hardens outside the mold in a hardening bath.

Features:

- obtained billets diameter — 40—150 mm;
- casting performance — 0,5—2,0 t/h;
- primary silicon dispersivity — 5—30 μ ;
- eutectic silicon dispersivity — 0,4—1,5 μ .

Expectancy

Hardening-cure casting technological process is eco-friendly, excludes the use of modifiers and provides high productivity and obtaining of cast bars with nano-structural eutectic silicon.

Realization

The contractor can offer technological documentation and assistance in putting the technology into operation.

Developer

Public Research Institution «Institute of Metals Technology of Belarus National Academy of Sciences»

V-69 High-performance heaters



Range of application Industrial enterprises.

Description Electro-heating elements are manufactured under powder metallurgy technology using the method of compaction of multilayer structure in one cycle. The structure includes protective, conducting and heat insulating ceramic layers with the subsequent process of solid-phase synthesis. coefficient of efficiency — 0,9. The product represents a new direction in heating engineering and enables to create on their basis a new family of high-efficiency heating deices surpassing in key parameters foreign analogues. The manufacturing application stage is in progress, the laboratory sample is available, and researches are being carried out.

Expectancy The used of the designed electro heating elements will decrease electric power consumption in 2-3 times compared to the conventional heating elements.

Realization *Sale of the technology, licensing agreement, finished product sale.*

Developer *Public Research Institution «Joint Institute of Solid-State Physics and Semiconductors of Belarus National Academy of Sciences»*

V-70 High-performance work pieces for piston and plunger rings from deformed cast iron



Range of application

Machine building, particularly automobile building. For a wide range of engines, transmissions and compressors. Cardinal improvement in quality and service characteristics of piston and plunger rings. In large-scale production for mass model of a combustion engine, perhaps, it will be a new model of the engine designed from «tabula rasa».

In piece-production especially high-loaded and expensive engines, for example, for race cars.

Description

The cast-iron, heated to high temperatures in a special fitting is impacted with large deformation. Standard equipment is used. The know-how lies in cast irons compositions, treatment parameters, fitting design. Intellectual property protection license is available.

After the deformation impact :

- Mechanical properties of cast iron increase (up to 2, 5 times), approaching the level of alloyed steels (up to 1400 MPa), and the plasticity is growing too. At the same time, unique antifriction factors of cast iron are preserved, including the ability of rapid vibrations and resonance oscillations damping, small sensitivity to cuts, lower specific mass, increased heat conductivity.
- The billet is shaped to be maximally approximated to the required one, with minimal allowances for mechanical treatment.

MACHINE-BUILDING. METALLURGY

- The graphite inclusions with the increase of deformation acquire a new, unusual shape, and the metallic matrix of cast iron is considerably minced.

The product is environmentally sound since chemical-thermal treatment has been removed.

Efficient fitting has been developed and manufactured to obtain billets for the rings diameter from 40 to 98 mm.

Pilot batches of rings have been manufactured. The technology application is in progress.

Expectancy

Stable and even quality along the whole billet's height, removal of casting defects in macrostructure. There is no usual porosity in the rear part. Up to 3mm pores and holes are welded.

High accuracy of shaping. Allowances make up tens of mm.

The widest spectrum of obtained structures gives more opportunities for cast iron mechanical and performance properties control. The structure is shaped on face, end and inner ring surface. It corresponds the conditions of work of a ring, both compression and oil control.

Rings improved performance characteristics. No breaks in the process of assembly and service. 4—7 fold reduction of oil losses. Compression ring rigidity has increased by 55%. Breaking stress has increased by 103%. Breaking deformation has increased by 85%. The conjugated component wear has remained stable.

Realization

We offer the development of technologies for analogues parts. The expenses can include the purchase of materials, development of design documentation, fitting, technology playback, personnel training, field supervision. We are interested in a partner for joint research. We are seeking for an investor to bring the technology to commercial level to sell the rings of the standard sizes (40-122 mm) we have already mastered, including others.

Developer

*Public Research Institution «Physical and Technical Institute of Belarus National Academy of Sciences»,
IRUE «Minsk truck tractors works»*

V-71 High-permeability ferrite electromagnetic concentrators. Standard technological process of their obtaining

Range of application Machine building enterprises and construction profile enterprises.

Description We designed a ferrite material with a set of electromagnetic parameters providing its operation in the conditions of high-frequency induction welding and the technology to manufacture electromagnetic concentrators from them for pipe induction welding industrial mill. The developed technological scheme to manufacture, using the method of plasticized mass extrusion, electromagnetic concentrators in the form of rod and hollow cores of 4 types and more than 100 standard sizes for induction welding of thin and thick-wall pipes of different diameter. Pilot batches outfit, processing procedure and specification have been developed. Pilot-industrial production of ferrite electromagnetic concentrators has been put into effect.

Features:

- density — 4,8—5,0 g/cm³;
- initial permeability at the frequency of 100KHz at frequency of 100 KHz— 1600—2000;
- magnetic induction at magnetic field voltage 250 A/m —0,50—0,53;
- Curie point—200—210 °C;
- cost — 10—11,2 USD for 1kg depending on concentrator standard size.

In a set of electromagnetic parameters the material approaches the world's standards. In cost the electromagnetic concentrators are 1, 34—1, 8 cheaper than those produced by TDK and HINODAY (Japan), by international corporation Siemens and its subsidiary Siemens Matsushita Components.

The technological process to obtain soft magnetic ferrites is environmentally friendly.

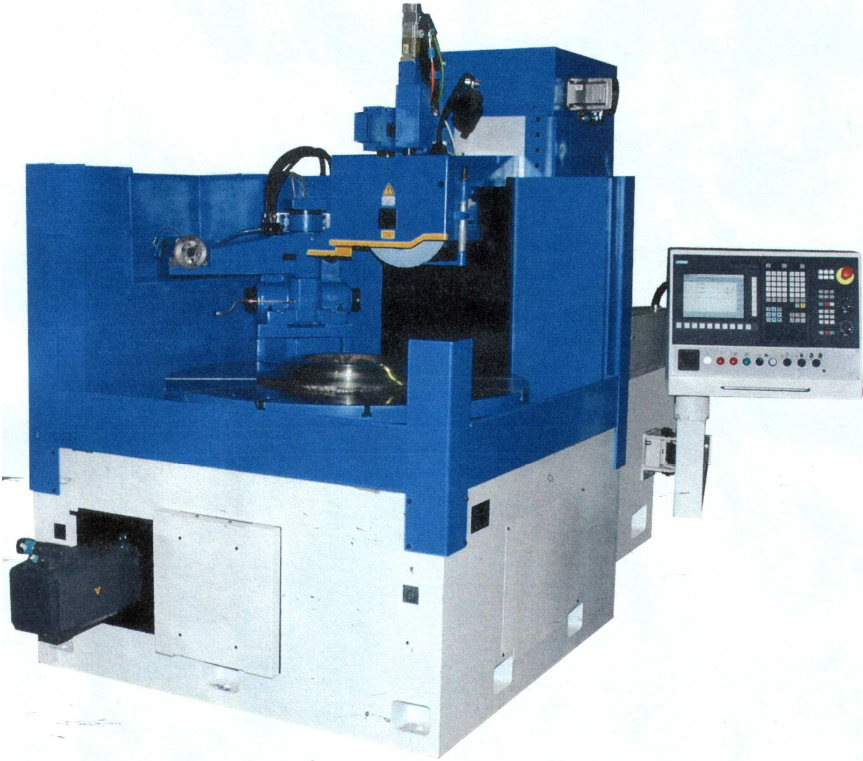
Pilot batch application has been put into operation and the output has been organized.

Expectancy Currency saving. The developed fitting and technological process enable to obtain common- standard- sized electromagnetic concentrators with the required set of electromagnetic properties. Welded pipes quality improvement.

Realization *The investing sum amounts 1450 thousand USD. Project payback period together with pilot production makes 2, 5 years. Sale of the documentation.*

Developer *Public Research Institution «Institute of Powder Metallurgy of Belarus National Academy of Sciences»*

**V-72 PNC surface grinding semi-automated machine with
a round rotary-axis table of the model OSH-641**



Range of application Piece, lot and full-scale production in all branches of industry, related to metal-working manufacturing in CIS and non-CIS states.

Description

- Rotary-axis table diameter — 1200 mm
- controlled coordinates — 3 (Y, Z, W)
- coordinates motion discreteness — 0,001 mm
- maximal motion, mm:
 - transverse of column — 625
 - vertical section, heads — 560
- primary motion drive power — 11KWt
- abrasive wheel size — 400x127x80 mm
- weight — 8850 kg

MACHINE-BUILDING. METALLURGY

- price— 125000 USD
- semi-automated machine accuracy class under the State Standard 8-82 — V
- table work area sizes, mm:
 - Diameter 1;
 - slope angle 1200;
 - degrees. — 0—5
- inserted work piece maximal weight — 400 kg
- spindle rotational speed — 1500 min⁻¹
- maximal distance from table face to spindle axis — 645 mm
- semiautomatic machine overall dimensions, not more than 3800x3500x2300 mm

In pace with world's analogues.

Eco-friendly.

Pilot sample acceptance tests have been carried out.

Expectancy

Organization of semiautomatic machines production to be sold in Belarus and CIS and non-CIS states. To master semiautomatic machines to be sold on home and foreign markets.

Realization

Payback period: 2, 8 years. Machine-tools sale.

Developer

PUPE « Machine-tool plant «Krasny borets»

V-73 Sheetbending hydraulic press with programmed numerical control intension 1000kN

Range of application High-precision manufacture of parts from sheet and rolled products using the bending method at the enterprises of any forms of property.

Description

Features:

- force rating — 1000 kN
 - table and sliding bar length — 3150mm
 - the maximal distance between the table and the sliding— 450mm
 - extension length — 320mm
 - sliding bar travel —230 mm
 - sliding bar speed at working travel, at least 9 mm/s,
 - controlled coordinates — 3
 - left-to-right distance between housings — 2600 mm
 - sliding bar approach speed, at least 100 mm/s
 - sliding bar lifting speed, at least 90 mm/s
 - backstops travel, mm
- along axis X — 630 — along axis R — 200
- PNC controlled coordinates — 3
 - positioning accuracy, mm
- of the slider at operating motion — $\pm 0,02$ — backstop — $\pm 0,1$
- pump drive electromotor power — 11 KWt

Direct home analogues are unavailable. In technical features the press is in appliance with the similar products by leading manufacturers of sheet bending equipment of companies "NASO" Belgium, "Trumpf" Germany, "ADIRA" Portugal

Environmentally friendly.

Technological pre-production activities have been carried out.

Expectancy

Creation of import substituting, competitive press-forging equipment, increase in quality and capacity. Export.

By graphically assigned part's parameters the system can calculate the parameters of bending in transitions, determine the sequence of transitions, check the material blank for fens impacting and issue current coordinates male die parts and backstops. In the process of operation the system controls the bending angle, provides slider's synchronous movement along axes Y1 and Y2, controls backstops along axes X and R, and also give instructions on table deflection regulation. The applied circuit designs provide bending accuracy, capacity, re-adjusting operational efficiency, service at the best analogues level..

Realization

The required funding sum: 230000 thousand rubles. Sale of the presses.

Developer

Republican Unitarian Machine building Enterprise «Kuzlitmach»

V-74 Spin casting technology and standard equipment to manufacture iron-carbon alloy turned billets

Range of application Metallurgy, machinebuilding.

Description The technological process of center die casting and standard equipment to manufacture iron-carbon alloy turned billets have been developed and put into effect. The equipment design documentation has been developed in the process of work. It enabled to accelerate billets knockout from the chill mould. The technological process allows casting turned billets from a wider range iron-carbon alloys. The technological process of center die casting to make turned billets has been actualized. The equipment has been modernized.

Expectancy The billets cost reduction at the expense of alloying elements consumption reduction.

Realization *The contractor can offer technical documentation and render assistance in putting the technology into effect.*

Developer *Republican Unitarian Enterprise «Institute BelNIILit; Beloozerski Energomechanical plant*

V-75 Structural sheet metal-plastic



Range of application

Structural sheet metal-plastic is designed as eco-clean structural material resistant to the impact of corrosive media and atmospheric factors.

Description

Structural sheet metal-plastic is fabricated using a thermo pressing method. The material contains inner polymeric composition layer which fully or partially consists of secondary thermo-plastic polymers.

In 20—50 weight. % the polymer is filled with plant dispersed and/or fiber wastes or synthetic or inorganic fibers. The inner polymeric layer is reinforced in two exterior surfaces with metal sheet having the width from 0, 25 to 3 mm. To increase the fastness of layers combinations the method short high-temperature treatment of a thin layer of the polymer on the surface of the metal under the impact of IR-radiation has been used and the use in the construction of metal sheets with one-sided through conical holes with bent burrs provides additional strength of the layers combination at the expense filling the conic holes inner volume with a polymer composite. The combination of these two methods increases the adhesion strength in the process of delaminating in 3—4 times compared to the bonding strength of inactivated layers of sheet materials.

The metal-plastic on the basis of thermoplastic composite material with plant fiber wastes (up to 40 weight. %), reinforced from two sides with sheet galvanized steel with the width of 0, 55 mm.

Features:

- thickness — 3— 10 mm;
- density— 2,4— 2,8 g/cm³;
- tension breaking stress — 120—180 MPa;
- bending breaking stress — 400— 600 MPa;
- bending rigidity modulus —10— 22 GPa.

Sheet metal-plastic is 1,5—2 times cheaper than the analogues in structure boards by «Dibond» and sheet aluminum boards.

Implmented.

Expectancy

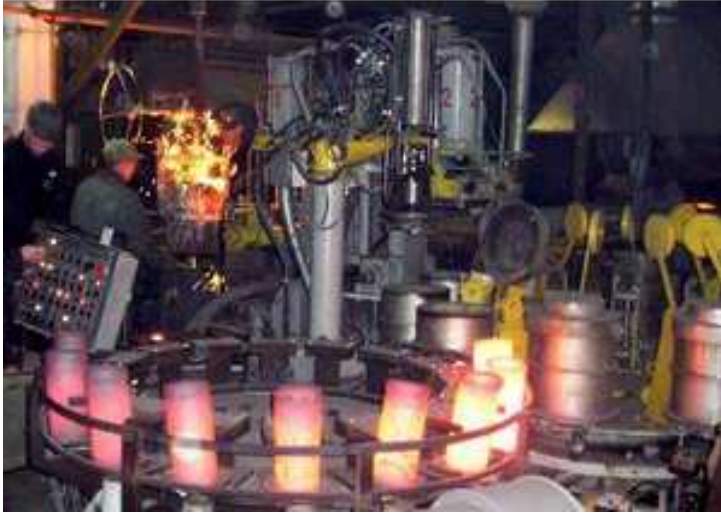
To give decorative and special functional properties the material can be laminated with decorative paper, wooden, plastic veneer, and glass fiber cloth or aluminum foil. It possesses a high tensing and bending strength. It is recommended to substitute steel, aluminum, veneer and other structural materials.

Realization Developer

Investments are required.

Public Research Institution «Research Center of Resource Savings of Belarus National Academy of Sciences»

V-76 Technological process and equipment freeze crystallization casting of hopped-up diesel engine cylinder sleeve billets



Range of application

Manufacture of pilot lots and exclusive batches of cylinder sleeves for hopped-up diesel engines of D-260 types for tractors, harvesters and trucks.

Description

The technological process is created on the basis of continuous-cyclic freeze crystallization casting method. The directional freezing principle has been put into its basis. The cast is shaped in the conditions of intensive heat dissipation into a water-cooled crystallizing tank and its internal surface is shaped at direct interaction with the melt. The casting process includes filling the steel water-cooled crystallizing tank with melted metal from the bottom, curing to shape the cast and its extraction from the crystallizing tank upwards with simultaneous filling-up of a new portion of the melt. The metal feed into the crystallizing tank is carried out using one-time metal-line fiddled with a refractory material. The process is carried out in continuous-cyclic mode the rate of which is assigned by hardening rate in the crystallizing tank of a cast of the required width. Combining casting and thermo-treatment into one process provides shaping the casts with the assigned structure and properties without additional power consumption.

- Billets size, mm:
— external diameter — 140; — wall width — 18; — height — 270
- structure:
— matrix: in external (4— 5 mm) layer — perlite-ferrite (P60-P85; NV 217-

MACHINE-BUILDING. METALLURGY

237), in sleeve surface work area — perlite (P96-P; Pd0,5-Pd1,0; NV 229-255);

— graphite: in external (up to 2— 4 mm) area of cast billets in the form of point or small-plate inclusions (PGr8, PGd15, PG8), in interior layers — evenly distributed thin-plate of rectilinear and whirling shape PGr 1; (PGr 8), PGd 45-PGd 90, PG 8- PG 10.

- foundry equipment:

— semi automated foundry facility weight — 4,5 t

— foundry bay floor space — 60 m²

— capacity — 100— 150 casts/h

— accepted cast output — 90— 95 %

The sleeves strength properties rank over those of off-the-shelf items. Particularly, the average pressure of sleeves breakup made 48,8 MPa, which in 32% ranks over the analogues characteristics of cylinder sleeves by «Motordetal», city of Kostroma and in 14% by «Iching », Czechs republic.

The designed technological process and the equipment have been put into operation.

Expectancy

Obtaining of hollow cylindrical casts without using the rod in stationary (non-rotating) water-cooled die. The formation of shrinkage and gas porosity, hot cracks has been removed. The billets have a highly refined structure, extra strength, density and hardness. Favorable conditions to control the process of structure formation and approaching the assigned properties in cast have been created. Using other methods to obtain the casts of this type the developer fails to obtain such a distribution of structural constituents. The technological process enables to obtain hollow cylindrical billets measuring length without a rod.

Realization

To bring the technology and equipment to commercialization at least 180 000 € is required. By-request production of hopped-up diesel engine cylinder sleeve billets for tractors, harvesters and trucks.

Developer

Public Research Institution «Institute of Metals Technology of Belarus National Academy of Sciences»

V-77 Technology and design documentation for the equipment to obtain pipes from polymeric wastes



Range of application In sewerage systems.

Description We created the technology and the design documentation on process line to obtain 75- and 90 mm- diameter pipes from secondary polyethylene. The process line includes: a worm press with a control board and a platform, a tubing string head, a calibration device, a cooling bath, a track pulling device, a cutting device, a discharger and an accumulator tank.

Features:

- Line capacity — 0,8—1,2 m/min;
- Power consumption — up to 120 KWt;
- Water consumption — up to 2 m3/h.

The analogues of the given equipment are unavailable in Belarus.

Expectancy The process of obtaining a pipe from secondary polyethylene will enable to use this polymer's wastes, preventing from environmental pollution.

Realization *Equipment replication.*

Developer *Republican Unitarian Enterprise «Special Design and Technological Office «Metallopolymer»*

V-78 Technology and equipment to obtain billets using the method of electroslag remelting



Range of application

The developed technology and the equipment enable to obtain billets of various profile from corrosion-resistance steels, non-ferrous alloys including bi-metallic ones. The typical examples of parts obtained with electro slug remelting are the billets of punching and cutting tools, the billets of large-size gears, rings, pulleys, tooth gears, various forks, ears, cases, pivots, bi-metallic billets of worm wheels, rolls etc.

Description

Electro slug casting is based on electro slag process of consumable electrode melting. The electrode is melted using the heat releasing in electro conductive slug when the electric current passes it. In the process of electro slug casting the cast crystallizes in a thin crust of a slug skull. As a result of accelerated and strictly directed crystallization of a small amount of liquid metal its high chemical and structural is provided

Features:

- two-phase circuit voltage — 380 V;
- secondary winding voltage— 45, 55, 65, 75 V;
- secondary winding current — 0—10 kA;
- power consumption — 650 kWt;
- billets weight — up to 300 kg;
- electrode travel — 2 m.

Expectancy

The developed equipment allows carrying out simultaneous manufacture of several billets in one operation. Besides, at all this one portion of flux for slug bath is used and power consumption is reduced, since there is no need to melt the consumable electrode for each cast separately. All this reduces the prime cost of manufacture of one part and the facility capacity.

Realization

Contract on the technology transfer, including electro slug remelting equipment manufacture.

Developer

Public Research Institution «Institute of Metals Technology of Belarus National Academy of Sciences»

V-79 Technology to obtain tubular billets form non-magnetic manganese steel for telemetric systems of horizontal and directed drilling

Range of application Foundry of casts from non-magnetic manganese steel. The use of the special composition of the steel and continuous casting instead of centrifugal casting.

Description The technology includes special steel smelt in induction melting furnace and its teeming into hollow billet on vertical continuous casting facility. The hollow inner surface is shaped with a sand core. The secondary cooling of the hollow billet is carried out in a caisson or a box with sand.

The study of hollow billets properties showed that the steel has a fine grain dense structure with the properties approximating the designed. They 25% rank over the strength of the centrifugal casting steel. The examination of hollow billets pilot samples proved the technology as one of the most progressive and available in any foundry having steel-melting furnaces.

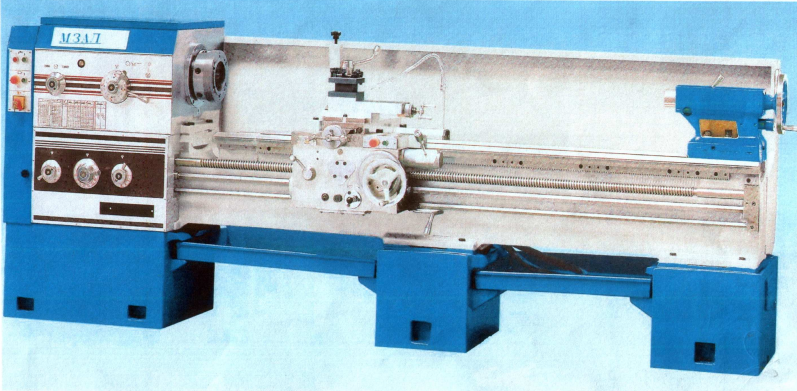
Expectancy When we use the developed technology:

- work place ecology improvement ;
- 50 % power consumption reduction in the process of shaping ;
- equipment production floor space reduction;
- 15 % average reduction in mechanical treatment allowances ;
- 95% increase in metal yield ratio;
- 25% increase of molding billet mechanical properties

Realization *The contractor can offer technological documentation and render assistance in putting the technology into effect.*

Developer *Belarusian National Technical University*

V-80 Universal lead-and-feed screw lathe SM1763



Range of application

Piece, series production and maintenance shops of large full-scale production enterprises

Description

Universal lead-and-feed screw lathe pilot sample has been manufactured. The center height makes 315 mm and between-centers-distance 3000mm, mod. SM 1763.

Key parameters:

- Precision class under National Standard 8-82 N;
- maximum work piece diameter inserted above the supporting frame — 700 mm;
- maximal turning diameter above the supporting frame — 630 mm;
- maximal turning diameter above the support — 350 mm;
- work piece maximal length — 3000 mm;
- spindle taper by DINIM;
- spindle revolutions per minute steps — 22;
- spindle revolutions per minute — 16—1600 rev;
- primary motion engine power — 15,0 KWT;
- support;
- rapid traverse speed, m/min :
 - lengthway — 5,2 — transversal — 2,6
 - feed, mm/rev:
 - lengthway — 0,05—5,6 — transversal — 0,025—2,8
 - size — 1600x5200x1600 mm;
 - weight — 5100 kg

Eco-friendly. Pilot sample acceptance tests have been carried out.

Expectancy

Equipping RB enterprises including CIS and non-CIS countries.

Realization

Payback period: 3 years. The contractor can offer technical documentation and render assistance in putting the technology into effect.

Developer

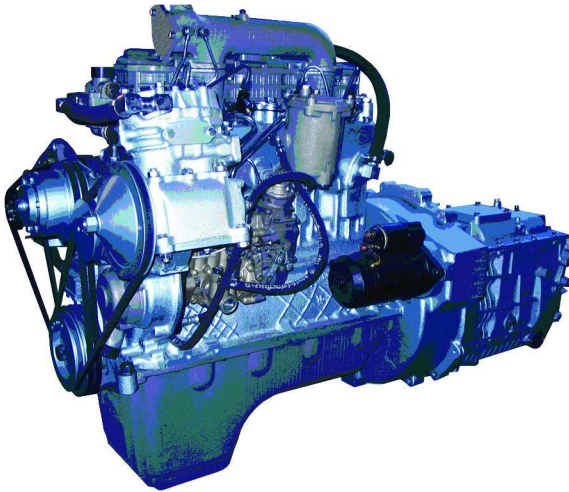
Unitarian Enterprise «Institute Belorgstankinpromm»;

IRUE «Minsk Automated Lines Plant named after P.M.Masherov»

VI.
AUTOMOBILE
AND TRACTOR BUILDING

№	Project name	P.
VI-81	114 KWt (155 h.p.) diesel engine	111
VI-82	184 KWt (250 h.p.) diesel engine	112
VI-83	220 KWt (300 h.p.) diesel engine	113
VI-84	58 -hp farmer tractor MTZ-622	114
VI-85	Airport bus MAZ 171	115
VI-86	City bus MAZ 107 (MAZ 107065)	116
VI-87	Diesel engine with power up to 350 h.p.	118
VI-88	Feller-forwarder «Belarus» ML-127	119
VI-89	Forest load-haul-dump machine«Belarus» ML-131	121
VI-90	Forest load-haul-dump machine«Belarus» MLPR-394	123
VI-91	Harvester-thresher BKI-01 technological modes control and indication unit	125
VI-92	High-traction forest load-haul-dump machine ML-131-05	126
VI-93	Hydro mechanical- transmission- 135 ton- heavy-duty dump truck	128
VI-94	Medium-duty dump truck MAZ-457041-220 and MAZ-457041-233 with side extended body	129
VI-95	Midsector coach MAZ 256	130
VI-96	Plastic complex lithium grease with diamond-containing improvers for heavy-loaded friction assemblies	132
VI-97	Tractor Belarus-2022	133
VI-98	Tractor Belarus-2102	135

VI-81 114 KWt (155 h.p.) diesel engine



Range of application

Machine building (motor-car production). To be installed to single-unit trucks, dump trucks, chassis, buses with wheel arrangement 4x2 and 4x4 with fully loaded mass up to 12 tons and autotrains on their basis with fully loaded mass up to 18 tons.

Description

Machine building (automobile manufacturing). The engines are installed to bolster trucks, chassis, buses with wheel arrangement 4x2 and 4x4, full weight up to 12 tons trains on their basis and full weight up to 18 tons.

Compression ignition turbocharging charge-cooled EGR engines.

Technical features:

- number of cylinders and their arrangement: four, in-line, vertical;
- cubic capacity — 4,75 l;
- indicated power — 114 KWt (155 h.p.);
- cranked shaft rated speed— 2400 rev/min.;
- sfc at indicated power — 252 g/KWt h.;
- free-from fuel and lubricants and cooling agent engine weight, not more than

Corresponds to the best world's analogues.

In compliance with ecological safety under the requirements Rules 49-04A- ECE, UN (E) Pilot samples and pilot batch of engines have been manufactured. Acceptance tests carried out. Recommendation to put the engines into production have been given

Expectancy

Engines' import substitution at business-to-consumer enterprises; contaminants, gaseous substances and solid atmospheric emission reductions (improvement of ecology).

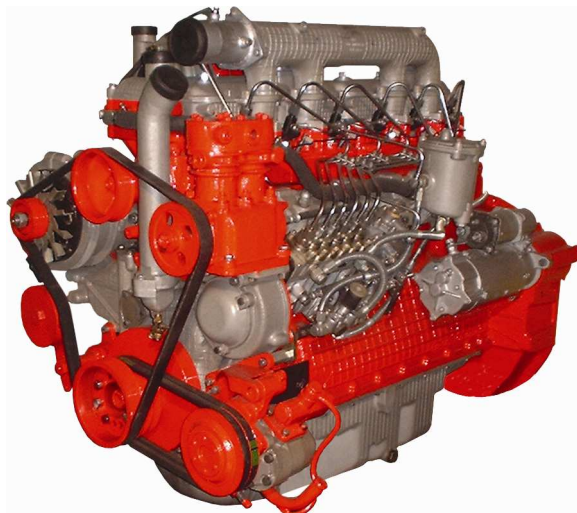
Realization

3-year project payback period. The contractor can offer technical documentation and implementation assistance. Finished product delivery.

Developer

PA «Minsk motor plant»

VI-82 184 KWt (250 h.p.) diesel engine



Range of application

Machine building (automobile manufacturing). The engines are installed to bolster trucks transporting goods up to 36 tons.

Description

Compression ignition turbocharging charge-cooled EGR engines.

Technical features:

- number of cylinders and their arrangement: six, in-line, vertical;
- cubic capacity — 7,12 l;
- indicated power — 184 KWt. (250 h.p.);
- cranked shaft rated speed — 2100 rev/min.;
- sfc at indicated power — 236 g/KWt h.;
- free-from fuel and lubricants and cooling agent engine weight, not more than 750 kg.

Corresponds to the best world's analogues.

In compliance with ecological safety under the requirements Rules 49-04A-ECE, UN (Euro-3).

Pilot samples and pilot batch of engines have been manufactured. Acceptance tests have been carried out. Recommendation to put the engines into production have been given

Expectancy

Engines' import substitution at business-to-consumer enterprises; contaminants, gaseous substances and solid atmospheric emission reductions (improvement of ecology).

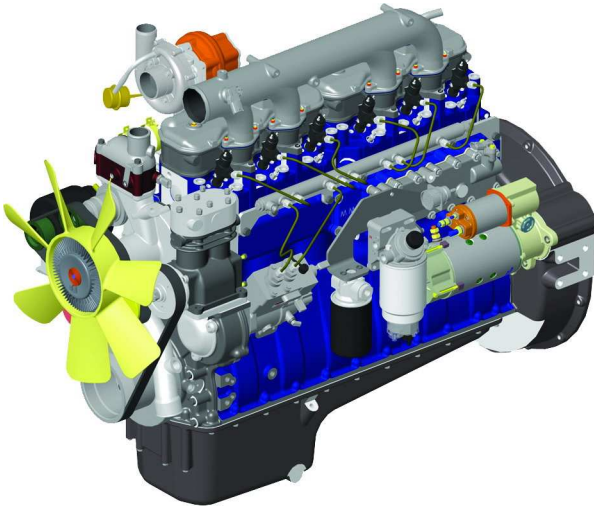
Realization

3-year project payback period. The contractor can offer technical documentation and implementation assistance. Finished product delivery.

Developer

PA «Minsk motor plant»

VI-83 220 KWt (300 h.p.) diesel engine



Range of application

Machinebuilding (agricultural machine building, tractor machine building,). The engine is installed on drawbar category 5 wheel tractors, fodder and grain harvesters and universal power machines.

Description

Compression ignition turbocharging charge-cooled EGR engines.

Technical features:

- number of cylinders and their arrangement: six, in-line, vertical;
- cubic capacity — 8,7 l;
- indicated power — 220KWt. (300 h.p.);
- cranked shaft rated speed — 2100 rev/min.;
- sfc at indicated power — 230 g/KWt h.;
- free-from fuel and lubricants and cooling agent engine weight, not more than 800 kg.

Corresponds to the best world's analogues.

In compliance with ecological safety under the requirements Rules 49-04A-ECE, UN (Euro-3).

Pilot samples and pilot batch of engines have been manufactured. Acceptance tests have been carried out. Recommendation to put the engines into production have been given

Expectancy

Engines' import substitution at business-to-consumer enterprises; contaminants, gaseous substances and solid atmospheric emission reductions (improvement of ecology).

Realization

3-year project payback period. The contractor can offer technical documentation and implementation assistance. Finished product delivery.

Developer

*PA «Minsk motor plant»;
Republican Unitarian Enterprise «Minsk tractor works»;
RCUE «SSDB on grain and fodder harvesters»*

VI-84 58-hp farmer tractor MTZ-622



Range of application A wheel-tyre universal tractor designed to operate in agriculture, construction, transport and industry

Description

Technical features:

- engine — LDW2004T (boost-pressure charge four-stroke diesel);
- power — 42,0 (57) KWt (h. p.);
- traveling speed forward/backward, — 1,9— 35,0/2,2— 15,3 km/h
- number of gears forward/backward — 16/8;
- overall dimensions — 3730x1825x2400 mm;
- operative weight, kg:

— without ballast — 2500

— with ballast — 2800 C with front driving axel.

Tractors' pilot batches have been manufactured.

Expectancy

Import substitution. Export. Obsolete tractor park replacement.

Realization

Finished product delivery.

Developer

PA «Minsk Tractor Works»

VI-85 Airport bus MAZ 171



Range of application

Airport bus is designed to transport passengers in airports.

Description

Technical features:

- Overall dimensions — 14400-3150-3050(3200) mm;
- base— 7120 mm;
- wheel track (front-rear — 2142— 2650 mm);
- footstep height over road level — 300 mm;
- front/rear axel admissible maximal load — 11000— 11000 kg;
- full maximal weight — 22000 kg;
- seating accommodation — 6;
- rated capacity — 103 (4 person.\sq.m.), 127 (5 person.\sq.m.);
- maximal speed —50 km;
- engine — Deutz BF4M1013FC (E3);
- engine power — 125 (170) KWt (h.p.);
- engine volume — 4,764 l;
- gear-box-automatic — ZF5P3502C;
- front/rear axel support — pneumatic with telescopic shock absorbers;
- drive axle — front, controlled;
- disc wheels — 11,75x22,5;
- tyres — 385\65R22,5;
- passenger doors — 12.

The bus requirements of ECE, UN and in technical level is in compliance with international standards in the key operational parameters: full weight, seating capacity, maximal speed, baggage rack, volume, external noise level and ecology. The large seat capacity city bus is protected with patents.

Pilot batch production was manufactured in 2006.

Realization

Sale of finished product.

Developer

*Republican Unitarian Enterprise «Minsk automobile plant»;
Research Republican Unitarian Enterprise «Belautotraktorostroyeniye»*

VI-86 City bus MAZ 107 (MAZ 107065)



Место крепления инвалидной коляски



Range of application Public transport low floor three wheel city bus.

Description

Technical features:

- Length — up to 15 meters.
- Overall dimensions — 14480-2500-2838 mm;
- base— 6800 (1615) mm;
- wheel track (front-middle-rear) — 2046-1825-2125 mm;
- outer turning radius , at least 12500 mm;
- step height — 335 mm;
- middle door floor height — 360 mm;
- pass width between seats — 790 mm;
- front-middle-rear axel admissible load — 6340-11560-5760;
- full weight — 23660 kg
- seats count 24, 25 to 32
- rated capacity — 145 passengers;
- maximal speed — 78 km;
- engine — Mercedes-Benz OM906LA (Euro-3);
- engine power — 205 (279) KWt (h.p.);
- engine volume — 6.37 l;
- gearbox — Voith Diwa D851.3E (automated);
- suspension (front-middle-rear) of axel, independent-dependent — dependent, pneumatic with telescopic shock absorbers;
- driver bridge — rigid beam with double diversity transmission;
- disk wheels — 8.25x22.5;
- tyres 275/70R22.5.

AUTOMOBILE AND TRACTOR BUILDING

The bus corresponds to the requirements of RB and ECE, UN, international standards and in technical level is in appliance with the best foreign analogues in the key operational parameters: full weight, seating capacity, maximal speed, baggage rack, volume, external noise level and ecology. The large seat capacity city bus is protected with patents.

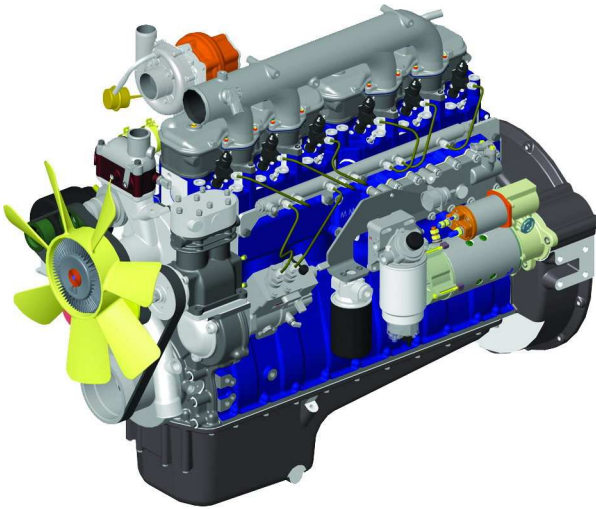
Pilot batch production has been manufactured.

Expectancy Import substitution. Export.

Realization *The customer can choose: kneeling body tilt, kneeling body tilt, information system, automatic central lubricating system, equipment to transport disabled people and other equipment.*

Developer *Republican Unitarian Enterprise «Minsk automobile plant»;
Research Republican Unitarian Enterprise «Belautotractoror-
stroyeniye»*

VI-87 Diesel engine with power up to 350 h.p.



Range of application

Machine building (automobile manufacturing). The engines are installed to artic and drop-side truck tractors with wheel arrangement 4x2, 6x6, and 6x4, dump trucks 4x2, 6x4, 6x6, 8x4, AWD vehicle, logging truck 4x4, 6x6, chassis 4x2, 6x4, 6x6, 8x4 aimed to transport different goods with full weight up to 52 tons.

Description

Compression ignition turbocharging charge-cooled EGR engines.

Technical features:

- number of cylinders and their arrangement: six, in-line, vertical;
- cubic capacity — 8,7 l;
- indicated power — 25 7KWt. (300 h.p.);
- cranked shaft rated speed — 2100 rev/min.;
- sfc at indicated power — 220 g/KWt h.;
- free-from fuel and lubricants and cooling agent engine weight, not more than 850 kg.

Corresponds to the best world's analogues.

In compliance with ecological safety under the requirements Rules 49-04A-ECE, UN (Euro-3).

Pilot samples and pilot batch of engines have been manufactured. Acceptance tests have been carried out. Recommendation to put the engines into production have been given.

Expectancy

Engines' import substitution at business-to-consumer enterprises; contaminants, gaseous substances and solid atmospheric emission reductions (improvement of ecology).

Realization

3-year project payback period. The contractor can offer technical documentation and implementation assistance. Finished product delivery.

Developer

PA «Minsk motor plant»

VI-88 Feller-forwarder «Belarus» ML-127



Range of application

Feller-forwarder «Belarus» ML-127 with roper-chocker equipment is designed to collect trees and full-length logs, assortments, full-length logs formation and skidding when carrying out final felling operations, selection cuttings and cleaning cuttings.

Description

- Engine — model D245
- direct injection diesel
- power — 77 (105) KWt(h.p.)
- crankshaft nominal speed — 2200 rev/min
- cylinders — 4
- peak torque at — 335 (34,2) Nm (kgsm)
 - fuel tanks capacity — 130 l
 - transmission
 - dry, 2-disk clutch coupling
 - mechanical reverse 5-speed synchronized transmission
 - number of gears: forward/backward — 5/5;
 - speed, km/h:
 - forward — 2,83—22,9
 - backward— 2,64—21,4
- operating weight — 10220 kg
- overall dimensions: 7200x 2880x 3190 mm
- axial base — 2950 mm
- track width — 2260 mm
- road clearance — 570 mm
- the shallow of the river — 850 mm
- barrier height — 500 mm
- wheels size — 30,5L32 LS
- 1700 mm extender ,

AUTOMOBILE AND TRACTOR BUILDING

- front,
 - cab control
 - height of ascent — 1250 mm
 - depth of fall below abutment level — 110 mm
 - plate
 - rear,
 - reverse cab control
 - reversed single-drum winch with hydraulic drive
 - chokers — 6
 - towing capacity — 80 (8000) kN (kGs)
 - rope speed — 0,5—1,0 m/s
 - rope diameter — 19,5 m
 - drag maximum volume — 3 m
 - brakes (service and parking) — disk, dry, closed.
 - front and rear drive axles are lead with main gear , differential lock-out, with final drives.
 - hydrostatic power steering.
 - 1,5 KWt AC generator with built-in rectifiers and voltage integral regulator,
 - 2 battery packs 12V/88Ah
- Pilot samples have been manufactured.

Expectancy Mechanization of efforts when carrying out final felling operations, selection cuttings and cleaning cuttings.

Realization *Finished equipment sale.*

Developer *PA«Minsk tractor works»*

VI-89 Forest load-haul-dump machine«Belarus» ML-131



Range of application Wood assortments collection, loading and transporting, as well as their unloading, sorting and stacking.

Description

- 4-cylinder diesel with turbo charging Engine :
 - model D 245.2 Power 88(119,7) — kWt (h.p.)
 - nominal speed — 2200 rev/min
 - cylinders — 4
 - peak torque at 1400 rev/min — 427,9(43,7) N.m (kgs.m)
 - fuel tank capacity — 160 l
- transmission
 - -disk, dry clutch coupling
 - mechanical reverse 4-speed synchronized transmission
 - number of gears: forward/backward — 16/8;
 - speed, km/h:
 - forward — 1,4— 26,5
 - backward — 2,2— 12,7
- maximum platform capacity — 10000 kg
- transported assortments lengths — 2, 4, 5, 6 m
- overall dimensions — 9200x3010x3550 mm
- axial base — 4660 mm
- track width — 2260 mm
- minimal road clearance — 600 mm

AUTOMOBILE AND TRACTOR BUILDING

- the shallow of the river — 850 mm
- barrier height — 500 mm
- wheels size
- front — 30,5L32
- rear — 600/55-26,5
 - hydrostatic power steering.
 - front drive axle is lead with main gear , differential lock-out, with final drives.
 - rear axle: tandem wheeled frame, with a gear drive, differential lock-out, released drive.
 - brakes:
- service — disk, closed;
- parking — disk, open.
 - 1,5 KWt AC generator,
 - 2 battery packs 12V88Ah,
 - electric power start system.
 - hydro manipulator
- modelM75, SF-65L or LIV 8.90, LIV 7.76
- maximal load moment — 80 kN/m
- boom-out — 9,0 m
- welded cargo bed with bolsters with

Expectancy

Mechanization of efforts when carrying out final felling operations, selection cuttings and cleaning cuttings.

Realization

Finished equipment sale.

Developer

PA«Minsk tractor works»

VI-90 Forest load-haul-dump machine«Belarus» MLPR-394



Range of application

The machine is designed to sort, load and unload full-length logs, wood assortments. It is equipped with a hydraulic manipulator with outrigger and a front extender

Description

- Engine :
 - 4-cylinder diesel with direct injection and turbo charging;
 - type — D-245;
 - power — 77(105) kWt (h. p.);
 - nominal speed — 2200 rev/min;
 - cylinders — 4;
 - peak torque at 1400 rev/min — 335 (34,2) N.m (kgs.m);
 - fuel tank capacity — 130 l;
- transmission;
- two-disk, dry clutch coupling ;
- mechanical reverse 5-speed transmission ;
- number of gears: forward/backward — 5/5;
- speed, km/h:
 - forward 2,83— 22,9;
 - backward 2,64— 21,4;
- maximum platform capacity —5000 kg;
- transported assortments lengths —2, 4, 5, 6 m;
- overall dimensions —: 7200x3600x3400 mm ;
- axial base — 3276 mm;
- track width — 2260 mm;
- wheels size — 30,5L32 LS;

AUTOMOBILE AND TRACTOR BUILDING

- minimal road clearance — 600 mm;
 - barriers :
 - ascending and descending angle — 20 degrees;
 - slope angle — 20 degrees;
 - the shallow of the river — 850 mm;
 - snow — 500 mm;
 - barrier height — 500 mm
 - hydrostatic power steering.
 - front and rear drive axles are lead with main gear , differential , with lock-out mechanism, with final drives.
 - service and parking brakes – disk, dry
 - armory: hydraulic manipulator Liv 8.90.H (Slovenia), M-75 (Belarus).
 - maximal load moment — up to 80. kN. m
 - extender, front location, hydraulic control from the cab.
 - height of ascent — 1220 mm
- depth of fall below abutment level — 100 mm.

Expectancy Mechanization of efforts when carrying out final felling operations, selection cuttings and cleaning cuttings.

Realization *Finished equipment sale.*

Developer *PA«Minsk tractor works»*

VI-91 Harvester-thresher BKI-01 technological modes control and indication unit

Range of application Designed to control and automate harvester-thresher KZS-10K operation technological process.

Description Harvester-thresher technological modes control and indication unit is designed for harvester separate aggregates automatic control and alerting about emergencies.

Technical features:

- control channels count — 24
- displayed parameters count — 24
- travel speed range — from 0,1 to 30 km/h
- box capacity — 70%, 100%
- availability of relative loss control:

— over straw separator

— over filtration

- voltage range — from 10,5 to 16 V.

Corresponds to the best world's analogues.

Environmentally friendly production

The product's pilot batch has been manufactured acceptance tests have been carried out.

Expectancy The expected profit of manufacturing application will make 5%. We also expect that the unit will favor to reduction of grain losses, improvement of work conditions, capacity improvement, import substitution.

Realization *Project payback period: 1, 36 years. The contractor can offer technical documentation and implementation assistance. Finished product delivery.*

Developer *Republican Unitary Research Enterprise «Zapad»«West»*

VI-92 High-traction forest load-haul-dump machine ML-131-05



Range of application Designed to exploit hard-to-get forest reserves. The machine's application range is a low ground bearing pressure forest area.

Description Technological processes to exploit water-logged and hard-to-get cutting areas with the use of the machine ML-131-05.

Technical features:

- Machine type— center pivot frame articulation three-axel , wheel arrangement 6x6 and flexible full track on rear wheels;
- operating weight — 13500 kg;
- overall dimensions in transport condition of technological equipment— 9360x3035x3700 mm;
- lengthways— 4660 mm;
- tandem wheeled frame lengthways— 1450 mm;
- wheel spacing, mm:
 - front axel wheels — 2260;
 - tandem wheeled frame wheels— 2260;
- Wheels tires:
 - front: 30,5L32;
 - rear: tubeless 1300x750;

AUTOMOBILE AND TRACTOR BUILDING

- minimum road clearance — 600 mm;
- forward-backward design speeds — from 5,7 to 31,5 km/h;
- engine rated brake power — 60 — 114 kWt;
- torque peak — 596,8 N·m;
- cranked shaft rated speed — 2100 rev/min;
- idling maximum rotation, restrained with a moderator — 2275 rev/min.

Expectancy 10—15% increase in skidding capacity will provide 4% reduction of total unit costs in the process of round timber logging and 20% increase in coping with hard-to-get forest reserves

Realization *The contractor can offer technical documentation and implementation assistance. Finished product delivery*

Developer *Belarusian State Technological University,
Republican Unitarian Enterprise «Minsk tractor works»*

AUTOMOBILE AND TRACTOR BUILDING

VI-93 Hydro mechanical- transmission- 135 ton- heavy-duty dump truck

Range of application Coal , ore, ferrous and non-ferrous metals , slates mining. The truck is designed to transport overburdens and mineral deposits of various density in quarries ,including ground coat and other loose goods outside general-purpose highways in complex mining conditions.

Description Two-axel rear dumper with front steer wheel and rear drive wheels, 4x2 axle configuration, 135- ton payload with a hydromechanical transmission. A heavy duty, lean-burn, competitive dump truck with world's level engineering solutions and data. The design has non-infringement quality relevant to RB, RF, Ukraine, Sweden, USA and Japan. Big hydromechanical transmission dump trucks pilot batch has been manufactured.

Expectancy The development resulted in 35—40 % increase in trucks' capacity and 25—30 % reduction of hauling operations.

Realization *Delivery on contractual basis. Sale of the product. Funding amount to fulfill the works makes up 4555400 thousand rubles. Payback period: 2,5—3 years.*

Developer *PA«BelAZ»*

VI-94 Medium-duty dump truck MAZ-457041-220 and MAZ-457041-233 with side extended body



Range of application

For the needs of city communal service, as silo wagon as well as in agriculture.

Description

Technical features:

- Admissible full weight, 10100 kg;
- Full weight distribution:
— for front axel — 3800 kg
— for back axel — 6300 kg

- Loaded truck weight, 5225 (5425)* kg;
- Admissible payload, 4725 (4525)* kg;
- Body capacity, 3,34(11,5)* m³;
- engine MMZ-D245.30E2 (E-2);
- engine power, 114(155) KWt (h.p.);
- gear box CAA3-433420;
- number of gears , GB 5;
- axel ratio 3,9 (4.44)*;
- maximal speed, 95 (85)*km/h
- fuel tank, 130 l;
- tires size 235/75R17,5(10.00R17,5)*;
- small two- or three-seat cab;
- 3-side-unload dump body ;
- bodies inside dimensions, 3500/2350/400(1400)' mm;

*) for MAZ-457041-233 with side extended bodies.
Pilot batch has been manufactured.

Expectancy

Import substitution. Export. Substitution of obsolete automobile park.

Realization

Sale through sales network.

Developer

Republican Unitarian Enterprise «Minsk automobile plant»;
Unitarian Enterprise «Autopoezd»;
Research Republican Unitarian Enterprise «Belautotraktorostroyeniye»

AUTOMOBILE AND TRACTOR BUILDING

VI-95 Midsector coach MAZ 256



MA3 256100(170)



MA3 256200(270)



Range of application

Midsector coach is designed to transport passengers at average distance routes.

Description

Technical features:

- overall dimensions — 8090-2550-3330 mm;
- base — 4200 mm;
- wheel track (front-rear) — 1982; 1398— 2006 mm;
- outer turning radius , at least — 8000 mm;
- pass width between seats — 615 mm;
- front-rear axel admissible load — 3960— 6165 kg (3980-6220 — MAZ 256200, MAZ 256270);
- full weight — 9550 kg (10200 — MA3 256200, MAZ 256270)
- seats — 24; 27;
- rated capacity— 24, 43 passengers;
- maximal speed — 110, 118 km;
- engine — MMZ-D 245.30 (Euro-2), DEUTZ BF4M1013 (Евро-3);
- engine power — 114 (155), 125 (170) KWt (h.p.);
- engine volume — 4.75; 4.764 l;
- gear-box — CAAZ 695D, ZF S5-42 (mechanical);
- front-rear axel suspension — dependent, spring with 2 shock absorbers, stabilizer bars;
- driver bridge - rigid beam with hydroid final drive ;

AUTOMOBILE AND TRACTOR BUILDING

- disk wheels — 6.75x17.5;
- tires — 235 75R17.5;
- boot capacity — 1,4 m³;
- fuel tank volume — 130 l;
- passenger doors — 2.

The bus corresponds to RB standards and requirements of ECE, UN, international standards and in technical level is in appliance with the best foreign analogues in the key operational parameters: full weight, seating capacity, maximal speed, baggage rack, volume, external noise level and ecology. The large seat capacity city bus is protected with patents.

Pilot batch production was manufactured in 2006.

Expectancy

Import substitution. Export. Providing with new equipment corresponding to world's standards.

Realization

Additional equipment: a set of exterior mirrors Mekra, roof ventilators, air conditioner, video-audio system, night heater.

Developer

*Republican Unitarian Enterprise «Minsk automobile plant»;
Research Republican Unitarian Enterprise «Belautotraktorostroyeniye»*

VI-96 Plastic complex lithium grease with diamond-containing improvers for heavy-loaded friction assemblies

Range of application Technological equipment, agricultural engineering and transport means heavy-loaded friction assemblies.

Description The lubricant is made on the basis of hydrocarbon oil, thickened with lithium complex of high-molecular 12-hydroxystearic acid and low-molecular ortho-boric and terephthalic acids adding ultra-dispersed diamonds and characterizing with the collapsing loads of more than 1200 N, welding load of more than 5000 N and drop point 230° C.

The developed materials have high loading capacity and the best physical and chemical and reologic characteristics which make it possible to use them at high unit loads and a larger temperature range.

The collapsing load, welding load and drop point of the developed complex lithium greases with diamond-containing improvers surpass (by 15—20%) the lubricant i.nergreaseL21-M by «British Petroleum», corresponding to the requirements of the company Caterpillar to lubricants containing MoS₂ and specifications of Ford-ESA MIC 71A/75A, at considerably lower price (2—2,5 times).

Application for a patent.

The technology is environmentally friendly.

The lubricant pilot batch has been manufactures its acceptance tests have been carried out. Technological equipment modernization with 120 kg barrel has been carried out providing the creation of the equipment with the possibility of, ultra dispersed diamonds fine disintegrating and homogenization of solutions of salts, alkalis, suspensions, emulsions, gels and paste-like materials modified with ultra-dispersed diamonds.

Expectancy The developed lubricant enables to increase tribocouplings lifetime working under heavy loads (up to 40 MPa) in 1,5—1,7 times in a wide range of temperatures from -45 °C to +150 °C with short-time overheat up to 180 °C.

Realization *The required funding sum: 80 thousand USD. Import substitution. Project pay-back period: 1, 4 years.*

Developer *Public Research Institution «Institute of Mechanics and Reliability of Machines of Belarus National Academy of Sciences»;
Public Research Institution «Institute of Heat and Mass Transfer named after A.V. Lykov of Belarus National Academy of Sciences»*

VI-97 Tractor Belarus-2022



Range of application

The product is designed for both agriculture and industry performing energy-intensive works in agriculture: soil main tilling and pre-sowing treatment, seed and other crops sowing in combination with wide-coverage and combined aggregates, carrying out harvesting in combination with high-producing harvest complexes in the process of fodder conservation, root-crops collection, seeds harvesting, hauling operations, load handling, as a prime mover to reach loads on silt roads, in break-up seasons.

Description

A 210-horse-power agricultural wheel-tire tractor of drawbar category 4 with all running wheels Belarus 2022 is manufactured by profound modernization of a drawbar category 3 Belarus 1523 and alongside with partial unification with the previous category it has a number of essential differences:

- *Belarus 2022* (a core model) has engine D-260.4 or D-260.C, with power 154 KWt;
- *Belarus 2022.3* has diesel D-260.4S2 with power 156 KWt, which corresponds in repugnant substance emission to directive 2000/25 EC (second stage);

AUTOMOBILE AND TRACTOR BUILDING

- *Belarus 2022B/2022B.3* has auto reverse control desk;
- 210 h.p. engine with aftercooling;
- a cooling system with c deaerator-compensation contour ;
- a single-staged (without monocyclon) air purifier installed next to the radiator ;
- a deafener under the cowl, a tail pipe on the right cab post;
- a fuel-oil pump with engine emergency stop system;
- enlarged fuel tanks;
- a gearbox and a rear axle have been modernized to increase a draft effect ;
- rear axle differential lockup is realized with the help of an electro-hydraulic actuation gear clutch;
- oil multidisk brakes ;
- rear leading axle is designed for increased hp
- enlarged rear wheels;
- hydrostatic power steering tank is designed as an autonomous unit , and accumulator batteries are installed in front of radiators.

Expectancy Import substitution. Export. Obsolete tractor park replacement.

Realization *Finished product delivery.*

Developer *PA «Minsk Tractor Works»*

VI-98 Tractor Belarus-2102



Range of application

In agriculture with linkage-mounted and semimounted and pull-type machines in the range of tractive resistances from 30 to 50 kN, including general-purpose works on waterlogged soils.

Description

A drawbar category- 4 agricultural chain-track tractor with a resin-reinforced or metallic caterpillar band with driving and idler sprockets , a hydraulic tightener.

Technical features:

- engine — intercooled diesel, model 260.4C2, indicated power, (hp.) 156 (212) KWt;
- transmission;
- dry two-disk spring-loaded clutch;
- mechanical, synchromesh, six-range (4/2) gear-box , number of gears (foreword/backward) 16/8, traveling speed, (foreword/backward) 2,3—30/3,2—14,1 km/h hand wheel control steering device;
- overall dimensions 6050x2085x2960 mm;
- operating weight — 10800 kg;

AUTOMOBILE AND TRACTOR BUILDING

- track — 1600 mm; road clearing — 355 mm; turning radius, minimal — 2,2 mm;
- Bosch hydraulic system, with cultivation depth automatic regulation system.

The tractor «Belarus 2102» stands out from those of the analogous. The availability of front suspension and front drive axel provide availability of sue of complex agricultural equipments enabling in one run several operations. A wider caterpillar band (470 mm) allowed specific ground pressure reduction. The torsion-bar suspension installed on the tractor has no analogues. Forest and melioration tractors pilot batch has been manufactured. Industrial tractor «Belarus 2102P» pilot sample has been refined.

Expectancy Import substitution. Export. Obsolete tractor park replacement.

Realization *Finished product delivery.*

Developer *PA «Minsk Tractor Works»
Research Republican Unitarian Enterprise "Belautotractorostrojenie"*

VII.
INSTRUMENT
ENGINEERING

№	Project name	P.
VII-99	Analog-digital oscilloscope S1-157/3	139
VII-100	Apparatus DST-1 power transformers diagnostics	140
VII-101	Automated ultrasonic units for diesel engines non-resistant insert pistons nondestructive testing	141
VII-102	Complex to measure radon volumetric activity in the air	142
VII-103	Discrete dosing weighing devices DVD-15, DVD -100, DVD -500, DVD -1000	143
VII-104	High repetition frequency multi-wave source pulse	144
VII-105	Indoor-air radon radiation- hygienic control equipment	145
VII-106	Measurement tools «Expert beta-gamma-HMS»	147
VII-107	Modernized high-capacity 4π-gamma-spectrometer «Pripjat-2π»	148
VII-108	Non-destructive inspection instrument SP-07 to determine weld joints quality	149
VII-109	Spectroscan: highly sensitive spectroscopic complex microfluorescent analysis	150
VII-110	Universal experimental complex SHS	151
VII-111	Viscoelastic properties gage IMPULSE-1R	152

VII-99 Analog-digital oscilloscope S1-157/3**Range of application**

To measure electric signals in laboratory and shop conditions. Radio engineering.

Description

Oscilloscope S1-157/3 is designed to study periodic electric signals visually and to measure their amplitude and time parameters within the frequencies from 0 to 120 MHz under CRT screen scale.

It is also used to visualize periodic and single electric signals and to measure their parameters using the cursors within the frequencies from 0 to 20 MHz including visualization of volt-ampere characteristics and two- and three-terminals with the help of components tester. In digital mode indication of operation modes and measured values is carried out on a screen.

Technical features:

- screen operating unit – 80×100 mm;
- vertical deflection tract bandwidth – 120 MHz;
- channels – 2;
- deflection factor range from 0,005 to 5 V/ind.;
- reference error maximum – ±3 %;
- scanning factors range from 2×10^{-9} to 0,5 s/ind.;
- reference error maximum from ±4 to ±5 %;
- components tester is available;
- TBO bandwidth in digital mode, at least 10 MHz;
- deflection coefficient s range in digital mode from 0,005 up to 5 V/ind.;
- scanning factors range in digital mode from 5×10^{-8} to 20 s/ind.;
- voltage measurement reference error maximum between cursors – ±3 %;
- time intervals reference error maximum between cursors – ±2,5 %;
- digitizing rate – 50 MHz;
- vertical resolution – 8 bit;
- weight – 9 kg;
- power consumption – 90 V/A

Manufacturing application.

Expectancy

Replacement of worn out and outdated universal oscilloscopes in CIS countries. Making them competitive on foreign market owing to up-to-date technical level and relatively low cost. Export deliveries are possible.

Realization

The product's cost makes 1588 USD. Project payback period – about three years. Sale of the device.

Developer

Joint Stock Company «Minsk Research Institute of Applied Researches»

VII-100 Apparatus DST-1 power transformers diagnostics



Range of application Electrical power engineering, electric machine industry. To diagnose power transformers in idling mode during acceptance tests (in the process of manufacture and repair), including maintenance process.

Description Enables to make software procedure of synchronous measurement of currents values of idle run and voltages over a period; on the basis of the information received calculation provides analysis of other electric parameters, including transformer operation conditions.

Features:

- measurable voltages range — 0—220 V
- measurable currents range — 0—60 mA
- measurable voltage frequency — 50 ± 5 Hz
- supply voltage — 220 V at 50 ± 1 Hz
- power consumption, not more than 35 VA,
- size — 120x290x180 mm

Considerable extension of functional performance, increase in efficiency compared to the best world's analogues.
Manufacture application is in progress.

Expectancy Import substitution. Considerable extension of functional performance of measurement devices.

Realization *Finished product sale.*

Developer *Public Research Institution «Institute of Applied Physics of Belarus National Academy of Sciences»*

VII-101 Automated ultrasonic units for diesel engines non-resistant insert pistons nondestructive testing



Range of application

The facilities are used to control pistons directly either in the process of technological production cycle or business-to-consumers for output control.

The facilities can be used for a 100% control in flow-production, including processing procedure checkout.

Description

To detect "non-seals zones" (low adhesion) of non-resistant insert with the main material of the piston and evaluate their range. Resting upon the received data and assigned objectionable parameters the unit makes a decision in accordance with the sign: «fit», «unfit».

Depending on the acoustic unit being installed the control is carried out either in pistons with open insert or in ready pistons. The facilities enable to carry out pistons' presorting under the introduced parameters of objectionable level. To carry out control on the facility it is only necessary to put a piston on lift supports and press the button ENTER. The facility will automatically feed the piston into the control area and make measurement results scanning and processing. The control is carried out through analysis of secondary acoustic fields formed with the interfaces: non-resistant insert — alpha-layer— piston material.

Features:

- capacity, at least 200, pistons /h
- weight , not more than 40 kg
- power consumption , not more than 300 Wt
- power supply — 220 V
- duty schedule — three-shift
- indication — digital

Expectancy

Acoustic units sensors in all modifications operate in immersion variant and are located at the distance at least 8 mm from the surface of the pistons under control. This guarantees efficient protection of the sensors from abrasive wear and damages providing reliability and durability of the facility. The device does not require special verification. The functional checkout is carried out with the help of the sample included into indicators set. The work with indicator does not require special skills of personnel.

Realization

The indicators are delivered on contractual basis. Guarantee and post guarantee service is provided.

Developer

Public Research Institution «Institute of Applied Physics of Belarus National Academy of Sciences»

VII-102 Complex to measure radon volumetric activity in the air

Range of application State testing, metrological certification CI, national standards, measurements technique certification and control.

Description Reference complex is designed to create a reference base to measure and display radon volumetric activity in the air. It will help specialist arrange metrological provision to calibrate radiation-measurement and spectrometric equipment to measure radon volumetric activity in the air. The technique of carrying out reference standards stability control has been developed and stability measurements have been carried out. Reference facility with radon chambers «Radon-1» and «Radon-2».certification has been made.

- Radon chambers volume — 0,142 3,087 m³
- Radon volumetric activity measurement range — 20x10 β 5 Bq* m³
- Measurement error for R = 0,95—6%.

The reference complex is an import substitution product and in metrological characteristics is in appliance of international requirements for secondary reference standards. Home analogues are unavailable. The complex can compete with the best world's samples.

The product is environmentally friendly.

Radon generators have been designed, manufactured and certified. Systems of external communications have been created. Reference complex research and certification have been carried out. The developers took part in international comparative measurements of national standards to measure radon volumetric activity in the air.

Expectancy Import substitution product having social-economic importance. The availability of the reference complex enables to conduct state testing, metrological certification CI, national standards comparative measurements , certify and check measuring technique which guarantees measurement quality and credibility.

Realization *The complex is located on the area of Republican Unitarian Enterprise "Bel-SIM".*

Developer *Republican Unitarian Enterprise «Belarusian State Institute of Metrology»*

VII-103 Discrete dosing weighing devices DVD-15, DVD -100, DVD -500, DVD -1000

Range of application Weighing and dosing of different materials at industrial and agricultural enterprises such as: coating plants, concrete mixing stations, building materials plants, glassworks, silicate manufactured article works, compound animal feeding stuff shops and others.

Description Discrete dosing weighing devices DVD consist of installed on receptacle strain-gauge indicators, tensosystem controllers KTU-2 and actuation mechanisms. KTU -2 controller or operator controller assigns the amount of the material to be dosed. The material comes from the falling mechanisms into the loading bin and the strain-gage indicator weighs it. When the assigned dose reaches its point the supply terminates, the shutter opens and the weighed material enters the mixing facility.

Technical features:

- dosing maximum: 15; 100; 500; 1000 kg depending on the modification;
- dosing minimum : 0,5; 10; 50; 100 kg respectively;
- dosing error ± 1 %.

Expectancy End product quality improvement owing to dosing accuracy increase. Equipment reliability increase. Equipment efficiency improvement. Industrial process simplification.

Realization *The contractor can offer delivery and manufacture application of dosing systems data.*

Developer *Belarusian National Technical University*

VII-104 High repetition frequency multi-wave source pulse



Range of application Spectroscopy, photo physics, medicine, ecology. The product can be used in medical and ecological systems and instruments including research purposes.

Description The source based on Raman transformation in crystals of radiation of the main and second harmonic of quasicontinuous YAG: Nd-laser additional dubbing of Stokesian components radiation frequencies.

Characteristics:

- radiation spectral range — 0,27—1,6 μ ;
- number of generated wavelengths , at least 15;
- output power — 10—1200 mWt;
- divergence — 3—7 millirad;
- repetition frequency — 1 KHz

The laboratory sample is available.

Expectancy High pulse repetition frequency, ability to generate other wavelengths using various crystals.

Realization *Co-design and commercialization.*

Developer *Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»*

VII-105 Indoor-air radon radiation- hygienic control equipment



Range of application

Indoor-air radon content control when carrying out radiation and hygienic examination in dwelling and public buildings to the compliance with the requirements of valid norms, technical and legal acts.

Description

Indoor-air radon content control equipment and methods have been developed. These facilities are oriented on the use of home commercial radiation detectors **MKS-AT1125** and gamma-detectors **RKG-AT1320** when carrying out radiation and hygienic examination in dwelling and public buildings

1 Radon volumetric activity -222

- 1.1 Minimal measurable activity per one absorber, 20 Bq/m³
- 1.2 Number of absorbers per one measurement, 1 item
- 1.3 Measurement range, 20 -103 Bq/m
- 1.4 Passive sampling absorber exposition time, from 1 to 5 days
- 1.5 Active sampling time, not more than 30 min
- 1.6 Apparatus measurement time, not more than 30 min
- 1.7 Radiometric measurement basic error, not more than 30 %
- 1.8 Gamma-radiometer type (measurement conditions)
RKG-AT1320 (laboratory)
MKS-AT1125 (full-scale)
- 1.9 Sorbent type. Coal-fiber material AUT-M, BUSOFIT
- 1.10 Sorption coefficient, at least, 4,5 dm³/g

INSTRUMENT ENGINEERING

1.11 There is no need to extract the sorbent from the absorber for regeneration and radiometry 2 equivalent equilibrium volumetric activity of radon -222

2.1 Measurement range, 50 -103 Bq/m

2.2 Measurement nominal basic error, not more than, % (in the measurement range of, Bq/m³) 50 (50 -102)35 (102 -105) min

2.3 Sampling time, 30

2.4 Apparatus measurement time, 15 min

2.5 Radiometer type PKF-AT1320

2.6 Filtering material type, FPP

Radon control facilities are in compliance with the best gamma-radiometric samples in relation with measurements of volumetric activity and have no analogues with regard to measurements of equivalent equilibrium volumetric activity of radon

The specifications of the created sample meet the requirements of the current normative documents in radon indoor-air control.

No home analogues. The developed apparatus and methodological methods of radiation and hygienic control have rank with the best world's gamma-radiometric samples with relation to measurement of radon volumetric activity an hake no analogues with regard to measurements of equivalent equilibrium volumetric activity of radon

Eco-friendly process.

The tests have been made with the sampling devices. Metrological examinations and certification MACH for radiometers RKG-AT1320 and MKS -AT1125 have been made. Built-in integrated fast IR for radiometers RKG -AT1320 and MKS-AT1125 and CD for sampling devices have been developed. Metrological expertise and certification of radon measuring technique has been carried out

Expectancy

Carrying out radon monitoring to prevent the population from unsound exposure to radiation bear social effect.

VII-106 Measurement tools «Expert beta-gamma-HMS»

Range of application Control of internal irradiation of population and personnel , practical radiation medicine

Description Measurement equipment characteristics allow the specialist to use it as the main measurement complex and as an expert unit.

Gamma-channel:

- Registered gamma-radiation power range — 0,05— 3,0;
- Detector type: scintillation , detection units NaI(Tl) — (150x100 mm and 63x63 mm);
- Range of measurable activity in human's body , from 7,5-10 to 8,5-10 β 5Bq;
- Minimal detecting activity ¹³⁷Cs in adults' body — 300 Bq;
- Controllable radio nuclides in standard mode Sr-90, Cs-137,I-131, Co-60, K-40 and others
- Energy resolution in energy 0,662 mega-erg V, %:

γ -channel, not more than 10 β - channel not more than 30;

- Measurement basic error, %:

Z channel \pm 30 % β -channel \pm 50 %

Beta -channel:

- Type and range of radiation registered from 0,2 to 3,5 mega-erg V;
- Detector type, combined detectors on the basis of activated para-terphenyl 63x4 mm and crystals CsI(Na) (NaI(Tl)) 63x40 mm;
- Minimal detecting activity ⁹⁰Cs in adults' body for measurement time of 30 min., Bq 1,1kBq/kg;
- Readings instability in the process of continuous work (12hours), % \pm 2 % and \pm 5 % respectively.

The complex has no analogues in Belarus. The developed measurement complex is in compliance with the best world's samples (ranks over Anti-Cancer Committee, Australia).

The measurement process is environmentally friendly.

Measurement complex prototype model manufacturing has been completed.

Research tests have been carried out.

Expectancy The actualization of the complex will have social effect since it helps to prevent population from ungrounded irradiation.

Realization *On contractual bases the designer can offer to sell documentation and help in coping with the development.*

Developer *International State University of Ecology after Sakharov*

VII-107 Modernized high-capacity 4π-gamma-spectrometer «Pripiat-2π»

Range of application Natural and induced radio nuclides contents control (137Cs, 40K, 226Ra, 232Th and others) in environmental objects, detection of radon volumetric activity in the air and office rooms, radon flow density from earth surface and building units.

Description A new data acquisition system for six-crystal gamma-spectrometer «PRIPJAT» and software have been developed. The measurement technique in countable samples has been created.

Measurable specific activity range:

- 137Cs from 1 Bq/kg,
- 226Ra from 1 Bq/kg,
- 232Th from 1 Bq/kg,
- 40K from 10 Bq/kg,
- 222Rn from 10 Bq/m³

Measurable radionuclide composition can be expanded.

- expressivity (minimal measurement time depends on sample's accuracy and activity) from 10 s
- capacity (maximal measurements per hour excluding sample preparation time) to 100
- supposed cost of the new spectrometer: — 80 million rubles.

Complete analogues are unavailable. Ranks over RKG-AT1320 (ATOMTEX) and GAMMA-1S (ASPECT RF).

Spectrometers «PRIPJAT» are environmentally friendly.

Two data acquisition systems have been created One data acquisition system has been set.

Expectancy Completer modernization of spectrometers park PRIPJAT. Advantages: 4π-geometry of registration simplifying sample preparation, high automation of setting (range, thresholds, zero shift, coincidence factor); amplitude and time analysis (by coincidences); sample density and size; measurements expressivity (at radiometric mode); high SW functionality.

Realization *The required investment money: 80 million rubles. Project payback period: 5 years. Measurements. Delivery by contract.*

Developer *Public Research Institution «Institute of Physics named after B.I.Stepanov of Belarus National Academy of Sciences»*

VII-108 Non-destructive inspection instrument SP-07 to determine weld joints quality



Range of application

To carry out ultrasonic non-destructive on-line control reinforced bars end weld joints from steels A240-A400 performed in baths in inventory forms by multiple-layer welds on steel clamps-plates without molding and auxiliary elements.

Description

The instrument is designed for non-destructive ultrasonic inspection of quality of weld joints of concrete-steel constructions reinforcing elements in stationary and site works. It includes the following key elements:

and electronic module (a control board, a control device, a pulse generator, a receiver-amplifier); transmitters; outfit for optimal location of the transmitter in the process of check-up and elusion of contact ultrasonic effect on operator's body.

Features:

- attenuator division value, not more than 2 dB;
- operating frequencies — 2,5 1,8 MHz;
- pulse maximum amplitude at generator output in idle mode , at least 200 V;
- power supply operating voltage — $12 \pm 1,3$ V (DC);
- controllable reinforced bars diameter, from 20 to 40 mm
- weight, not more than 2 kg;
- overall dimensions, not more than 125x130x270 mm.

The control of weld joints with the use of the inspection instrument pilot sample and ultrasonic control method have been implemented.

Expectancy

Compactness, small weight and size, easy to handle in site works; requires no special training in adjustment and service; possesses high reliability and durability, safety in operation (requires no high-voltage power supply).

Realization

With customer's request the devices can be manufactured in the required amount and assistance in handling the personnel can be rendered.

Developer

*Public Research Institution «Research and Design-Technological Institute of Welding and Protective Coatings with Pilot Production»;
Public Research Institution «Institute of Applied Physics of Belarus National Academy of Sciences»*

VII-109 Spectroscan: highly sensitive spectroscopic complex microfluorescent analysis



Range of application

Study, detection of very small amounts of substances. Examination of surface photoluminescence, thin films, detection of very small amounts of substances, single molecules, clusters and nano-particles detection.

Description

The operational principle of the complex lies in excitation and registration of the glow of molecules and nano-structures through one and the same microscope objective using a single-mode continuous wave laser, space division of radiation emitted with various elemental emitters and spectral division of exciting radiation and luminescence. point emitters image with the spatial resolution making about 1μ is examined with the help of a highly sensitive matrix of CCD-detectors (1024x300 elements), cooled down up to -120°C , which enable simultaneous, independent and durable registration of radiation of several molecules or molecular clusters (up to 24 h). For registration and examination of emission spectrum an image-forming diffraction spectrograph is installed at CCD-detector input. In this mode a 4-dimensional data array is analyzed: coordinate (300 channels), wavelengths (1024 channels), rate (up to 216 counts) and time (up to 105 s). These measurements enable simultaneous and independent research of emission spectrums of several molecules, clusters, or nano-particles, their dependence on time, exciting radiation rate and dose.

Characteristics:

- spectral range — 400—950 μm ;
- spectral resolution — 1 μm ;
- sample area — 100x100 μ^2 ;
- spatial resolution — 1 μ^2 ;
- registration channels — 3—10⁵;
- sensitivity — 100 photon /h
- dynamic range >10⁴;
- acquisition interval, up to 24 h.

The complex operates together with the equipment of collective use center of IMAP of Belarusian Academy of Sciences.

Expectancy

When using high-quality components and thin-film samples (<1 μ identification of radiation source with the accuracy better than 1 μ^3 is possible, which is sufficient for a separate molecule luminescence signal extraction when the concentration in the matrix reaches 10¹² cm⁻³.

Realization

Contracts.

Developer

Public Research Institution «Institute of Molecular and Atomic Physics of Belarus National Academy of Sciences»

VII-110 Universal experimental complex SHS

**Range of application**

Research in the field of SHS heat-proof compounds (carbides, nitrides, borides, silicides, intermetallic compounds etc.) in the mode of solid-phase and filtrational combustion.

Description

The universal experimental complex of self-propagating high-temperature synthesis (SHS) includes an experimental reactor, a PC, a case, a vacuum rotary, a digital camera, a control module, a control board, a pre-heating device. The experimental reactor consists of a case, a lid and a bow latch mechanism. The lid has electrical inputs to enable reaction initiation means and thermo electrical sensors. The case has pipe branches to enable the cooling system, vacuuming and gas reagents filling, windows for visual observation and photo registration of synthesis process.

The results of input parameters are processed with the help of a PC with a special software.

- SHS reactor capacity — 4,5+0,1 l;
- Measurement temperatures range, up to 2500°C;
- Maximum operation pressure, up to 2,5 MPa;
- Sample pre-heating temperature, up to 800±10°C;
- The weight of simultaneously loaded material for synthesis, up to 0,3 kg;
- Maximal power consumption — 3 KWt.

The product is protected with RB patent. It is in appliance with the best world's samples. Home analogues are unavailable.

Expectancy

The complex enables to carry out SHS experimental works including examination of heat-proof compounds (carbides, nitrides, borides, silicides, intermetallic compounds etc.) synthesis kinetics in the mode of solid-phase and filtrational combustion as well as to measure physical parameters using four channels, to make visual observation over the process or make photo-registration, maintain constant pressure and controlled atmosphere in reaction volume.

Realization

A set of design documentation (partial or full completion with the periphery) creation of a collective use center.

Developer

Public Research Institution «Institute of Powder Metallurgy of Belarus National Academy of Sciences»

VII-111 Viscoelastic properties gage IMPULSE-1R



Range of application

For input and output non-destructive control of non-metallic materials and manufactured articles. For input and output non-destructive control of the quality of off-the-shelf products of enterprises manufacturing and using fabricated rubber products and plastics articles (fluorine plastics, carbon plastics, polymethylmethacrylates and others); for a comparative analysis of a wide class of materials : asphalt concretes, bitumen mixtures, biological tissues, foam polyurethanes and others.

Description

When creating the gauge we used the method of The used method dynamic identifying which lies in striking a local blow on the tested material, registration the analog signal proportional to the indenter travel current velocity and calculating main physical and mechanical characteristics under the specially developed algorithms. IMPULSE-1R includes a sensor, source signal processing unit and works in conjugation either with a PC or independently. A convenient database enables to store the measurement results data and accumulate them for statistic analysis.

Feature:

- measurement time — 15 s;
- gage transducer ADC unit weight — 0,6 kg
- physical and mechanical characteristics measurement error — 10%.

The device has been put into effect.

Expectancy

Availability to control a set of characteristics of the manufactured articles directly, materials in production conditions , high speed, productivity and control information capacity ; availability to control thin-walled article, their quality pre-sorting. PC software enables to have on-line data on Shore hardness and in international units IRHD, on elasticity, viscosity, dynamic modulus of elasticity and other characteristics of rubber including plastic materials' hardness, modulus of elasticity and tensile yield.

Realization

Product's sale.

Developer

Public Research Institution «Institute of Applied Physics of Belarus National Academy of Sciences»

VIII. TOOLS

№	Project name	C.
VIII-112	Diamond and cubic boron nitride micropowders synthesis technologies	155
VIII-113	Range of modular cutting instruments	156
VIII-114	Superhard material «Almazot» synthetic monocrystals	157
VIII-115	Waste-free technology, instrument and machine-tool attachments for face-hardening of instrument steel manufactured articles	158
VIII-116	Work areas relief recovery technology using dressings	159

VIII-112 Diamond and cubic boron nitride micropowders synthesis technologies



Range of application

Preparation of composites to make grinding and polishing, blade and abrasive instrument designed for ceramics, steels, alloys, glass, cast irons and other materials of enhance hardness including super finished treatment of the above-mentioned materials.

Description

Features:

- micropowders main fractions grain size — 10/7—20/14 μ
- abrasive ability — 3,8 relative units.
- micropowders caking capacity

— diamond— 85 %,
— cubic boron nitride — 83%.

- recovery

— for diamond — 70%,
— for CBN — 62%.

Compared to the analogues the recovery relative to micro powder's total weight has increased by 48 % (for CBN) and by 60% (for diamond). The abrasiveness has increase in 1, 6 times (for CBN) and in 1, 5 times (for diamond). Powders caking capacity has increased by 15 % (for CBN) and by 11% (for diamond).

The micropowders synthesis technological processes are environmentally friendly.

Diamond and cubic boron nitride micropowders pilot batches have been manufactured. The technologies have been put into operation in the manufacturing area

Expectancy

The developed technologies of synthesis enable to increase the output of micropowders owing to the choice of optimal level of additive as well as optimal parameters of synthesis. The energy content will be reduced by 15%, materials consumption by 10%, prime cost by 15%.

Realization

Payback period: 2, 29. Export. Import substitution. The contractor can offer technical documentation and render assistance in putting the technology into effect.

Developer

Public Research Institution «Joint Institute of Solid-State Physics and Semiconductors of Belarus National Academy of Sciences»

TOOLS

VIII-113 Range of modular cutting instruments

Range of application	Machinebuilding and repair.
Description	<p>The designs of cutting instruments include standard cutting plates, unified cutter blocks and body modules.</p> <p>Technical features:</p> <ul style="list-style-type: none">• cutting-tool/ miller life — 80/600 min;• cutting-tool/ miller treatment efficiency — 80/520 cm/min;• cutting-tool/ miller treatment quality — 0,63/0.63 Ra. <p>The product has novelty to the following countries: Russian Federation, Republic of Belarus.</p> <p>In appliance with the level of CIS-countries products, processable in manufacture, assembly and adjustment, reliable in service. Provides 15 %reduction in cost of mechanical treatment, life-time increase in 1, 5 times. Two RB patents. The design of cutting blocks and modular cutting instruments corresponds to the requirements of business-to-consumer occupational safety and the work-flows are environmentally friendly.</p> <p>Pre-production</p>
Expectancy	<p>The range of modular cutting instruments has been developed using a progressive module principle of instrument making.</p> <p>The designs of cutting instruments are processable in manufacture and assembly :</p> <ul style="list-style-type: none">— main location surfaces have a simple geometry;<ul style="list-style-type: none">— cutting plate grooves and fixture elements are open— cutting blocks and modular cutting instruments are aesthetic, easy to adjust and handle.
Realization	<p><i>The required investment money: 200 million rubles. Project payback period : 1 year. The contractor can offer technical documentation and render assistance in putting the technology into effect.</i></p>
Developer	<i>Polotsk State University</i>

VIII-114 Superhard material «Almazot» synthetic monocrystals



Range of application

Instrument making.

Description

Features:

- weight up to 2,5 karats;
- average growth velocity — 3,5 mg/hour;
- linear size, up to 8 mm;
- background impurities content — $10 \times 10^{-19} - 10 \times 10^{-20} \text{ cm}^3$;
- heat conductivity, more than $1200 \text{ Wt/(m}^* \text{K)}$;
- output of high-quality crystals (1-4 defect groups under Specifications of RB 600124613.002-2002), more than 60 %.

Superhard material «Almazot» synthetic monocrystals cost is twice as low as that of analogues natural diamond raw material.

Superhard material «Almazot» in its technical performance ranks on the level of diamond raw materials, and a number of instrument crystals characteristics after thermo-baric treatment rank over natural raw material (SAR).

The work has been done of a very high level. Its results are in compliance with the best world's analogues. Patent application has been submitted.

A special area for superhard material «Almazot» large crystals with increased growth velocity of 2000 karats /year has been created.

Expectancy

Import substitution.

Realization

The contractor can offer technical documentation and render assistance in putting the technology into effect.

Developer

*Republican Unitarian Enterprise «Adamas BSU»,
Research and Scientific Institution «Institute of Applied Physical Problems named after A.N. Sevchenko» Belarusian State University*

VIII-115 Waste-free technology, instrument and machine-tool attachments for face-hardening of instrument steel manufactured articles

Range of application Machinebuilding, instrument making and building materials.

Description **Features:**

- energy intensity (when making saturating medias) — 0,007 MWt-h/t
- strain-hardening range formation speed, μ/h :
 - in the process of carbidization >100;
 - in the process of carbonitration >20;
- treatment cost (from manufactured item cost) — 10— 15 %;
- relative wear resistance (X12M1=1) — 3— 5 times;
- pitting potential (3%p-pNaCl) — 1,6 V;
- increase in coated manufactured article cost — 0,15 times;
- friction coefficient — 0,3.

The workflow ranks over the results by best home and foreign samples in energy intensity (in 1000 times), saturating media use factor (unlimited), strain-hardening range formation speed in the process of carbidization (7 times), saturating medias transformation from one media to another availability. Friction coefficient (in 1,5 times), relative wear resistance factor (B 1,5 times). The hardening technique has no analogues and is easy to handle, characterizing with the techniques unification when obtaining various-type coatings. The manufacturing procedure is environmentally friendly. The waste utilization is realized through their re-use and as technological filler when manufacturing new saturating medias. The developed technology has been put into effect.

Expectancy The application of the technological process enables:

- 3—5-fold increase in cutting instrument , instrument and technological equipment life-time
- possibility to treat various listed products without additional expenses.
- 30% increase in productivity;
- 70—80% energy cost reduction
- 10—15% ,materials consumption reduction

Realization *Project payback period: 2, 5 years. The contractor can offer technical documentation and render assistance in putting the technology into effect. Technology transformation is also possible.*

Developer *Research Laboratory of Steel Articles Hardening*

VIII-116 Work areas relief recovery technology using dressings

Range of application Metalware recycling.

Description Technological equipment work surface recovery process is done owing to saturating element diffusion acceleration (boron, aluminum, nitrogen, carbon) in the places of dislocation density local enhance and other defects of metals crystalline lattice, i.e. «healing» of cracks (width up to 10 μ, depth up to 1,5 mm) occurs

Two recovery processes have been worked out:

Carbonitriding.

- The recovery is done at the temperatures 500—600 °C
- for 4 — 6 hours
- layer width — up to 0,3 mm.

Pressure casting compression molds from steels 4X5MΦC, 3X2B8Φ, 5X3B3MΦC.

Boriding.

- The recovery is done at the temperatures 850—1050 °C
- for 2 — 4 hours,
- layer width — до 0,1 mm

Cold-die instrument for bending, rolling-out, extruding, hot-die instrument for forging and stamping.

2 applications for a discovery have been submitted.

The technology has been put into effect.

Expectancy The technological process provides technological equipment life-type 1,5—4 – fold prolongation owing to the recovery of its surface by application of boriding and carbonitriding dressings
The process can be actualized at any thermal section.

Realization *The proposed cooperation: signing of economic contracts on product implementation and mixture delivery.*

Developer *Belarusian National Technical University*

IX. CHEMICAL INDUSTRY. BIOTECHNOLOGIES

Nº	Project name	P.
IX-117	Antiseptic KGFM	163
IX-118	Boron-containing composition for solutions of electrochemical deposition nickel-boron, cobalt-boron and nickel-cobalt-boron coatings	164
IX-119	«Gentamicin hydrogel laminas 0,1%» and «Miramistin hydrogel laminas 0,05%». Technology	165
IX-120	High-purity silica gel with high absorbing capacity on the basis of pyrogenous silicon dioxide	166
IX-121	Hydroxyapatite gel. Obtaining technology	167
IX-122	Technology and plant for medical and biological plasma processing	168
IX-123	Wasteless technology of water-soluble chlorine -free fertilizer — potassium nitrate	169
IX-124	Water-soluble chlorine-free NPK fertilizer — potassium ammonium phosphate	170

IX-117 Antiseptic KGFM



Range of application Forestry and wood processing industry. To prevent wood from fungi attacks when storing and transporting.

Description Antiseptic KGFM is a multi-component protective agent (prescribed or a preparation) including the following components: sodium silicofluoride (Na_2SiF_6), sodium hypochlorite (NaClO), sodium carbonate (Na_2CO_3), alkylsulfonate ($\text{R}[\text{C}_{10}\text{--}\text{C}_{16}]\text{SO}_3\text{Na}$). Water soluble. Treatment solution concentration makes – 3–10%.

Features:

- odorless;
- easily penetrates the wood in the process of surface treatment preservation treatment
- does not color the processed wood;
- does not deteriorate physical and mechanical properties
- does not deteriorate technological properties (ability to be subjected to mechanical treatment, glue up and take a dye);
- highly inflammable protective agent;
- can cause corrosion of ferrous metals.

Home analogues are unavailable. Ranks at the level of best worlds analogues Antiseptic KGFM is innocuous for people and animals, free from pervasive smell, environmentally friendly since it does not contain the substances of the 1st class of hazard under National Standard 12.1.007.

Expectancy The use of the product will enable effective protection of wood (round timber, lumber) when storing and transporting.

Realization *Antiseptic formula sale, as well as technology to prepare the treatment solution and wood fashioning.*

Developer *Belarusian State Technological University*

IX-118 Boron-containing composition for solutions of electrochemical deposition nickel-boron, cobalt-boron and nickel-cobalt-boron coatings

Range of application	Instrument making, radio engineering, microelectronics, precision electronic engineering The application of protective functional coating on various metallic surfaces: copper, brass, beryllium copper, kovar, steel, tungsten, aluminum and its alloys and others.
Description	<p>We developed import –substituting technology of electrochemical deposition technology from water solutions of electrolyte of protective functional coatings metal-boron to be deposited on PC boards, car sensors.</p> <ul style="list-style-type: none">• velocity of coating electrochemical deposition for baths: — stationary type — 25— 50 μ/ hour; — drum and dome type — 5— 10 μ/ hour;• depositing temperature — 20— 50°C;• coating microhardness after thermal treatment (300 °C) —10— 13GPa;• transient electric resistance — 3— 6 mOhm;• wear resistance: — nickel-boron (in dry friction), 2□10-7 mm³ — nickel, 8□10-5 mm³;• adhesive strength Ni-B with aluminum conductor — 10–16 g. <p>Corrosion resistant against salt spray, condensed deposit atmosphere, atmospheric changes (thermo cycling). The designed coating not only successfully substitute the previous coatings from precious metals (palladium, silver, gold), but improve service characteristics of the manufactured articles. The coatings are characterized with low transient resistance, enhanced hardness, wear resistance, corrosion resistance, good ultrasonic welding abilities and solderability. Environmentally friendly. The new technology has been put into operation.</p>
Expectancy	<p>Products cost reduction; electrolyte simple use and its durability when correcting; the nickel-boron alloy depositing technology is material and energy saving; boring at low temperature. Possesses high chemical resistance and efficiency. The technology is simple and requires no additional equipment. Sodium dekahydroborate substitution.</p>
Realization	<p><i>The contractor can offer to sell the technology, render assistance in mastering the technology.</i></p>
Developer	<p><i>BSU Institution «Research Institute of Physical and Chemical Problems»</i></p>

IX-119 «Gentamicin hydrogel laminas 0,1%» and «Miramistin hydrogel laminas 0,05%». Technology

Range of application Medicine.

Description Medicinal agents on the basis of polymeric hydrogel matrixes designed for local treatment of wounds and burns of various genesis and localization. Hydrogel laminas are elastic, transparent; possess adhesive properties, sufficient strength which provides the protection of a wound from mechanical damages, preventing a secondary infection, easily removed causing no pain in the process of dressing without injuring a tender granulation tissue, possess good drainage and sorption properties, create optimal curing microclimate owing to maintaining moist environment. Pharmacologically active components (gentamicin, miramistin) give the hydrogel laminas antimicrobial properties which considerably enhance their efficiency in curing infected wounds and burns. Belarus does not produce this kind of medical product. It ranks over the foreign analogues. In polymeric components of hydrogel base and properties they are close to the application remedy AQUA-GEL by Kik Gel® (Poland). Unlike the foreign analogue «Gentamicin hydrogel laminas 0, 1%» include antibiotics Gentamicin and «Miramistin hydrogel laminas 0, 05%» antiseptic miramistin. The workflow is environmentally friendly. The medications have been certified. The first pilot lots have been produced.

Expectancy The creation of the technology will enable to obtain a medicinal agent, having no analogues in RB and meet the requirements of RB Ministry of Health Protection.

Realization *The required funding sum makes only 100 thousand USD. Projects payback period 5 years.*

Developer *Republican Unitarian Enterprise «Belmedpreparaty»*

IX-120 High-purity silica gel with high absorbing capacity on the basis of pyrogenous silicon dioxide



Range of application To manufacture indication tubes to detect organic and inorganic impurities in analytical chemistry, to fill chromatographic columns, to dry liquids and gases, in perfume industry.

Description The developed sol-gel technology to obtain high-purity silica gel on the basis of pyrogenous silicon dioxide, enabling to have silica gel with 0,5—4 mm particles size without using special milling equipment.

Technical features:

- visual appearance — white powder or granules
- granules size — 0,1— 4 mm;
- samples specific surface area — 250— 350 m²/g;
- density — 0,5 g/cm³;
- impurities (Fe, Al, Na) — 10-3 weight %;
- thermo resistance — 0— 900 °C;
- sorptive capacity — 0,8 — 1,2 mmol• equivalent /g;
- supposed price — 40 USD./kg.

Environmentally friendly.
Pilot batches have been manufactured.

Expectancy The application of silica gel enables to refuse imported materials. The sol-gel method allows obtaining of high-purity silicate gel at low (up to 60°C) temperatures without milling stage.

Realization *Delivery by customer's request with the required size of particles or granules. Manufacture and delivery of silicate gel pilot batches, sales of the technology, rendering assistance in technology implementation.*

Developer *F. Skoryna Gomel State University*

IX-121 Hydroxyapatite gel. Obtaining technology

Range of application Medicine (traumatology, stomatology).

Description Hydroxyapatite gel in the form of single-use injection syringe, filled with hydroxyapatite gel, with 1 g, 2 g, 5 g, 10 g. Applied in surgery and stomatology to be implanted into bone tissue defect to fill it. In surgery: for fracture patients including decelerated synostosis and long bone false joints назначают. In stomatology: availability of upper and lower jaws bone stock defects, gnathic cysts and partial secondary adentia (dental implants fixing).

The advantage of hydroxyapatite gel lies in the fact that the main reactant is nanocrystalline hydroxyapatite in a gel form, containing the smallest amount of tricalciumphosphate impurity compared to the given analogues. Hydroxyapatite gel has enhanced power to transform in biological environments into calcium ions and phosphates providing better adoption of the said ions in «the area of interest» - bone wound compared to powder-like forms.

Ground substance:

- Nano-crystal hydroxyapatite $[\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2]$ - (82%-100%)
- With the mixture of tribasic calcium phosphate $\text{Ca}_3(\text{PO}_4)_2$, not more than 18%

Belarus does not produce this kind of medical product. It ranks over the foreign analogues: «Hydroxipol» (RF) and «Osteogenon» (France). RB patent.

The workflow is environmentally friendly.

The product is recommended for medical application. Registration certificate. The industrial batch has been worked out.

Expectancy Reparative osteoregeneration processes optimization. It is characterized with full biocompatibility with a human's organism, enhances a proliferative activity of osteoblasts and slows down the function of osteoclasts and the processes of reparative osteogenesis, non-hazardous for a human's organism in whole and for soft tissues, adjacent to the place of the gel's depositing in a bone wound.

Realization *The required funding sum makes only 150 thousand USD. Projects payback period 7 years. Further production by-request is planned.*

Developer *Republican Unitarian Enterprise «Belmedpreparaty»*

IX-122 Technology and plant for medical and biological plasma processing

Range of application In medical establishments, R&D laboratories, medical and biological industries. Mobile option is used in small-sized local medical establishments.

Description Medical and biological wastes plasma-and-thermal decontamination and procession equipment has been developed. The plant includes a combustion chamber, a reheat chamber, gas purification system and a power service. Waste processing plasma plant key element is plasma electric-arc generator which creates thermal plasma of any gases with the temperature over 5000 K. With such a temperature any complex organic and non-organic compound including atoms and ions are decomposed completely. The main distinctive feature of plasma technology lies in considerable intensification of the process and destruction of wastes. As a result the necessity to use oxygen to destruct wastes is completely excluded. The temperature increase in the reaction zone up to 1800-2000 K enables to improve ash residue penetration from combustion and exclude preservation of formation of toxic agents or biological forms in gaseous phase.

Features:

- power — 200 KWt;
- waste processing capacity — 200 kg/h;
- temperature in the furnace — 1800—2000 K.

Expectancy To make it possible to process a wide spectrum of medical and biological wastes in hospitals, research laboratories including medical and biological industries; to decontaminate processed wastes; to exclude formation and preservation of toxic agents and biological forms in gaseous phase; to obtain silicate materials from mineral substances with small degree of leaching; to reduce considerably the volume and weight of the processed wastes. We also expect that it will be possible to place the plant directly in the places of wastes formation excluding transporting and storing stages; availability of the mobile plant.

Realization *Patent, specification, technical and service documentation, pilot sample.*

Developer *Public Research Institution «Institute of Heat and Mass Transfer named after A.V. Lykov of Belarus National Academy of Sciences»*

IX-123 Wasteless technology of water-soluble chlorine -free fertilizer — potassium nitrate

Range of application Mineral fertilizers for green houses and chlorine-phobias agricultural crops.

Description Technical products as chemical potassium chloride (PA «Belaruskali») and liquid nitrogen fertilizer KAC (Joint Stock Company «Hrodna Azot») are used as raw materials.
The product is in appliance with the requirements of National Standards of RB 100354659.049–2004 « potassium nitrate ».
As a result we have a side product: a liquid complex fertilizer KAS-K(sort 26:0:3) - National Standards of RB 100354659.050–2004
The technology has passed through commercial treatment. Under the results of agrochemical tests in green houses of Republic of Belarus the product ranks at the level of foreign analogues and in some indices surpasses them. Recommended for application.
The technology is protected with 2 RB patents.

Expectancy The potassium nitrate cost is lower than that of imported

Realization *The contractor can offer to sell the technology, render assistance in mastering it and developing technical documentation.*

Developer *Belarusian State Technological University*

**IX-124 Water-soluble chlorine-free NPK fertilizer — potassi-
umammoniumphosphate**

Range of application	Mineral fertilizers for green houses and chlorine-phobias agricultural crops.
Description	<p>Technical products as chemical potassium chloride (PA «Belaruskali») and ammophos (Joint Stock Company «Homel Chemical Plant ») are used as raw materials.</p> <p>The product is in appliance with the requirements of National Standards of RB 100643856.003 2004.</p> <ul style="list-style-type: none">• Contents of P₂O₅ 50 55%, potassium 24 29 % (in equivalent to K₂O),• nitrogen 1,3 3%. <p>As a side product we have a suspended liquid complex fertilizer of the sorts 10-5-15, 12-6-7.</p> <p>The technology has passed through commercial treatment. Under the results of agrochemical tests in green houses of Republic of Belarus the product ranks at the level of foreign analogues and in some indices surpasses them. Recommended for application.</p> <p>The technology is protected with 3 RB patents.</p>
Expectancy	The cost of the potassiumammoniumphosphate is lower than that of imported analogues.
Realization	<i>The contractor can offer to sell the technology, render assistance in mastering it and developing technical documentation.</i>

Developer *Belarusian State Technological University*

CONTENTS

№	Project name	P.
I. ELECTRONICS. INFORMATION TECHNOLOGIES		7
I-1	Automated information-analytical systems for medicine	9
I-2	Automatic telephone digital station «Beta M 12»	10
I-3	Automatic telephone digital station «Beta M 4»	11
I-4	Facility to control flatness deviation of semiconductor plates EM-6319	12
I-5	Hybrid- neuronet- model-based information technology to analyze data: software complex «Hybrid»	13
I-6	Operator's controller	14
I-7	Polaroids for optoelectronics and protective technologies	15
I-8	Porous powder material to obtain mini flat heat pipes capillary structures	16
I-9	Programmed numerical control universal system UPNC TAIS.421415.007	17
I-10	Protected PC BM2002	19
I-11	Software-driven system CAD "AutoKroy-D"	21
I-12	System of cartographic expressions automated digitizing and editing	23
I-13	System to process earth surface images	24
I-14	Tensor-sensor systems controller «SGC-2»	25
II. LASER TECHNOLOGIES		27
II-15	A facility to measure parameters of laser radiation reducers (MPLRR)	29
II-16	Continuous diode-pumping two-frequency laser sources	30
II-17	Diode laser surgical apparatus DIOLAS-810	31

№	Project name	P.
II-18	Diode-pumped pulse microchip lasers with intracavity Raman-transformation	32
II-19	Facility to cut metals with laser	33
II-20	Facility to measure average power of continuous laser radiation and average power measurement tools verification	34
II-21	Facility to measure continuous laser radiation power stability	35
II-22	Facility to measure LR pulse energy and verification of tools to measure LR energy	36
II-23	Facility to measure the stability of pulse energy of pulse laser radiation	37
II-24	Laser scanning marking facility	38
II-25	Laser spectral analyser (LSA)	39
II-26	Medical-and-technical universal laser module for complex ophthalmology diagnostics and rehabilitation	40
II-27	Powder laser stereolithography facility	41
II-28	Pulse radiation multifrequency transmitters	42
II-29	Stomatological laser «Optima»	43
II-30	Technology of unification into a system of array ICs on silicon wafer	44
II-31	Type-series of secure for visual organs pulse radiation sources based on Raman Effect in chips	46
III. NEW MATERIALS		47
III-32	Aluminum oxide-based thermoresistant ceramic material	49
III-33	Alumosilicates-based composite material and filtering element from it. Manufacturing method	50
III-34	Ceramic materials and UHF-range antenna elements made from them. Hot casting facility for antenna ceramic elements	51

№	Project name	P.
III-35	Complex graphitizing modifying agent for iron casting MIG	52
III-36	Constructional –heat insulating board on the basis of a dolomite binding agent and a wood filler	53
III-37	Extrusion profile manufactures, technology of their obtaining	54
III-38	Gypsum- binding- agent- based materials	55
III-39	High-temperature and corrosive medium resistant composite materials. The engineering procdere to make manufactures from them	56
III-40	High-temperature ceramic material and two-layer non-swirl nozzles from it	57
III-41	Light-weight keramzites manufacturing method. Manufacture of effective expanded-clay concrete blocks for exterior and interior walls	58
III-42	Material to manufacture soil pumps working in the conditions intensive hydro-abrasive wear	59
III-43	Thermodynamically- incompatible- thermoplastics- based -composite material	60
III-44	Wear-resistant composite material on polymeric matrix. Technological process of applying coatings from the composite material	62
IV. COATINGS		63
IV-45	Anticorrosion compositions with antistatic properties	65
IV-46	Ceramic-coated glass fabric filters	66
IV-47	Copper self-fluxing- alloys-based powder compositions and their coatication technology	67
IV-48	Frameless metal-fiber filtering elements	68
IV-49	Materials to shape thin-film coatings for enhanced wear-resistance devices crystals. Technique to shape silicon wafers thin-films	69
IV-50	Metal-polymeric belt from wear-resistant self-fluxing al-	70

Nº	Project name	P.
	loys	
IV-51	Mine equipment high-wear parts manufacturing and reinstating procedure	71
IV-52	Nonleaded painter's enamel for glassware decoration	72
IV-53	Powder compositions with nitrogen-boron containing components, the manufacturing procedure to obtain and improve the manufactured articles with their help	73
IV-54	Powder polymeric paints	74
IV-55	Silicon-dioxide-based polishing suspension	75
IV-56	Technological process to increase holographic work matrixes wear resistance	76
IV-57	Technology and equipment to manufacture copper anodes using continuous horizontal casting	77
IV-58	The body with the applied DLC included into IR «Planics-T». Coating application engineering procedure	78
V. MACHINE-BUILDING. METALLURGY		79
V-59	Alloyed steel casting technology using hot pressed cakes from bearing wastes.	82
V-60	Arc ignition insulator for catode art spraying facilities	83
V-61	Arc weld processes multiparameter control system by arc electric parameters and heat-affected zone thermal parameters	84
V-62	Bracket-milling machine with autochanger and NPC model. FSS500CNC	85
V-63	Compact drilling-milling machine SF-1	87
V-64	Complex resource saving technology to manufacture forgings of car front suspension cross bars and pins	88
V-65	Device to detect defects in polimeric pipes lap welds (SP-09)	89
V-66	Eddy-current defectoscope FD	90
V-67	Fast speed single-screw continous mixer to prepare short-life sand-resin mixtures model. S1SH3.	91

№	Project name	P.
V-68	Hardening-cure casting	93
V-69	High-performance heaters	94
V-70	High-performance work pieces for piston and plunger rings from deformed cast iron	95
V-71	High-permeability ferrite electromagnetic concentrators. Standard technological process of their obtaining	97
V-72	PNC surface grinding semi-automated machine with a round rotary-axis table of the model OSH-641	98
V-73	Sheetbending hydraulic press with programmed numerical control intension 1000kN	100
V-74	Spin casting technology and standard equipment to manufacture iron-carbon alloy turned billets	101
V-75	Structural sheet metal-plastic	102
V-76	Technological process and equipment freeze crystallization casting of hopped-up diesel engine cylinder sleeve billets	103
V-77	Technology and design documentation for the equipment to obtain pipes from polymeric wastes.	105
V-78	Technology and equipment to obtain billets using the method of electroslag remelting	106
V-79	Technology to obtain tubular billets from non-magnetic manganese steel for telemetric systems of horizontal and directed drilling	107
V-80	Universal lead-and-feed screw lathe SM1763	108
VI. AUTOMOBILE AND TRACTOR BUILDING		109
VI-81	114 KWt (155 h.p.) diesel engine	111
VI-82	184 KWt (250 h.p.) diesel engine	112
VI-83	220 KWt (300 h.p.) diesel engine	113
VI-84	58 -hp farmer tractor MTZ-622	114
VI-85	Airport bus MAZ 171	115
VI-86	City bus MAZ 107 (MAZ 107065)	116

№	Project name	P.
VI-87	Diesel engine with power up to 350 h.p.	118
VI-88	Feller-forwarder «Belarus» ML-127	119
VI-89	Forest load-haul-dump machine«Belarus» ML-131	121
VI-90	Forest load-haul-dump machine«Belarus» MLPR-394	123
VI-91	Harvester-thresher BKI-01 technological modes control and indication unit	125
VI-92	High-traction forest load-haul-dump machine ML-131-05	126
VI-93	Hydro mechanical- transmission- 135 ton- heavy-duty dump truck	128
VI-94	Medium-duty dump truck MAZ-457041-220 and MAZ-457041-233 with side extended body	129
VI-95	Midsector coach MAZ 256	130
VI-96	Plastic complex lithium grease with diamond-containing improvers for heavy-loaded friction assemblies	132
VI-97	Tractor Belarus-2022	133
VI-98	Tractor Belarus-2102	135
VII. INSTRUMENT ENGINEERING		137
VII-99	Analog-digital oscilloscope S1-157/3	139
VII-100	Apparatus DST-1 power transformers diagnostics	140
VII-101	Automated ultrasonic units for diesel engines non-resistant insert pistons nondestructive testing	141
VII-102	Complex to measure radon volumetric activity in the air	142
VII-103	Discrete dosing weighing devices DVD-15, DVD -100, DVD -500, DVD -1000	143
VII-104	High repetition frequency multi-wave source pulse	144
VII-105	Indoor-air radon radiation- hygienic control equipment	145
VII-106	Measurement tools «Expert beta-gamma-HMS»	147
VII-107	Modernized high-capacity 4π-gamma-spectrometer «Pripjat-2π»	148

№	Project name	P.
VII-108	Non-destructive inspection instrument SP-07 to determine weld joints quality	149
VII-109	Spectroscan: highly sensitive spectroscopic complex microfluorescent analysis	150
VII-110	Universal experimental complex SHS	151
VII-111	Viscoelastic properties gage IMPULSE-1R	152
VIII. TOOLS		153
VIII-112	Diamond and cubic boron nitride micropowders synthesis technologies	155
VIII-113	Range of modular cutting instruments	156
VIII-114	Superhard material «Almazot» synthetic monocrystals	157
VIII-115	Waste-free technology, instrument and machine-tool attachments for face-hardening of instrument steel manufactured articles	158
VIII-116	Work areas relief recovery technology using dressings	159
IX. CHEMICAL INDUSTRY. BIOTECHNOLOGIES		161
IX-117	Antiseptic KGFM	163
IX-118	Boron-containing composition for solutions of electrochemical deposition nickel-boron, cobalt-boron and nickel-cobalt-boron coatings	164
IX-119	«Gentamicin hydrogel laminas 0,1%» and «Miramistin hydrogel laminas 0,05%». Technology	165
IX-120	High-purity silica gel with high absorbing capacity on the basis of pyrogenous silicon dioxide	166
IX-121	Hydroxyapatite gel. Obtaining technology	167
IX-122	Technology and plant for medical and biological plasma processing	168
IX-123	Wasteless technology of water-soluble chlorine -free fertilizer — potassium nitrate	169
IX-124	Water-soluble chlorine-free NPK fertilizer — potassium ammonium phosphate	170

Developer List

Developer	P.
Belarusian National Technical University 220013, Nezavisimost` Avenu, 65, Minsk, tel. (+375 17) 232-77-52, fax (+375 17) 232-91-37, e-mail: bspa@abspa.unibel.by, http://www.bntu.by/ Rector: Khrustalev Boris Mikhailovich	14, 26, 52, 58, 59, 66, 68, 73, 82, 107, 143, 158, 159
Belarusian State Technological University 220050, Sverdlov Str.13a, Minsk tel. (+375 17) 226-14-32, fax (+375 17) 227-62-17, e-mail: root@bstu.unibel.by, http://www.bstu.unibel.by Rector: Zharski Ivan Mikhailovich	53, 56, 127, 163, 169, 170
Belarusian State University of Informatics and Radioelectronics 22013, P. Brovki Str., 6, Minsk, tel. (+375 17) 232-04-51, fax (+375 17) 231-09-14, e-mail: kanc@gw.bsuir.unibel.by, http://www.bsuir.unibel.by Rector: Batura Mikhail Pavlovich	45, 69
Belarusian State University 220050 Nezavisimost` Avenu, 4, Minsk, tel. (+375 17) 226-59-40, e-mail: rector@bsu.unibel.by, http://www.bsu.by Rector: Strazhev Vasilii Ivanovich	146
Beloozerski Energomechanical plant 225215, Zavodskaya str., 1, Brest region, Beloozersk, tel. (+375 1643) 59-565, 59-566, fax (+375 1643) 59-518, e-mail: omives@saturn.belpak.brest.by, , http://www.bemz.org	101
BSU Institution «Research Institute of Physical and Chemical Problems» 220050, Leningradkaya Str. 14, Minsk tel. (+375 17) 226-51-41, fax (+375 17) 226-46-96, e-mail: fhp@bsu.by, http://www.fhp.bsu.by/ Director: O.A. Ivashkevich	164

- Engineering Center «Plasmoteg»** 76, 78
 220141, Kuprevich Str, 1, building 3, Minsk,
 tel.-fax (+375 17) 211-83-71,
 e-mail: pec@bas-net.by, <http://plasmoteg.org.by/>
 Director: Tochitskii Eduard Ivanovich
- F. Skoryna Gomel State University** 40, 75, 166
 246699, Sovietskaya Str, 104, Gomel,
 tel. (+375 232) 57-82-58, fax (+375 232) 57-30-02,
 e-mail: nis@gsu.unibel.by, <http://www.gsu.unibel.by>
 Rector: Selkin Mihail Vasilevich
- International State Ecological University named after
 A.D.Sakharov** 147
 220009, Dolgobrodskaya Str., 23, Minsk,
 tel. (+375 17) 230-69-98, fax (+375 17) 230-68-97,
 e-mail: info@iseu.by, <http://www.iseu.by/rus/default.html>
 Rector: Kundas Semen Petrovich
- IRUE «Minsk Automated Lines Plant named after P.M.Masherov»** 108
 220038, Dolgobrodskaya Str., 18, Minsk,
 tel. (+375 17) 238-13-32, fax (+375 17) 230-32-51,
 e-mail: mzal@tut.by,
 Director general: Stolyarov Nikolai Borisovich
- IRUE «Minsk truck tractors works»** 96
 220021, Partizan Ave., 150, Minsk,
 tel. (+375 17)291-31-78, fax (+375 17)291-31-93,
 e-mail: volat@mail.belpak.by,
<http://www.mzkt.by/index.php?module=main>
 Director: Sinegovski Genadii Alexandrovich
- Ja. Kupala Grodno State University. Research Institute of Material
 Science and Resource Saving Technologies** 61
 230023, Ozheshko Str., 22, Grodno
- Joint Stock Company «Minsk Research Institute of Applied
 Researches»** 10, 11, 18,
 20, 139
 220113, Ya.Kolas Str., 73, Minsk,
 tel. (+375 17) 262-24-81, fax (+375 17) 262-88-81,
 e-mail: root@mnipi.belpak.minsk.by, <http://mnipi.belhost.by>
 Director: Kukhareno Nikholai Antonovich

- Pilot-design Unitarian Enterprise «Aksicon» Belarus National Academy of Sciences** 33, 38
 220141, Kuprevich Str., 1/2, Minsk
 tel. (+375 17)263-35-56, fax (+375 17)263-26-30,
 e-mail: info@axiconoptics.com,
<http://www.axiconoptics.com/indexrus.html>,
 Director: Kirev Anatolii Victorovich
- Polatsk State University** 156
 211440, Blohin, 29, Vitebsk region, Novopolatsk,
 tel. (+375 214) 53-60-19, fax (+375 17) 55-42-63,
 e-mail: post@psu.unibel.by, <http://www.psu.by/>
 Rector: Babenko Ernst Mihailovich
- Production Association «Belorussian Autoworks»** 128
 222160, 40 Let Oktiabria Str., 4, Minsk region, Zhodino,
 tel. (+375 1775) 3-27-82, fax (+375 1775) 7-01-37,
 e-mail: root@belaz.minsk.by, <http://belaz.minsk.by/about/?lang=ru>
- Production Association «Minsk Motor Plant»** 111, 112,
 220070, Vaupshasova Str., 4, Minsk, 113, 118
 tel. (+375 214) 230-11-24, fax (+375 17) 218-30-37,
 e-mail: general@po-mmz.minsk.by, <http://po-mmz.minsk.by/>
 Director general: Lobach Nikolai Ivanovich
- Production Association «Minsk Tractor Workshops»** 113, 114,
 220009, Dolgobrodskaya Str., 29, Minsk, 120, 122,
 tel. (+375 214) 230-12 -68, fax (+375 17) 230-21-11,
 e-mail: sales@tractors.com.by, <http://www.tractors.com.by/> 124, 127,
 Director general: Puhovoi Alexandr Alexeevich 134, 136
- Public Research Institution «Institute of Chemistry of New Materials NAS of Belarus»** 15
 220141, Staroborisovskii tract, 36, Minsk
 tel. (+375 17) 263-19-23, fax (+375 17) 237-68-38,
 e-mail: dvas@ichnm.ac.by, <http://ns.ichnm.ac.by/>
 Director: Agabekov Vladimir
- Public Research Institution «Institute of Metals Technology of of Belarus National Academy of Sciences »** 77, 93, 104,
 212030, Byalynitskogo-Byaduli Str., 11, Mogilev, 106
 tel. (+375 222) 27-93-67, fax (+375 222) 28-01-49,
<http://www.itm.by>
 Director: Marukovich Evgenii Ignat`evich

- Public Institution «Research and Design-Technological Institute of Welding and Protective Coating with Pilot Production» (RDTI WC with PP) 41, 89, 149
 220071, Platonov Str., 12b, Minsk,
 tel. (+375 17) 232-63-63, fax (+375 17) 210-11-17,
 e-mail: inadm@wpc-i.ac.by, <http://wpc-i.ac.by/>
 Director: Sheleg Valerii Konstantinovich
- Public Research Institution «RI of Pulse Processes with PP» 57
 220005, Platonov Str., 12-B, Minsk,
 tel. (+375 17) 507-22-00, 231-39-54, fax (+375 17) 210-05-25,
 e-mail: impuls@bn.by, <http://www.pmi.basnet.by/niip/>
 Director: Shuganov Aleksandr Dmitrievich
- Public Research Institution «Institute of Applied Physics of Belarus National Academy of Sciences» 89, 90, 140, 141, 149, 152,
 220072, Academicheskaya Str., 16, Minsk,
 tel. (+375 17) 284-17-94, fax (+375 17) 284-10-81
 e-mail: admcom@iaph.bas-net.by, <http://iaph.bas-net.by>
 Director: Prohorenko Petr Petrovich
- Public Research Institution «Institute of General and Inorganic Chemistry of Belarus National Academy of Sciences» 50, 65, 72, 74
 220072, Minsk, Surganov Str., 9,
 tel. (+375 17) 284-27-42, fax (+375 17) 284-27-03,
 e-mail: sekretar@igic.bas-net.by
 Director: Kut'ko Nikolai Petrovich
- Public Research Institution «Institute of Heat and Mass Transfer named after A.V. Lykov of Belarus National Academy of Sciences» 84, 132, 168
 220071, Minsk, P.Brovka Str., 15,
 tel. (+375 17) 284-21-36, fax (+375 17) 232-25-13
 e-mail: ogm@hmti.ac.by, <http://www.itmo.by>
 Director: Martynenko Oleg Grogorievich
- Public Research Institution «Institute of Mechanics and Reliability of Machines of Belarus National Academy of Sciences» 67, 70, 71, 132
 220072, Minsk, Academicheskaya Str., 12,
 tel. (+375 17) 284-06-84, fax (+375 17) 284-29-15,
 e-mail: root@ncpmm.bas-net.by
 Director: Krasnevskii Leonid Grigorievich

- Public Research Institution «Institute of Mechanics of Metal
Polymeric Systems named after V.A. Belyi of Belarus National
Academy of Sciences» 54, 62
246050, Gomel, Kirov Str., 32a,
tel. (+375 232) 77-52-12, fax (+375 232) 77-52-11,
e-mail: mpri@mail.ru, <http://mpri.org.by>
Director: Myshkin Nikolai Konstantinovich
- Public Research Institution «Institute of Molecular and Atomic
Physics of Belarus National Academy of Sciences» 39, 150
220072, Minsk, Nezavisimost` Avenu, 70,
tel. (+375 17) 284-16-35, fax (+375 17),
e-mail: imafbel@imaph.bas-net.by, <http://imaph.bas-net.by>
Director: Gaponenko Sergei Vasilievich
- Public Research Institution «Institute of Physics named after
B.I.Stepanov of Belarus National Academy of Sciences» 29, 30, 32, 34,
220072, Nezavisimost` Avenu, 68, Minsk 35, 36, 37, 46,
t. (+375 17) 284-17-55, fax (+375 17) 284-08-79, 144, 148, 42
e-mail: ifanbel@ifanbel.bas-net.by, <http://ifanbel.bas-net.by/russian/index.html>
Director: Kazak Nikolai Stanislavovich
- Public Research Institution «Institute of Powder Metallurgy of
Belarus National Academy of Sciences» 16, 49, 83, 97,
220071, Minsk, Platonov Str., 41, 151
tel. (+375 17) 232-82-42, fax (+375 17) 210-05-74,
<http://wpc-i.ac.by/bgipmeng.htm>
Director: Ilyushenko Aleksandr Fyodorovcih
- Public Research Institution «Joint Institute of Solid-State
Physics and Semiconductors of Belarus National Academy of
Sciences» 51, 94, 155
220072, Minsk, P.Brovka Str., 17,
tel. (+375 17) 284-15-58, fax (+375 17) 284-08-88,
e-mail: olekhov@ifftp.bas-net.by, <http://ifftp.bas-net.by>
Director: Olekhovich Nikolai Mikhailovich
- Public Research Institution «Physical and Technical Institute
of Belarus National Academy of Sciences» 88, 96
220141, Minsk, Kuprevich Str., 10,
tel.-fax (+375 17) 263-76-93
e-mail: phti@ns.igs.ac.by, <http://phti.at.tut.by/>
Director: Gordienko Anatolii Illarionovich

- Public Research Institution «Research Center of Resource Savings of Belarus National Academy of Sciences» 102
 230023, Tyzengauz squer, 7, Grodno,
 tel. (+375 152) 77-13-45, fax: (+375 152) 73-81-85
 e-mail: resource@mail.grodno.by,
<http://resource-nanb.narod.ru/index.html>
- Public Research Institution «United Institute of Informatics Problems of Belarus National Academy of Sciences» 9, 13, 23, 24
 220012, Surganov Str., 6, Minsk,
 tel.-fax +(375 17) 284-21-75
 e-mail: abl@newman.bas-net.by, <http://uiip.bas-net.by/index.html>
 Director general: Ablameiko Sergeji Vladimirovich
- R&D and manufacturing company «Design Office for Precision Electronic Engineering — optomechanical equipment» («KBTEM-OMO») 12
 220033, Partizan Ave., 2, Minsk,
 tel. (+375 17) 226-12-05, fax (+375 17) 226-12-05,
 e-mail: mve@kbtem.avilink.net,
<http://www.planar.by/ru/about/kbtem-omo/>
 Director: Matyushkov Vladimir Egorovich
- Republican Design Unitarian Enterprise «Special Design-Technological Office on grain and feed harvesting equipment» 113
 246035, Efremov Str., 61, Homel
 tel. (+375 232) 59-34-18, fax (+376 232) 57-70-52,
 e-mail: gskb@mail.spbnit.ru,
 Director: A.A. Djuzhev
- Republican Unitarian Enterprise «Adamas BSU» 157
 220064, Kurchatova Str., 517, Minsk
 tel. (+375 17) 509-27-35, fax (+375 17) 509-23-53,
 e-mail: dg.@almazot.com,
<http://www.bsuproduct.by/index.php/.39...0.0.0.html>,
 Director: Dubrov Genadii Antonovich
- Republican Unitarian Enterprise «Belarusian State Institute of Metrology» 142
 220053, Starovilinskii tract, 93, Minsk,
 tel. (+375 17) 233-55-01, fax (+375 17) 288-09-38,
 e-mail: belgim@belgim.belpak.minsk.by,
<http://www.belgim.by/theme/home/>
 Director: Zhagora Nikolai Adamovich

- Republican Unitarian Enterprise «Belmedpreparaty»** 165, 167
 220007, Fabritsiusa Str., 30, Minsk,
 tel. (+375 17) 228-10-12, 229-37-16, fax: (+375 17) 229-37-16,
 e-mail: market@belmedpreparaty.com,
 http://www.belmedpreparaty.com/
 Director general: Dvoskin Boris Efimovich
- Republican Unitarian Enterprise «Institute BelNIILit** 92, 101
 Mashinistroytelei Str., 28, Minsk,
 tel. (+375 17) 241-89-44, fax (+375 17) 240-03-22
 e-mail: belniilit@mail.ru, http://www.belniilit050.narod.ru/index.html
 Director: Mel`nikov Aleksei Petrovich
- Republican Unitary Enterprise « Machine-Tool Plant «Krasniy Borets»** 87, 99
 211030, Engelsa Str., 29, Vitebsk region, Orsha,
 tel. (+375 2161) 2-63-10, fax (+375 2162)1-81-23,
 e-mail: borets@vitebsk.by, http://www.krasnyborets.com/index.html
 Director: Shul`gin Aleksandr Viktorovich
- Republican Unitarian Enterprise «Special Design and Technological Office «Metallopolymer»** 105
 246007, Fedyuninskogo Str., 4, Gomel,
 tel. (+375 232) 57-91-76,
 e-mail: sktb@sktb.by, www.sktb.by
- Republican Unitarian Enterprise «Hemel machine-tool plant named after S.M.Kirov»** 86
 246050, Internatsionalnaya Str., 10, Gomel,,
 tel. (+375-232) 72-05-43, fax (+375-232) 53-17-96,
 e-mail: StankoGomel@tut.by, http://kirov.server.by/
 Director general: Shevko Aleksandr Aleksandrovich
- Republican Unitarian Enterprise «Minsk Automobile Plant»** 115, 117,
 220021, Socialisticheskaya Str., 2, Minsk 129, 131
 t. /fax (+375 17) 217-96-01,
 e-mail: maz-market@tut.by, http://www.maz.by
- Republican Unitary Research Enterprise «Zapad»«West»** 125
 224022, Suvorova Str., 96/1, Brest,,
 tel. (+375 162) 43-31-59, fax (+375 162) 43-31-59,
 e-mail: skbwest@rambler.ru, http://skbwest.iatp.by/index.htm
 Director: Leshkevich Ivan Vikent`evich

- Republican Unitarian Enterprise «Plant «Transistor»** 69
 220108, Korzhenevskogo Str., 16, Minsk,
 tel. (+ 375 17) 277-29-22, fax (+375 17) 278-29-17,
 e-mail: office@transistor.com.by, www.integral.minsk.by/t
- Republican Unitarian Machine building Enterprise «Kuzlitmach»** 100
 225710, Zholtovski Ave, 109, Brest region, Pinsk.
 t. (+375 165) 37-13-80, fax (+375 165) 37-14-25,
 e-mail: kuzlitmach@belpages.com, http://kuzlitmach.by.ru
- Research Experimental and Designed Republican Unitarian Enterprise «Institute BelNIIS» Minstroiarhitekturi RB,** 55, 58
 220114, Staroborisovskii tract, Minsk,
 tel. (+375 17) 264-10-01, fax (+375 17) 264-87-92,
 e-mail: imdp@nsvs.by,
 http://minstroyarch.gov.by/Predpr/belniis.htm
 Director: Mordich Aleksandr Ivanovich
- Research and Scientific Institution «Institute of Applied Physical Problems named after A.N. Sevchenko» Belarusian State University** 157
 220064, Minsk, Kurchatov Str., 7,
 tel. (+375 17) 212-49-06, fax (+375 17) 278-04-17,
 e-mail: paliishuk@bsu.by,
 www.bsuprodukt.by/index.php/.41....0.0.0.html
 Director: Chernyvsckii Aleksandr Fyodorovich
- Research Republican Unitarian Enterprise «Belautotractobuilding»** 115, 117, 129, 131, 136
 220072, Akademicheskaya Str., 12, Minsk
 t. (375 17) 210-07-49, fax(375 17) 284-02-41,
 e-mail: bats@bats.basnet.by, http://bats.basnet.by,
 Director general: Vysotski Mikhail Stepanovich
- Scientific and production Limited Company (SP. LTD) «Lakshmi»** 22
 220070, Dolgobrodskaya Str., 75, Minsk,
 tel. (37517) 295-14-94,
 e-mail: lakshmi@mail.belpak.by, http://www.autokroy.com/
 Director: Rodionova Olga Leont`evna
- Unitarian Enterprise «Institute Belorgstankinpromm»** 108
 220088, Smilenskaya Str., 15, Minsk
 tel. (+ 375 17) 294-54-11, 294-53-14, fax (+375 17) 283-68-57,
 e-mail: dir@stanki.net, www.machine.solo.by

Unitarian Enterprise «Lasers in ecology, medicine and technology»

31, 43

220023, Makajenok Str., 23, Minsk

t. (+ 375 17) 264-00-20, fax (+375 17) 263-82-00

e-mail: lemt@lemt.by, <http://www.lemt.by/>

Director: Shkadrevich Aleksei Petrovich

Catalogue of innovation projects and elaborations
Issue 13

Responsible for publishing	E.F. Krasnikov
Translation	A.A. Minkovsky
Computer composition	R.A. Olekhovich

Printing by Belarus,
Chernjahovvskogo Str., 3, Minsk, 220049
Licence № 2330/0148775 30.04.2004