NTP CENTR



2015

The scientific and industrial activities of the

UP «NTP «Centr» are focused on the design and production of educational laboratory equipment for educational institutions at all levels. Our purpose is to create technically innovative equipment for the educational process in accordance with the requirements of modern educational technologies.

Since 1991 we have developed and launched the production of more than 300 kinds of products in various technical disciplines. Among our customers there are more than 900 higher and secondary educational institutions of the CIS countries, the EU, Africa and Asia.

The basic concept of our company is to create the most universal laboratory stands in order to reduce the amount of equipment required for the educational process. In the other words, the company implements the idea of «one academic discipline – one stand».





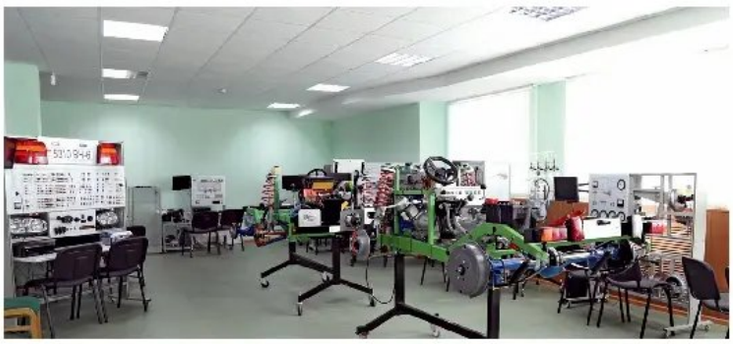






The following creative innovative solutions can be regarded as the features of our stands:

- **the use of a set of interchangeable panels in order to conduct the required set of laboratory experiments and focus students on the investigated object;**
- **the possibility of supplying stands with replaceable blocks depending on the information content of the topics studied;**
- **the use of the mounting jumpers of a fixed length (15 mm), which reduce the probability of incorrect connections in the process of students' work and do not violate the visibility of the mounting plate;**
- **the use of software, which allows students to perform laboratory experiments in the network «PC – stand – interactive whiteboard» in manual and remote modes;**
- **conducting test surveys, circuit simulation experiments on the virtual panel, monitoring graphs of electrical values variation in real time;**
- **automatic collection and processing of the experimental results with printing the report on the results of the work.**





The stands' construction is constantly updated and modernized. We produce stands taking into account customers' thematic plans and educational programs. The company has received a patent for a new block model of the stand «Basis», which provides a possibility to equip its construction with a defined set of removable panels and blocks depending on the list of laboratory experiments or topics studied.

The table modification of a big line of benches, which allows for the simplification, facilitation and price reduction of the equipment design, is an innovation of 2015. The work on providing the most complicated bench models with training videos hosted on the website is successfully conducted. Computer-animated models of physical experiments, which fully reflect all the stages of the work, and the software to synchronize the experiments with the animated model of the processes, were developed. The models can be used for the preparation for laboratory work and for the illustration of the theoretical material.

Our equipment provides a possibility to:

- intensify the educational process maximally by simplifying the laboratory work preparatory phase using an interactive whiteboard;
- exclude mathematical calculations and data processing routine due to automatic graphing and printing reports using software on the PC;
- improve students' cognitive activity and maximize th training effectiveness.

In 2013 the company became a member of the WOLDDIDAC (the global trade association for companies providing products for education).

The company's products are exhibited at the global exhibitions of training equipment held in Astana, Basel, Dubai, Moscow and Jakarta.

High quality of our products is additionally guaranteed by the International Certificate of Quality Management System ISO 9001, which we received in 2010.


СИСТЕМА СЕРТИФИКАЦИИ РУССКОГО РЕГИСТРА
RUSSIAN REGISTER CERTIFICATION SYSTEM

СЕРТИФИКАТ

ISO 9001:2008

More detailed information about the company's products can be found on our website, and the promotional video will make your visit pleasant and informative.

We always welcome your comments and suggestions and we are ready to implement your projects related to educational technical equipment!

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ELECTRICAL ENGINEERING AND BASIC ELECTRONICS
NTC-01.00

The training equipment of the section «Electrical engineering and basic electronics» is intended for laboratory and practical classes in basic subjects of the same name at schools of technical profile. The lists of labs fully correspond to the content of theoretical courses in electrical engineering for non-electrical specialties and in theoretical foundations of electrical engineering for electrical specialties of higher and secondary specialized educational institutions.

Depending on the modification, the stands can be equipped with dial gauges (NTC-01.01, NTC-01.06, NTC-01.07) or digital instrumentation. Stands with the MPMS measuring system, which has 28 measuring channels, allow user to conduct all experiments with a PC through the supplied program «Electronic oscillograph».

A new series of stands «Basis» allows the customer to configure their own equipment for a specific thematic plan: for this purpose the stand is equipped with a specific set of removable panels with pictures of the circuitries (labs), switching jacks, electrical components and controls on their frontal surfaces.

Preparing the stand for work implies the «plug & play» principle: most removable panels are intelligent and the measuring system is adjusted automatically after the stand actuation. So the teacher should just install the selected panel in order to prepare the stand for work. In this stand concept the student is focused only on the investigated circuit or device.

Basis Series

Electrical engineering and basic electronics with MPMS NTC-01.01.B

Structurally the bench consists of three parts:

- basis-bench;
- two-motor electric aggregate;
- set of removable panels.



NTC-01.01.B
Electrical engineering and basic electronics with MPMS

Basis-bench contains repeatedly used modules: input device, regulated and unregulated power sources, power measuring and displaying unit, loads and other devices, as well as working field for removable panels.

Basis-bench can be equipped with different sets of removable panels in accordance with the stated list of labs and allows the user to investigate any of the typical electric machines in any combination of 2 or 3 machines (supplied optionally). Additionally, synchros and rotating transformers can be installed on the bench. For studying tracking systems encoder installation is envisaged. Typically one panel is used for several labs. The circuits are assembled using standard hard switching jumpers at a pitch of 15 mm. Jacks on circuits are arranged in a way which possibly eliminates the students' erroneous actions.

Software and methodological support are supplemented to the stand including knowledge control software package.

Standard Series



NTC-01.01
Electrical engineering
and basic electronics



NTC-01.01.1
Electrical engineering and
basic electronics with MPMS



NTC-01.01.3

Electrical engineering and basic electronics with MPMS M1



NTC-01.06

Theoretical foundations of electrical engineering



NTC-01.06.1

Theoretical foundations of electrical engineering with MPMS



NTC-01.06.2

Theoretical foundations of electrical engineering with MPMS



NTC-01.07

Theoretical foundations of electrical engineering with MPMS

ELECTRONICS, CIRCUIT ENGINEERING, COMPUTING AND MICROPROCESSOR TECHNOLOGIES

NTC-02.00



NTC-02.05
Electronics



NTC-02.05.1
Electronics with MPMS

The technical capability of the stands for «electronics and microprocessor technologies» allows students to acquire practical skills in investigating all the basic components used in modern electronic devices.

A special feature of the stands is the ability to arrange complexity of work according to the principle «from simple to complex», i.e. after studying individual electronic components, students will be able to build a simple circuit based on them, and then combine them into complex functional devices.

The stand «Electronics with MPMS» expands the options of the stand «Electronics» due to an additional module of microcontroller and programmable logic integrated circuit (PLIC), digital multi-channel oscilloscope and expanding the list of laboratory experiments on the basis of the operational amplifier (bandpass filters investigation scheme).

Measurements are conducted by means of a digital measuring complex embedded in the stand and connected to a PC via USB.

Conducting laboratory work is possible in manual mode, and in «dialog with PC» mode.



NTC-02.58

Fundamentals of digital electronics and microprocessor technologies with MPMS

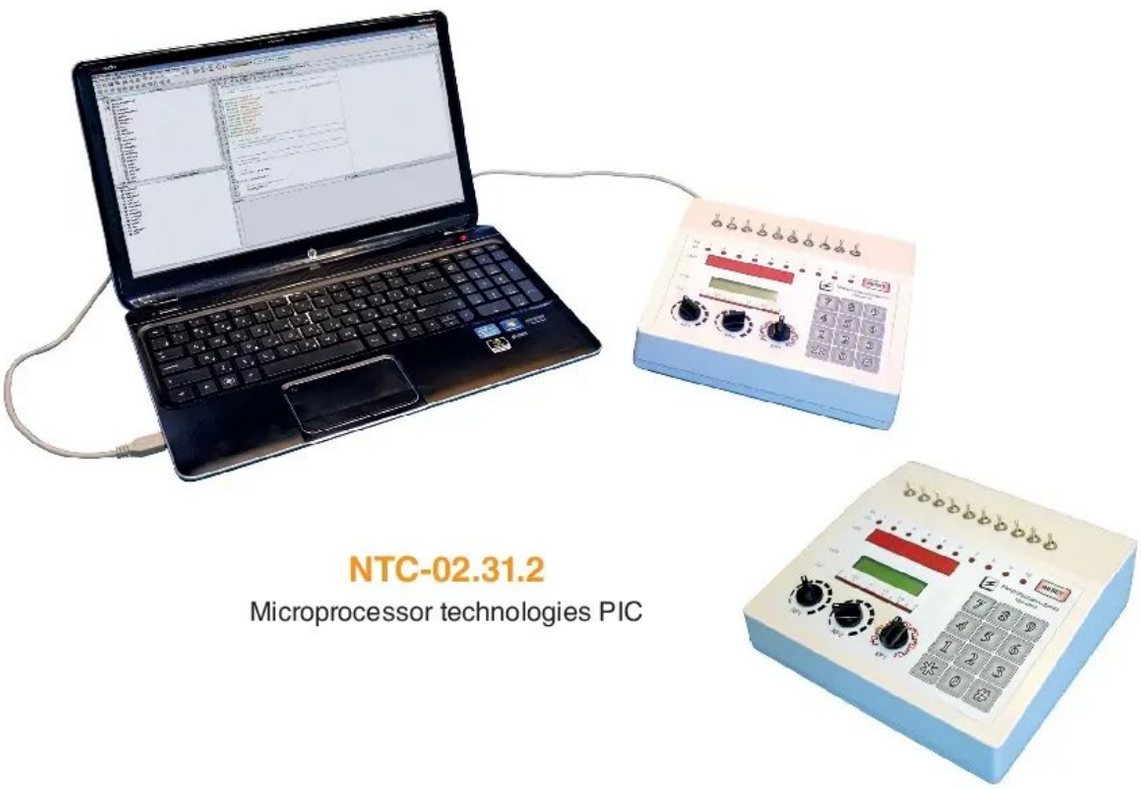
The following software and methodological support is supplemented to the stand:

- testing program for student admission to the laboratory work;

measuring complex software;

- software for work with PLIC and microcontroller;
- methodical and technical documentation set intended for academic staff.

A special feature of the stands for microprocessor technologies is their desktop modification. The stands are used in computer classes and they are designed to study the construction of microcontrollers AVR and PIC. Loading the user program and mode switching are carried out via the PC.



NTC-02.31.2

Microprocessor technologies PIC

RADIO ENGINEERING AND TELECOMMUNICATION
NTC-03.00

The training equipment of this section is intended for demonstrating the construction and studying the basic principles of telecommunication equipment in the course of practical training in telecommunication and radio engineering. The stands are supplemented with industrial hardware devices and replaceable modules for studying basic radio circuits and properties of the elements of fiber optic networks.

Basis Series



NTC-03.04.B

Radio engineering and telecommunication with MPMS

Radio engineering and telecommunication with MPMS NTC-03.04.B

The stand is implemented in «Basis» modification being equipped with replaceable modules according to the subject of the experiment. The product provides conducting laboratory experiments for studying:

- single-stage bipolar transistor amplifier;
- two-stage amplifier with direct bipolar transistor connection;
- emitter follower;
- single-ended push-pull amplifier;
- input receiver circuit with various types of communication;
- amplitude and frequency detector;
- transistor high-frequency generator «inductive oscillatory circuit», «capacitive oscillatory circuit»;
- balanced ring modulator;
- intermediate frequency amplifier with AGC.



NTC-03.53.B

Radio circuits and systems

Radio circuits and systems NTC-03.53.B

Constructively the training laboratory equipment consists of the basis and removable panels. The basis is implemented in desktop modification. It contains a measuring system, a signal generator and a power supply unit. In accordance with the curriculum of the educational institution the stand can be supplied with differents sets of removable panels. A removable panel is a printed circuit board with internal structure or a block diagram of the investigated object depicted on its frontal side. Switching devices are installed there as well. The panels are designed for studying transistors, filters, amplifiers, harmonic generators, modulators-demodulators.

Standard Series



NTC-03.03
Fiber-optic communication

Fiber-optic communication NTC-03.03

The stand is designed for conducting the following laboratory experiments:

- study of optical radiation source and optical power meter;
- study of fiber damage detector and investigation of its parameters;
- experimental measurement of losses introduced by a curved section of an optical fiber at different wavelengths and different radii of curvature;
- study of optical connectors and attenuators and power splitters;
- measurement of dependence of fiber light conductor attenuation on its length;
- investigation of laser LED and phototransistor characteristics;
- investigation of numerical aperture in fiber-optic systems;
- measurement of dependence of dynamic attenuation factor on fiber ends longitudinal and lateral displacements.

Global, local wired and wireless networks NTC-03.05

The stand includes industrial hardware devices and instruments which provide the functioning of telecommunication networks: hardware multiservice router of enterprise class, controlled switch of the second and the third level, uncontrolled switch, wireless access point of standard 802.11n. The stand allows students to study global, local wired and wireless networks and provides the conduction of the following experiments:

- managing controlled switches;
- study of link layer technology and technology of service quality management;
- study of network security principles;
- study of the third level commutation technologies, transport and application levels;
- routing in global networks;
- study of network technologies of Linux operating system;
- infrastructure and efficiency of Wi-Fi networks.



NTC-03.05
Global, local wired and wireless networks

POWER AND CONVERTING EQUIPMENT

NTC-04.00

Basis Series



NTC-04.64.B

Converting equipment with MPMS



NTC-04.84.B

Secondary power sources with MPMS

The laboratory equipment for the discipline «Converting equipment» implemented in «Basis» modification allows students to gain practical skills in investigating basic functional units of electronic power converters which provide power and control of motors. The list of laboratory experiments includes the study of controlled rectifiers, pulse width converters with pulse width and frequency modulation, linear and pulse stabilizer and others.

The feature of «Basis» modification is the ability of supplementing stands with a certain set of removable panels for the implementation of a specific thematic plan. Moreover, there is a possibility of adding new equipment when changing the curriculum.

Most removable panels are intelligent so the measuring system, power source parameters and some other options are adjusted automatically after the stand actuation. The teacher should just install the selected panel, which is also protected from erroneous user actions.

The following software and methodological support is supplemented to the stand:

- methodical and technical documentation set intended for academic staff.
- knowledge control software package for:
  - repeating basic theoretical points studied in the laboratory work;
  - checking students' knowledge before conducting laboratory experiments (theoretical questions, correct circuit assembly, knowledge of the hardware, a step by step control of the understanding of experimental scheme and measuring instruments selection for the implementation of specific educational purposes);
- measuring complex software providing a possibility to:
  - output 2 measuring channels on the same coordinate axes with individual vertical tuning of scale parameters for each of them and with common horizontal tuning of scale parameters;
  - carry out either channel spectrum analysis;
  - register amplitude-frequency response in automatic and manual mode;
  - carry out either channel signal frequency measurement.

The basis-stand can be implemented in stand or desktop modification.

TECHNICAL AND ELECTRICAL MEASUREMENTS
NTC-05.00

The equipment of this section is intended for the acquisition of practical skills in working with measuring instrumentation of various systems, measuring electrical quantities (resistance, power, current, voltage, inductance, and capacitance), checking devices. Depending on the modification the stands are equipped with dial gauges or digital devices.

Non-electric measurements. Temperature measurement NTC-05.01.1

The bench allows for the study of thermoelectric converter and resistance temperature device, the procedure for verification of resistance thermometers and software for work with microprocessor thermometers.



NTC-05.01.1
Non-electric measurements.
Temperature measurement



NTC-05.01.2
Non-electric measurements.
Flow rate measurement

Non-electric measurements. Flow rate measurement NTC-05.01.2

The bench is used for studying the characteristics of ultrasonic, vortex and electromagnetic flowmeters and the influence of fluid temperature and air impurities on measurement accuracy.



NTC-05.05
Process sensors

Process sensors NTC-05.05

The stand is designed for conducting laboratory works that study process sensors and their characteristics:

- static characteristics of current, voltage, tachogenerator and encoder;
- static and dynamic characteristics of temperature sensors;
- static characteristics of linear displacement sensors, proximity switch sensors, angular position sensors;
- static characteristics of pressure sensor.

Multimeters are supplemented to the stand in order to be used as measuring equipment.

Electrical measurements NTC-05.08



NTC-05.08
Electrical measurements



NTC-05.08.1
Electrical measurements with MPMS

Electrical measurements with MPMS NTC-05.08.1

Measurements are conducted by means of a digital measuring complex embedded in stand and connected to a PC via the USB. On the stand panel there are 11 digital measuring instruments of accuracy class not less than 1.0 and 6 analog instruments of accuracy class 2.5.

Digital instruments contain embedded memory 50 for measurements, which makes it possible to perform an automatic series of measurements at intervals of 0.1 seconds with saving the results in memory.

Laboratory work can be conducted in both manual and "dialog with a PC" mode.

Software and methodological support are supplemented to the stand.

Energy audit in housing and utility sector NTC-05.09

The bench enables the thermal mapping of liquid heating system, «warm floor» system, power distribution units, protecting and heat-insulating structures, as well as the study of their actual energy consumption.



NTC-05.09
Energy audit in housing and utility sector



NTC-05.16
Measuring complex

Measuring complex NTC-05.16

The measuring complex is designed for the simultaneous measurement of parameters and studying several forms of electrical signals in the frequency band from 0 to 60 kHz with an amplitude from 0 to 750 as well as for receiving signals of a special shape (sinusoidal, triangular, rectangular, etc.). It consists of a PC, a measuring complex and software required for work. Power is supplied from the PC via the USB. The measuring complex has a signal shaper of different shapes. Selecting the shape and the signal parameters is implemented using the software on the PC.

Training digital device NTC-05.56

The device is designed for using as training equipment at higher and secondary special educational institutions for conducting laboratory and practical classes containing the measurements of voltage, current, power, phase angle. A distinctive feature of the stand is the ability to record 200 instantaneous measured values, with an interval of 0.1 seconds into its own memory. The recorded values can be read using a PC via the USB. The package includes software and drivers for Windows XP, Windows Vista and Windows 7 operating systems.



NTC-05.56
Training digital device

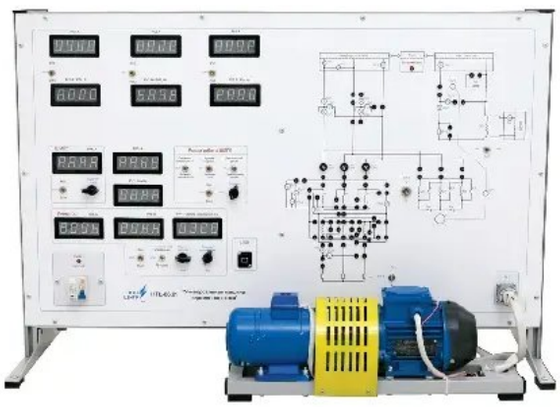
ELECTRICAL MACHINES

NTC-06.00

The laboratory stands of this section are dedicated to studying the basic types of electrical machines:

- **single-phase and three-phase transformers in different modes: idling, short circuit, under load; the external characteristic of the transformer is registered;**
- **groups of three-phase transformer connection;**
- **DC motor and generator with independent excitation (characteristics of idling and the external adjusting characteristics of the generator are registered);**
- **asynchronous squirrel-cage motor, operating and mechanical motor characteristics are registered;**
- **selsyns in indicator and transformer modes;.**

The circuit of the investigated object is assembled using unified jumpers without losing clarity.



NTC-06.1
Electrical machine

Electrical machine NTC-06.01

The bench contains: DC motor, asynchronous motors with squirrel-cage rotor and slip ring, optical speed sensor detecting the direction of rotation. For motor control frequency and pulse width converters are provided. The investigated parameters are recorded by digital devices.

The bench is used for the investigation of:

- two-winding transformer by idling, short circuit mode, and reading its external characteristics;
- three-phase transformers;
- asynchronous motor with squirrel-cage rotor in idling, short circuit mode and under load;
- methods of starting three-phase asynchronous motors;
- separately excited and parallel direct current generators;
- shunt direct current motor.



NTC-06.03
Electrical machines

Electrical machines NTC-06.03

The electrical circuits of studied objects, which are depicted on the front panel, are divided into groups in accordance with the topic of work. There are switching jacks, pointer switchboard instruments, switchgear and controls, which allow user to change the parameters of the elements during the laboratory work, are installed on the panel.

The following electrical machines are installed on the stand:

- asynchronous motor with squirrel-cage rotor UAD-052;
- DC motors with separate excitation SL-221
- tachogenerator;
- contactless selsyns BD1404;

Measurements are conducted using pointer switchboard instruments.

The line of the stands NTC-06.11... NTC-06.15

is designed for studying individual types of electrical machines in accordance with the title of the stand. The circuits allow students to study electric motors using open circuit and short-circuit methods as well as to study natural and artificial mechanical and electromechanical characteristics.



NTC-06.11
Asynchronous electric motor



NTC-06.12
Synchronous electric motor and generator



NTC-06.13
Direct current motor and generator



NTC-06.14
Transformers



NTC-06.15
DC series motor

Electrical machines with MPCS NTC-06.23

The stand provides conducting laboratory work in manual mode, and in «dialog with PC» mode.

Using the software, it's possible to conduct comprehensive laboratory work, in which the student is offered to pass the following stages:

- theoretical test of the studied material related to the work performed;
- assembling, verifying and correcting circuits of the experiment on the virtual panel of the stand;
- conducting laboratory work on the stand.
- If one of the stages fails, the student is not allowed to perform the following stage.

An option of an automatic PC-controlled conduction of the work is envisaged. The circuit should be assembled and the necessary parameters of the experiment should be set. After these operations a completely automatic reading of the machines characteristics is implemented.



NTC-06.23
Electrical machines with MPCS



NTC-06.24
Three-phase asynchronous electric motor with fault simulator

ELECTRIC DRIVE AND CONVERTING EQUIPMENT

NTC-07.00

The training equipment of the section «Electric drive and converting equipment» is used for investigating basic motor control circuits: start in the function of different coordinates, braking and reversing, studying open-loop and closed-loop DC motor control systems, single-phase and three-phase controlled rectifiers, pulse-width inverter and autonomous inverter.

The stands are available in various modifications and implement various sets of laboratory experiments depending on customer's request. They can contain analog or digital devices. As well they can be equipped with embedded microprocessor control system (MPCS) and the microprocessor measuring system (MPMS), which allows user to control measured values in steady-state and transient conditions, to maintain the communication with a PC for simplifying and automating the process of data registration and calculations, to control experiments from a PC screen.

Basis Series

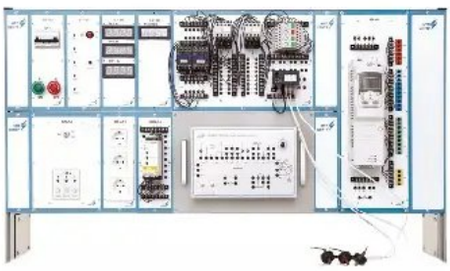


NTC-07.01.B
Converting equipment
for electric drives

Converting equipment for electric drives NTC-07.01.B

The device consists of a basis-bench and a set of removable panels, which allows the user to configure it under the thematic plan of the institution, as well as to purchase additional modules, removable panels when changing the list of labs. Typically, one panel is used for several labs. Most removable panels are intelligent, so measuring system and power source parameters are automatically adjusted when the bench is actuated. The basic set of equipment provides the following labs:

- removable panel NTC-07.01.B/01 "Pulse-width converter":
  - measuring parameters of PWM signals.
  - studying principle of formation and regulation of output voltage of bridge PWM converter with symmetrical and asymmetrical control law.
- removable panel NTC-07.01.B/02 "Autonomous inverter":
  - studying principle of formation and regulation of output and voltage and frequency of autonomous inverter.



NTC-07.37.B
Installation and commissioning of electric drives

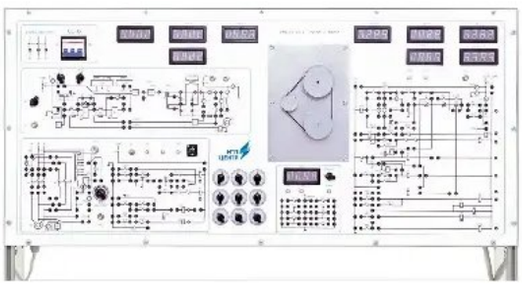
Installation and commissioning of electric drives NTC-07.37.B

The present bench model is made in the modular design and consists of a basis-bench, an asynchronous motor module and a set of removable panels. Basis-bench is implemented on universal aluminum basement and contains aluminum blocks, which are repeatedly used in labs. The blocks are easy to install, and their composition is determined by a list of labs performed on the bench. The basic set of equipment provides the following labs:

- removable panel NTC-07.37.B/01 "Asynchronous motor starting circuit";
- removable panel NTC-07.37.B/02 "Asynchronous motor reverse";
- removable panel NTC-07.37.B/03 "Soft start";
- removable panel NTC-07.37.B/04 "Frequency converter";
- removable panel NTC-07.37.B/05 "Two-speed asynchronous motor".

The bench can be equipped with removable modules and panels for installation and set-up of direct current electric drives.

Standard Series



NTC-07.02
Automated electric drive control



NTC-07.02.1
Automatized electric drive control with MPMS



NTC-07.36
Servo drive

Servo drive NTC-07.36

The stand is designed for acquiring skills in positioning systems programming. As a control device a programmable alpha-controller Mitsubishi is used, as a drive a stepper motor is used, mechanical transmission is «screw-nut.» This stand is available as an addition to the stand NTC 07.24.1 «Electric drive with MPMS» for broadening the options of the latter or for being used as a stand-alone device.

Automated electric drive control with MC NTC-07.02.2

The stand is a modification of the stand NTC 07.02. A modern measuring system in the form of digital instrumentation and a control system based on industrial controller MITSUBISHI AL2-14MR-DR are added. The controller provides a possibility to modify flexibly the algorithm of the executive relay with a variety of different logic functions, calculating features, time delays, analysis of analog and digital signals.

The MC block diagrams are created on a personal computer using special software included in the package. Then the obtained block diagram is stored in the MC memory. The delivery package of the stand already includes ready solutions (block diagrams) for the supposed labs.

The following software and methodological support is supplemented to the stand:

- testing program for student admission to the laboratory work;
- software for alpha-controller MITSUBISHI;
- methodical and technical documentation set.



NTC-07.02.2
Automated electric drive control with MC



NTC-07.24
Electric drive with MPCS

Electric drive with MPCS NTC-07.24

enables the conduction of laboratory experiments of various difficulty levels:

- in fully automated mode (basic level);
- creating custom algorithms of work conduction on the basis of block diagrams;
- creating custom method of work conduction and custom computational part of the research focus;
- conducting real-time mathematical calculations on the measured electrical values and realizing their graphic performance;
- saving the data obtained and working with them when the stand is switched off;
- exporting the data (graphs, oscillograms, estimated data) to office software in order to provide the convenience of the subsequent reporting.



NTC-07.24.1
Electric drive with MPCS M1

Fundamentals of electric drive and converting technologies with MPCS NTC-07.25

The stand is equipped with a microprocessor control system (MPCS), which allows user to control commands to start and stop the drive from the PC screen, to carry out experiments in a fully automatic mode using a command from the PC, to measure current, voltage, speed, to store values at an interval of 0.1 seconds, to plot start/braking graphs in automatic mode.

Relay-switching stand control circuit implements the following operations:

- DC motor resistance start and dynamic braking as a function of current, electromotive force, speed or time;
- asynchronous motor dynamic braking and back-to-back braking.

For studying closed systems the stand is equipped with:

- single-loop DC motor current stabilization system;
- single-loop speed stabilization system;
- dual-loop speed stabilization system.



NTC-07.25
Fundamentals of electric drive and converting technologies with MPCS



NTC-07.30
Electric drive with servo drive – MPCS

Electric drive with servo drive – MPCS NTC-07.30

The laboratory stand is designed for studying automated electric drive, power converting equipment, electric drive control systems and automatic control systems. The product is a modification of the stand «Electric drive NTC-07.24» and it is complemented with a laboratory experiment studying servo drive on the basis of DC motor.



NTC-07.31
Frequency converter OVEN – asynchronous motor



NTC-07.32
Three-phase inverter

ELECTRIC DEVICES, WIRING

NTC-08.00

The electric devices of the stands presented in this section are the basic components of relay-contact circuits. This equipment provides a possibility to get experience in working with contactors, AC and DC electromagnetic time relay, automatic switches, overcurrent relays, thermal relays, thyristor voltage regulators, fuses. On the front panel the wiring diagrams of studied objects are depicted. All these diagrams are divided into groups in accordance with the topic of conducted work. Switching jacks, pointer panel meters, a stopwatch indicator, switchgear and controls, which allow user to change the parameters of the elements during the laboratory work, are installed on the panel.

Installation and setup of electric equipment for enterprises and civil buildings NTC-08.15

The stand provides a possibility to test and study:

- ground loop;
- electric motor with switching devices;
- capacitors for power factor increase;
- lighting network protection;
- fluorescent lamps operation;
- AC electric motor after repair;
- DC electric motor after repair;
- ballasts and power transformers after repair;
- studying apartments lighting installation rules;
- troubleshooting in automated electric drives.



NTC-08.09
Electric devices



NTC-08.15
Installation and setup
of electric equipment
for enterprises and civil buildings

Radio engineering complex
NTC-08.47

The stand is designed for studying repair of television and radio being a wiring table with sockets, instrumentation and power supply unit.



NTC-08.47
Radio engineering complex



NTC-08.47.1
Wiring complex

Wiring complex
NTC-08.47.1

The stand is designed for practical work with students of electrical specialties. The complex structurally consists of a wiring table and additional sets of elements placed on a mounting box. On customer's request the embedded electric unit can provide necessary security systems, power supply units, instrumentation, asynchronous motor fault introduction module, etc. A perforated mounting plate allows user to assemble and dismantle wiring accessories repeatedly.

Relaying and automation MR301
NTC-10.10.2

The stand provides a possibility to:

- study the programming of microprocessor relay MR-301;
- study current changes in line phases in nominal operating mode and with different types of faults (single-, two-, three-phase short-circuits);
- study microprocessor relay MP-301 operation in nominal mode and with different types of faults;
- microprocessor relay MP-301 remote control.



NTC-10.10.2
Relaying and automation MR301

AUTOMATION, AUTOMATICS AND CONTROL SYSTEMS
NTC-09.00

In this section we present training equipment designed for studying the basic components of automation systems and allowing students to investigate the characteristics of individual elements of automatic devices and systems of different difficulty levels: inductive and induction measuring transducers, modulators and demodulators, rotary transformers, selsyns, elements of digital servo systems. A multicomponent stand is designed for laboratory and practical experiments in the disciplines of mechanical engineering dedicated to studying CNC machine tools components and part processing basic programming. The stand is equipped with an industrial computer with touch screen control, inductive sensors and contains a built-up machine tool station allowing user to create machine tool stations of different configuration: lathe, milling machine, etc.

Means of automation
NTC-09.02

The laboratory unit is intended for the development and implementation of automatic control circuits based on programmable logic controllers. The automation object has a frame base with a system of two transparent tanks, a circulation pump, a flow control with proportional control, a flow meter, a pressure sensor, a temperature sensor, a level sensor, and a heating element located on it. The bench is used for the following labs:

- development and testing of level control system;
- development and testing of temperature control system;
- development and testing of pressure control system;
- development and testing of flow control system.



NTC-09.02
Means of automation

Fundamentals of automation
NTC-09.11

The front panel of the stand structurally divided into the following units:

- power supply +5V, ±15V;
- dial gauge unit;
- electric motor and optic coupler unit;
- unit of thermistor, analog and digital angle sensors;
- unit for studying digital and analog circuit technologies: transistor in switching mode, thyristor, relay circuits, comparator, encoder, decoder, counter, basic logic gates, RS and JK-flip-flops, half-adder, comparing circuits, multiplexer, demultiplexer, DAC, memory chips.

Measurements are conducted using the dial gauges.



NTC-09.11
Fundamentals of automation

Fundamentals of automation and computer engineering
NTC-09.12

The equipment provides a possibility to investigate:

- potentiometric and induction measuring transducers;
- modulators and demodulators;
- rotary transformers and selsyns;
- tracking systems with potentiometers, selsyns and rotary transformers;
- linear generating circuits;
- limiter diodes and flip-flops;
- blocking transistor oscillators;
- sawtooth generators;
- elements of digital tracking systems;
- time and digital phase discriminators.



NTC-09.12
Fundamentals of automation and computer engineering



NTC-09.12.1
Automation of production processes and automatics

Automation of production processes and automatics
NTC-09.12.1

The stand provides a possibility to study automatic control systems, including slave systems and tracking systems based on selsyns and potentiometers. The set of the studied components includes programmable logic control devices based on a logic controller (PLC) “Mitsubishi Electric ALPHA-2”, an automatic control system of technological parameters and actuators using PID - controller. The following studied objects are located on the front panel:

- «Alpha-controller»;
- couple of selsyns;
- potentiometric sensors;
- DC motor for servo systems on selsyns and potentiometers;
- executive DC motor with disc;
- thermistor heater;
- optic coupler with photoresistor;
- analog and digital angle sensor.



NTC-09.15
Programmable logic controller – Autonomous inverter

Programmable logic controller – Autonomous inverter NTC-09.15

The bench is intended for studying the structure, the operating principle of logic controller and its basic programming, as well as for acquiring skills in building automation systems with AC motor. The bench contains: Siemens Simatic S7-300 controller with built-in input-output operator control panel with touch screen KTP-600, as well as Simatic NET communication module for connecting the operator panel to the PLC. The bench is used for the following labs:

- study of technical characteristics, command system, and basic programming of controller;
- development of control program;
- use of timers, counters, study of touch screen;
- implementation of algorithms for automatic control in system «PLC – Autonomous Inverter».

Programmable logic controller – Pulse-width converter NTC-09.16

The bench is intended for studying the structure, the operating principle of logic controller and its basic programming using the example of Siemens Simatic S7-300, as well as for acquiring skills in building automation systems with DC motor.

The bench can be used for the following labs:

- study of technical characteristics, command system, and basic programming of controller;
- development of control program;
- use of timers, counters, study of touch screen;
- implementation of algorithms for automatic control in system «PLC – Autonomous Inverter»;
- implementation of algorithms for automatic control in system «PLC – Pulse-Width Converter».



NTC-09.16
Programmable logic controller – Pulse-width converter



NTC-09.21.1
Smart Home

Smart Home NTC-09.21.1

The bench is used for practical work when training specialists in the field of automation of premises. The basic element base and performance characteristics of individual management and control systems as well as techniques of programming events are studied. The front panel contains the following equipment:

- module of discrete sensors (switches, state plumes, humidistat, room thermostat, motion sensors);
- lighting unit (four independent light sources form two lighting zones);
- temperature control unit (simulation of temperature sensors by potentiometers and opportunity to connect real thermal sensors):
- module of proportional actuators (thermostatic valves with proportional control);
- lighting control unit (light sensor which directly controls lighting);
- blinds unit (exterior lighting control).

Labs performed:

- power supply systems, data bus system of central element's connection with peripherals;
- setting up connection of system central element with PC;
- setting central element into operation. System configuration;
- adjusting lighting control system with relay and analog outputs. Central element programming;
- assembly and commissioning of discrete signal input system. Incoming signals operation programming;
- sensors used in control and security systems and their connection to control system;
- lighting control with motion sensors and light sensors.
- temperature control. Events processed by temperature control unit;
- assembly and commissioning of control system for proportional actuators with analogue control;
- programming two-way communication between control system and user via GSM channel.

Smart Home NTC-09.21.2

Recommended labs:

- setting up the connection of «Smart House» system central element with PC;
- assembly and testing of power supply system and data bus system, setting up central element's connection with peripherals;
- assembly of lighting system with contact and analog outputs and central element programming;
- assembly of security system with motion sensor and central element programming;
- assembly and testing of «Smart House» system and central element programming.



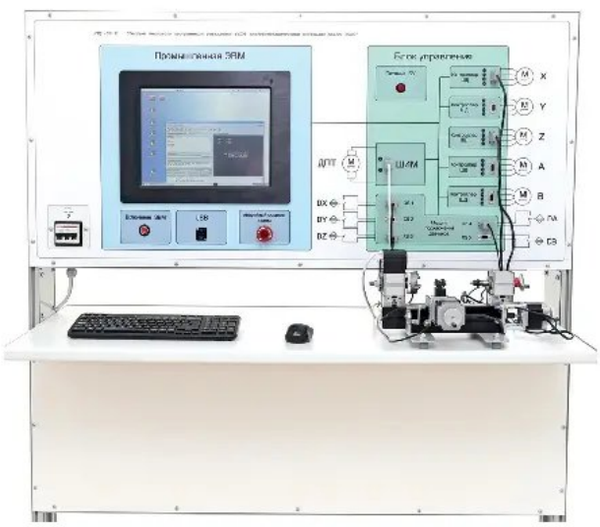
NTC-09.21.2
Smart Home

Computer numerical control system (CNC) of PCNC class electromechanical systems NTC-09.31

We present a stand produced on the basis of industrial equipment components with the following itens installed:

- industrial computer with touch control;
- controller unit with stepper motor;
- pulse width modulator for controlling spindle rotation of the spindle;
- unit of sensors connection;
- power supply units.

The connected equipment includes a built-up machine-tool station equipped with stepper motors, DC motors and inductive sensors mounted on an aluminum built-up frame allowing user to create machine tool stations of different configurations: lathe, milling machine, three-axis horizontal milling machine, three-axis vertical milling machine, vertical milling machine with the axis of rotation A. EMC2 is used as software.



NTC-09.31
Computer numerical control system (CNC) of PCNC class electromechanical systems

POWER SUPPLY, POWER INDUSTRY

NTC-10.00

This section unites training stands for such electrical disciplines as "Power supply for industrial enterprises", "Relaying and automation", "Energy saving technologies", "Cables, wires and couplers." Measurements are conducted using pointer board devices or digital displays. The equipment allows user to analyze the modern ways and means of resources economy: the efficiency of frequency converters, reactive power compensation, the effect of semi-conductor converters for power factor, the energy efficiency of different light sources and others. The software with MPMS allows user to:

- **control all embedded stand systems stand directly from a PC;**
- **check students' knowledge for work authorization;**
- **implement mathematical calculations with measured electrical values and display them graphically in real time as well as export the data to office programs office for report preparation.**

Power supply for industrial enterprises NTC-10.10

The stand is designed for laboratory and practical classes studying certain types of electrical equipment used in the industrial enterprises power supply, in particular:

- studying circuits of current transformers secondary windings;
- testing overcurrent protection with inductive current relay;
- studying transmission line operating modes;
- testing relaying for high-voltage electric motor and step-down transformer.



NTC-10.10
Power supply for industrial enterprises



Power supply for industrial enterprises with MPMS NTC-10.10.1

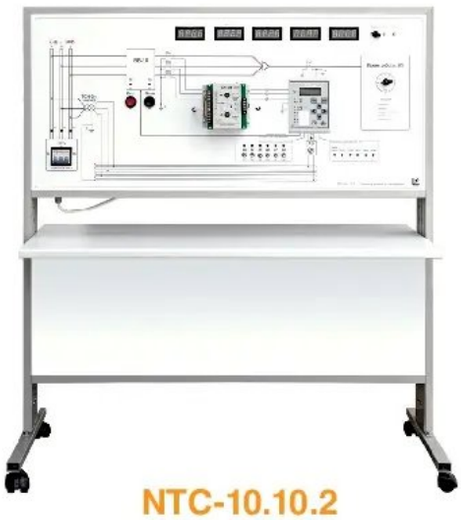
The stand is an improved modification of NTC-10.10. The feature is the use of the built-in microprocessor-based measurement systems (MPMS), which provides displaying the results of measurements on digital displays, improves accuracy, and simplifies the process of data reading.

NTC-10.10.1
Power supply for industrial enterprises with MPMS

Relaying and automation MR301 NTC-10.10.2
Relaying and automation MR500 NTC -10.10.3

The basis of the stand concept is the use of microprocessor relay MR-301 and MR-500. The stands are designed for studying:

- the programming of microprocessor relay, their nominal operation and operation with different types of faults;
- microprocessor relay remote control;
- current change in line phases in nominal mode of operation and in case of one, two, three-phase short circuit;
- set up for receiving digital control signals and issuing relay control commands;
- operation of BPT-615 power supply unit for microprocessor relay protection devices in the operating modes «main power» and «standby power».



NTC-10.10.2
Relaying and automation MR301



NTC-10.10.3
Relaying and automation MR500

Relaying and automation in power supply systems with MPMS NTC-10.66

The stand includes a microprocessor-based measurement system that allows displaying currents, voltages and power values in each of the three phases in static mode on the PC screen. The user can assemble their own circuits with jumpers of various lengths and connect MPMS to measurement channels.



NTC-10.66
Relaying and automation
in power supply systems with MPMS



NTC-10.48
Energy saving technologies.
Autonmous energy system DCM-SG
with MPMS

Energy saving technologies.
Autonmous energy system DCM-SG with MPMS
NTC-10.48

Laboratory work can be conducted in manual mode and in «dialog with PC» mode.

The investigated objects are:

- stand-alone power unit with mixed load;
- three-phase power unit connected for parallel operation;
- efficiency factor and power unit voltage drop;
- methods for synchronizing power units to each other and to network;
- parallel operation of two power units.

Energy saving technologies.
Autonmous energy system ICE-SG with MPMS
NTC-10.48.1

The stand allows students to conduct laboratory experiments studying the autonomous power system with two three-phase generators with internal combustion engines operating on liquid fuel. One of the generators has a mixer for providing the opportunity to operate on generator gas.

The generators have the ability to operate individually and together with the load device in an autonomous system or in parallel with network. It's possible to register voltage and current waveforms of the autonomous electrical system.



NTC-10.48.1
Energy saving technologies.
Autonmous energy system
ICE-SG with MPMS



NTC-10.49
Energy saving technologies.
Power supply with MPMS

Energy saving technologies.
Power supply with MPMS
NTC-10.49

The stand supplies, controls and distributes primary energy resources for different types of load. The power system reproduces in laboratory conditions the reduction of the input power from the transmission line through transformer substation into internal production network. The load unit consists of the rotary unit (DCE-AE) with a frequency inverter and a pulse-width converter, an adjustable resistive-inductive load, lighting devices and a thyristor rectifier with resistive-inductive load. Reactive power compensation in the system is carried out by means of a synchronous machine and store capacitors. The stand is equipped with measuring and computing system based on PC. The energy system of the enterprise reproduced by the laboratory complex is managed and controlled by a PC with software and methodological support.



NTC-10.65
Power quality in electric supply systems with MPMS

Power quality in electric supply systems with MPMS NTC-10.65

The investigated object is a model of a transmission line loaded with an active-inductive load with the ability to connect compensating capacitors.

Distribution networks of power supply systems with MPMS NTC-10.67

The stand allows user to conduct the following laboratory experiments:

- measuring steady-state operating parameters of transformer, power line and open distribution network;
- the impact of reactive power compensation with the use of a capacitor bank on the steady state operating parameters of open distribution network;
- studying power static characteristic by capacitor bank voltage.



NTC-10.67
Distribution networks of power supply systems with MPMS



NTC-10.72
Emulation of transients in power systems with MPMS

Emulation of transients in power systems with MPMS NTC-10.72

The stand provides a possibility to study:

- the modes and the static stability of a simple electric system using electrodynamic model;
- the impact of short-circuit types on the dynamic stability of the power system using electrodynamic model;
- asynchronous mode in a simple electric system;
- mode characteristics of a simple electric system of the two stations of commensurate capacity.



NTC-10.86
Load node static model with MPMS

Load node static model with MPMS NTC-10.86

The stand is designed for using as training equipment at higher and secondary special educational institutions for conducting laboratory and practical classes in«Electric system stability».

Cables, wires and couplers NTC-10.78

The set consists of two floor-standing units with visual aids.

On panel №1 there are samples of cable products (with impregnated paper insulation, armored, with insulation of cross-linked polyethylene, wires for overhead lines). Cables have fan-out, near each sample there is a nameplate with identification, structure deciphering and nominal parameters.

On the panel № 2 there are overhead power line accessories (bracket, link, clip, dead-end clamp, insulators).

On panels № 3 and №4 there are cable coupling samples.



NTC-10.78
Cables, wires and couplers

HYDRAULICS
NTC-11.00

The educational equipment of this section consists of experimental demonstrative stands made of hydraulic devices industrial components and that's their apparent advantage. They are designed for laboratory work in "Hydraulics", "Fluid dynamics", "Water supply and sewerage", "Hydrology and hydrometry", "Water supply and reconstruction of water-supply systems of industrial enterprises", "Water treatment, wastewater treatment technology", "Water intake facilities". The basic equipment includes: a hydraulic station; a gear pump; a pressure filter; hydraulic valves; a pressure relief valve; a manually operated directional valve; two-port or three way flow control unit; an adjustable throttle.

The selection of hydraulic devices of the stands provides the coordination of their pressures and flow rate characteristics, allowing user to conduct studies in different modes, including nominal modes.

The data measuring system of stands provides measuring pressure, temperature, fluid, flow rate, process time.

Hydro piston pump unit
NTC-11.01

The laboratory unit is intended for studying the operating principle and characteristics of hydraulic piston pump and can be used for training specialists in extractive industry.

The bench contains:

- transparent tanks, which simulate layer of liquid, and tank for pumping;
- hydraulic piston (or pneumatic) pump with transparent pipe and piston;
- hydraulic or pneumatic cylinder with position sensors; hydro station or compressor;
- pressure sensors for layer, pump and receiving tank;
- circulation pump for pressure generation and control in layer;
- electromagnetic valve and flow control;
- pressure regulator in receiving tank and level sensor.



NTC-11.01
Hydro piston pump unit

The measuring system provides the indication of time charts from pressure sensors on PC screen, the calculation of the pump capacity, the drive unit power measurement.

The software is designed for work with the bench and allows for the automated process of collection, storage and graphical display of the data obtained in the course of laboratory work. During the operation the software automatically establishes connection with the bench, determines start and

stop of the investigated processes and plots the graphs of the measured values in real time. Research performed:

- study of principle, determination of capacity and reading indicator diagram of hudraulic piston pump;
- determination of drive unit power and pump volumetric efficiency.

Sucker rod pumping unit NTC-11.02

The bench has a frame basement with the following items placed on it:

- transparent tanks, which simulate layer of liquid, and tank for pumping;
- sucker-rod pump with transparent pipe and piston;
- acting model of pumping unit;
- pressure sensors for layer, pump and receiving tank;
- circulation pump for pressure generation in layer;
- electromagnetic valve and level sensor;
- compressor for pressure generation in receiving tank.



NTC-11.02
Sucker rod pumping unit

The software allows for the automated process of collection, storage and graphical display of the data obtained in the course of laboratory work. During the operation the software automatically establishes connection with the bench, determines start and stop of the investigated processes and plots the graphs of the measured values in real time Research performed:

- study of operating principle, determination of capacity and volumetric efficiency of sucker-rod pump;
- reading sucker-rod pump indicator diagram;
- determination of dependence of motor power consumption on pressure in layer and tank.



Outflow through openings and nozzles NTC-11.09.C

The bench is designed for conducting labs in "Hydraulics", "Fluid and gas mechanics", "Water supply and sewerage", "Hydrology and hydrometry".

The following labs are conducted:

- determination of coefficients of outflow and resistance of small opening in thin wall;

NTC-11.09.C
Outflow through openings and nozzles

- outflow through small opening in thin wall at constant head;
- outflow through small opening in thin wall at variable head;
- outflow through nozzles.

The bench has a frame construction with the following items on it: two hydraulic tanks, tray, pump unit, connecting fittings. One of the side walls of the tray is made of organic glass with a grid, which allows the user to measure the coordinates of the resulting jet.

The information and measuring system of the bench enables the measurement of geometric and hydraulic head, flow rate, flowing stream diameter. The bench has closed water circulation, which does not require connection to water supply and sew.

Hydraulics NTC-11.17

There are the following items installed on the stand: a three phase electric motor, a gear pump, a pressure hydraulic valve, a filter, two solenoid valves, two-port flow-control unit, a hydraulic accumulator, mounting plates, connecting fittings and piping.

The stand equipment provides:

- measuring pressure and flow, liquid flow regime identification;
- drawing pressure and piezometric pipe lines. Study of Bernoulli's equation;
- determination of the coefficient of local hydraulic resistance;
- determination of hydraulic friction (coefficient of Darcy);
- studying non-stationary (unsteady) liquid flow through throttle valve.



NTC-11.17
Hydraulics



Hydraulics M1 NTC-11.17.1

The stand is a modification of the educational laboratory stand NTC-11.17: the number of tested objects (local resistance and pipelines) is increased.

On the frame construction of the stand, which is implemented in the form of a unilateral basis with a table, there are two hydraulic panels and electric measuring and control panel. The stand has a hard configuration that does not require any assembly work prior training. The stand includes a hydraulic station.

NTC-11.17.1
Hydraulics M1



NTC-11.17.2
Hydraulics M2

Hydraulics M2
NTC-11.17.2

Proposed research:

- measurement of pressure and flow, liquid flow regime identification;
- drawing pressure and piezometric pipe lines. Study of Bernoulli's equation;
- determination of coefficient of local hydraulic resistance and hydraulic friction (coefficient of Darcy);
- investigation of non-stationary (unsteady) liquid flow through throttle valve;
- investigation of characteristics of volumetric pump used together with safety valve;
- study of construction and investigation of discharge and drop characteristics of hydraulic control valve and one-way restrictor;
- determination of the throttle valve flow rate dependence on temperature of working fluid.



NTC-11.36.1
Hydraulic machines
and hydraulic drives M2



NTC-11.37
Hydraulic
equipment M1

Hydraulic equipment M2
NTC-11.37.1

The stand is a modification of educational laboratory stand NTC-11.37 and it contains a three phase motor, a gear pump, a pressure filter, two pressure hydraulic valves (direct and indirect), a pressure reducing valve (indirect), a manually operated distribution valve, two-port and three way flow control unit, an adjustable throttle.

On the frame there are two stand structural panels: hydraulic and electric. The electric panel contains hydraulic schematic dia-



NTC-11.37.1
Hydraulic equipment M2

gram. In the lower par of the stand there is a hydraulic station and a table with drawers for storing pipes and hydraulic devices. The hydraulic panel contains a plug-board with necessary devices with mounting plates connected with the use of elastic pipes and quick couplings.

Before the new lab the circuit of required configuration must be assembled.

Hydraulics, hydraulic machines and hydraulic drives NTC-11.38

The stand is a joint version of the training laboratory stands NTC-11.17 and NTC-11.36.

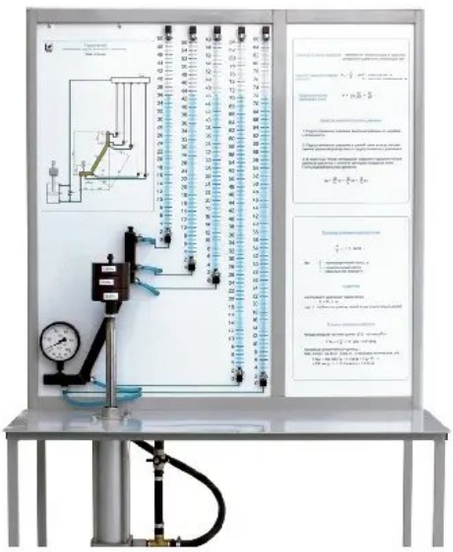
On the stand frame supporting structure implemented in the form of bilateral basis there are four hydraulic panels and three panels with controls, electric measuring elements and principal hydraulic diagrams. The stand has a hard configuration that does not require any assembly before conducting laboratory experiments. Due to the use of two three-phase electric motors for driving pumps, it's possible to determine the input power of the main stand pump accurately, as well as obtain cavitation pump characteristics correctly and to determine the efficiency of hydraulic drive with continuous and rotational motion of output elements. The stand provides the wide range of changing speeds of hydraulic motors output elements and loads on them.



NTC-11.38
Hydraulics, hydraulic machines and hydraulic drives



NTC-11.60
Study of the pumping equipment hydraulic characteristics with MPMS



NTC-11.89
Hydrostatics

Open flows
NTC-11.90

The stand has a closed fluid circulation system.

On the frame there is a hydraulic tank and the pump (monoblock) unit consisting of a centrifugal pump and a three-phase electric motor. The front part of the tray is mounted on the hydraulic tank by means of joint coupling. On the opposite side the tray is supported by the second frame structure, which has a special hydraulic drive with a hydrocylinder and a manual pump providing the tray rotation about the hinges fixed on the hydraulic tank. This allows user to change the tray bottom pitch infinitely. The centrifugal pump output is connected with the tray with elastic pipeline.



NTC-11.90
Open flows

On one of the tray walls on the x and y axes the coordinate grid is drawn. The data measuring system of the stand allows user to measure the local longitudinal velocity and tray input water flow rate as well as the coordinates of the flow free surface.

The stand provides a possibility to conduct:

- measurement and distribution of local longitudinal velocities in open flow cross section. Determination of the Coriolis and Boussinesq coefficients;
- determination of the coefficient of roughness in the channe;
- study of hydraulic jump in a rectangular horizontal tray;
- determination of discharge coefficient of clear overflow rectangular weir with a thin wall without lateral compression;
- determination of discharge coefficient of broad crested weir without lateral compression;
- study of spillway with nappe-shaped profile wall;
- fluid drainage from the bolt;
- study of water free surface on inclined drop.



NTC-11.90.1
Hydraulics: filtering

Hydraulics: filtering
NTC-11.90.1

The stand has a closed water circulation system that does not require connection to the water mains and sewage systems. The working fluid is water.

The stand includes a tray rectangular device, a pump unit, a Darcy device, a hydraulic tank, a data measuring system. An earthen dam is located in the tray.

The data measuring system allows user to measure water flow rate and piezometric heads. The stand provides a possibility to study the flow of water through the soil under different conditions.



NTC-11.91
Hydrodinamics



NTC-11.92
Investigation
of water hammer



NTC-11.94
Hydraulic equipment
with electric proportional control



NTC-11.99
Electric hydraulic automatic
control system

Automated hydraulic drive
NTC-11.95

The laboratory stand has soft configuration. Various circuits of the regulated hydraulic drive with the forward motion of the output element can be assembled. The stand includes two hydroelectric stations. The load on the output element is changeable within wide range. The following objects are studied:

- hydraulic drive with distribution valve and electric hydraulic proportional control;
- hydraulic drive with two-port flow regulator with electric proportional control;
- system with pressure and reducing hydraulic valves with electric proportional control.



NTC-11.95
Automated hydraulic drive

PNEUMATICS
NTC-12.00

The training stand equipment of this section is designed to provide practical skills of work with the basic elements of pneumatic devices in the preparation of specialists in the field of service and automation of production processes, including pneumatic automation control systems construction: pneumatic throttles and pneumatic switches, safety valves and timing pneumatic valves, reducing valves. The "Basis" stand is complemented with a set of educational elements (removable devices), for the assembly of various pneumatic circuits. The devices are mounted on special brackets. The pneumatic circuit assembling is carried out on the stand plug-board.



Pneumatic equipment
NTC-12.01

Suggested investigated elements: directional control valves and pneumatic throttle valves, safety valves, timing pneumatic valves, pressure reducing valves.

NTC-12.01
Pneumatic equipment

Pneumatic automation
NTC-12.02

The stand measuring system allows user to record compressed air pressure, the linear motion of the cylinder rods, the status of the inputs and outputs of the controller.

The equipment allows students to work off the motion control of pneumatic cylinder rods using a programmable logic controller, as well as to adjust and monitor programs in real time.

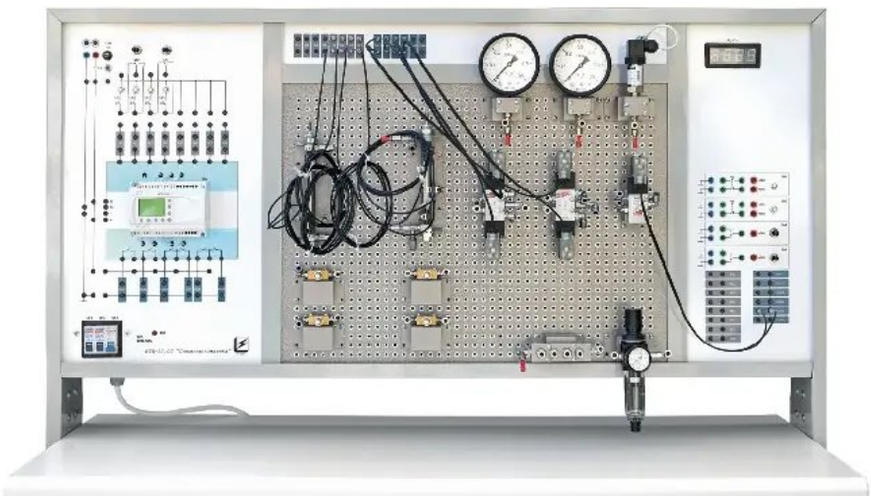


NTC-12.02
Pneumatic automation

Pneumatic automation «Basis»
NTC-12.03

The laboratory stand consists of a basis-stand and a set of training elements mounted on the plug-board. It suggests a primary study of the element base and operating characteristics of the following apparatus:

- determination of local resistance coefficient and the flow rate of pneumatic distributor;
- study of pneumatic systems with a single- or double-acting air cylinder;
- study of characteristics of double-acting pneumatic cylinder with variable load on the rod;
- investigation of pneumatic switches operating characteristics;
- implementing logical operations of control of pneumatic drive based on high pressure elements;
- study of the pneumatic drive with pneumatic input control signal delay;
- study of the electro-pneumatic circuits with signal storage;
- development of electropneumatic drive control systems based on double-acting pneumatic cylinders;
- programming for the programmable logic controller (PLC) Mitsubishi Electric ALPHA-2 using programming environment AL-PCS/WIN-EU on the computer. Recording programs in PLC memory;
- development of algorithm and software for control systems of cylinder rod cyclic movement using distributor 5/3;
- development of algorithm and software for control systems of two cylinders' rods cyclic movement using distributors 5/3 and 5/2 with end-position sensors.



NTC-12.03

Pneumatic automation "Basis"

APPLIED MECHANICS
NTC-13.00

This section provides laboratory-experimental and demonstration equipment for practical training in the disciplines of «Theoretical mechanics», «Strength of materials», «Building mechanics», «Physics», «Applied mechanic». The design feature of the stands is their visibility and open implementation, the possibility of being used as a demonstration model of the experiment in lecture classes. The section contains a wide assortment of equipment covering almost all the topics of the courses. The stands are easy to maintain, reliable and aesthetic.



Applied mechanics NTC-13.01

Structurally the stand is a universal desktop aluminum base on which the investigated object is installed depending on the experiment conducted. Featured experiments:

- study of two-dimensional system of converging forces;
- study of the plane system of forces;
- determination of support reactions of beams;
- the determination of the centre of gravity of plane figures;
- balancing bodies of revolution;
- determination of modulus of torsion;
- determination of linear and angular displacements of the statically determinate beam cross sections;
- determination of deflection at oblique bending;
- determination of principal stresses in torsion and under combined effect of the bending and torsion;
- determination of critical force for compressed great flexibility rod;
- compression testing of straight flexible rods.

Study of two-dimensional system of converging forces NTC-13.01.1

The stand allows students to study the converging forces and determine the magnitude and direction of the resultant force balancing the investigated system.



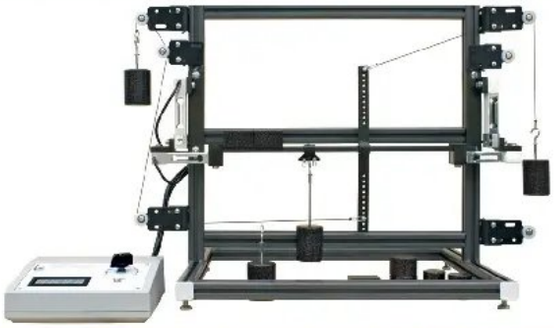


Study of plane system of forces
NTC-13.01.2

The stand allows students to determine magnitude and direction of the moment that balances the sum of moments of forces acting on a solid body with fixed axis of rotation, to demonstrate the dependence of the moment of force about an axis on force line orientation.

Determination of beam reactions
NTC-13.01.3

The stand allows students to model a beam lying on a hinged expansion bearing and hinged fixed bearing, and a reference beam with one end fixed, as well as to determine the magnitude of support reaction of beams.





Determining plane figures centre of gravity
NTC-13.01.4

The stand allows students to determine the coordinates of the centre of gravity of the material bodies of constant thickness and different configurations.

Balancing bodies of revolution
NTC-13.01.5

The stand allows students to determine the static balance of rotating parts changing their unbalance.





Compression testing of straight flexible rods
NTC-13.01.6

The stand allows students to determine the loss of compressive strength; determination of deflections.



Strain digital gauge
NTC-13.01.10

The device is used for measuring deformations at static stress as part of multi-purpose stands of series 13.01.

Determination of modulus of torsion
NTC-13.01.11

The stand allows students to determine the torsional modulus caused by different weight shaft loading as well as to study the stress state of torsional rods.





Determination of linear and angular displacements of statically determinate beam cross sections
NTC-13.01.12

Determination of deflections at oblique bending
NTC-13.01.13





Determination of principal stresses in torsion and under combined effect of the bending and torsion
NTC-13.01.14



Determination of critical force for compressed great flexibility rod
NTC-13.01.15



Determination of friction coefficient
NTC-13.01.16

A combination of four materials for supporting surfaces and linings of rolling bars provides 10 options for friction coefficient.

Natural triangle
NTC-13.02.1

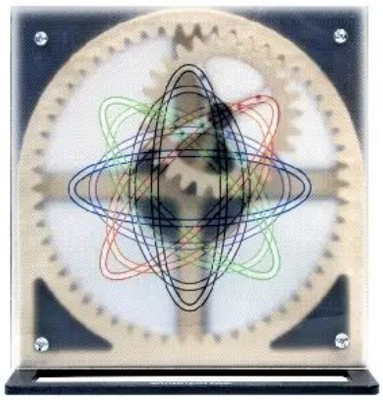
The device demonstrates the natural coordinate axes (tangent, principal normal and binormal), moving along with the point on its path, and the whereness of coordinate planes (tangent, normal and rectifying line).





Euler angles
NTC-13.02.2

The device can show the Euler angles when driving a mobile system of coordinate axes about its centre and the independent Euler angle change when turning a mobile system about the respective axes.



Elliptograph
NTC-13.02.3

The device demonstrates the laws of plane motion of elliptograph ruler, the trajectory of the ruler individual points, the methods of determining the instantaneous velocity centers of the speed and the centroid shape of the elliptograph ruler in a plane movement.

Couple of rotations
NTC-13.02.4

The device allows students to demonstrate rotation addition about parallel axes with equal but oppositely directed angular speeds for external gears, as well as the equivalence of couple of body rotations to one linear motion.



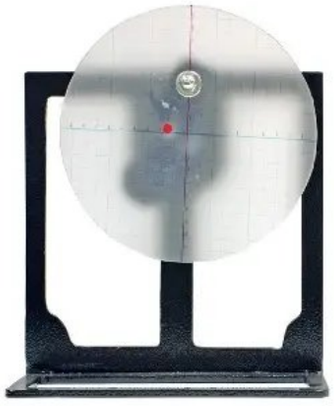


Elliptical wheels
NTC-13.02.5

The device demonstrates the rotation transmission from one body to another with a variable gear ratio, changing periodically.

Rotation axis
NTC-13.02.6

The device demonstrates the position of the instantaneous axis of rotation at a complex body movement (simultaneous rotation around two parallel axes with different size and direction of the angular velocity).



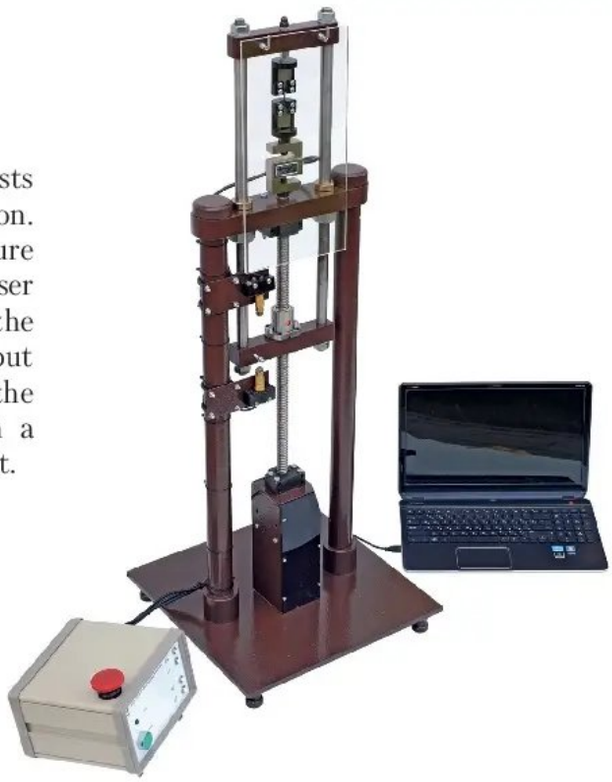


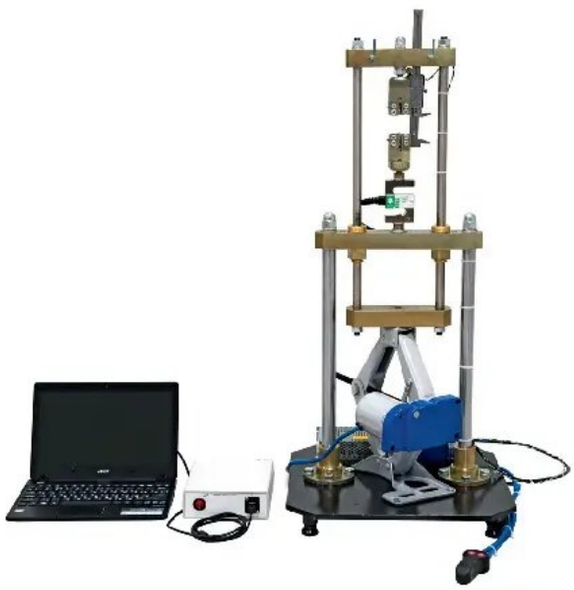
Hinge four-link chain
NTC-13.02.7

The device allows students to study the laws of linear, rotary and flat movement of bodies. It consists of mechanical and electrical parts and includes base, two-stage worm reduction unit driven from the electric motor and the crank on the output shaft, connecting rod and carrier (with the possibility to change their lengths), gearing and a swinging crank arm.

Breaking machine 2000H
NTC-13.04.2

The device is intended for conducting static tests of durability of materials for axial tensile/compression. The machine has a mechanical drive active seizure control operated using a PC. The software allows user to test samples for the specified parameters with the installation of the required test speed. Graphic output of experimental dependencies in real-time and the ability to save the results of the experiment in a separate file facilitates and visualizes the experiment.





Tearing machine 5kN
NTC-13.04.5



NTC-13.04.20
Breaking machine 20000N



NTC-13.04.40
Breaking machine 40000N



Demonstration model «Worm reduction gearbox» NTC-13.09.1

The model serves as a visual aid in studying the characteristics of composition and principles of gearboxes. It provides a possibility to see the worm gear and practically estimate the difference between the moments applied to the input and output shafts by applying manual forces to the handwheel. The model consists of a real gearbox installed on the aluminum frame with soft legs. The gearbox has a housing slit for easy access to the elements of design.

Demonstration model «Cylindrical gear» NTC-13.09.2

The model is designed as a visual aid in studying the composition and principle of cylindrical gearboxes. It provides a possibility to see the helical gear and practically estimate the difference between the moments applied to the input and output shafts by applying manual forces to the handwheel.



HEATING AND THERMODYNAMICS
NTC-14.00

The educational equipment represented in this section combines in its models all the necessary elements of modern heating systems: electric boiler, electric water heater-accumulator, heat pump, tank, radiators, circulation pumps, expansion tank, temperature transducers, flow meters, valves, etc. Special attention is paid to energy saving technologies on the base of heat pump. The stands allow user to visualize the processes occurring in heating, ventilation, and hot water supply, to conduct the necessary experiments for studying construction and operation of heating systems, and to illustrate the appearance and interaction of all components. Some models of stands are implemented as universal basic constructions (NTC-14.61, NTC-14.79, NTC-22.05.1, NTC-22.05.2). Being equipped with respective modules, they provide performing the full range of laboratory experiments in the respective disciplines.

Basis Series

Choking. Gas flow in the narrowed nozzle. Gas flow in Laval nozzle with MPMS NTC-14.61.B

The unit is intended for study and practical development of methods and means of measurement, used in studies of thermodynamic and heat transfer processes in gas streams:

- determination of velocity field of swirling air stream;
- the narrowed air nozzle;
- the air nozzle of Laval;
- air choking.



NTC-14.61.B
Choking. Gas flow in the narrowed nozzle. Gas flow in Laval nozzle with MPMS



Thermodynamic processes with MPMS NTC-14.79.B

Possible investigated processes:

- isothermal, adiabatic, isobaric, isochoric.

NTC-14.79.B
Thermodynamic processes with MPMS

Heat engineering and thermodynamics
NTC-22.05.1.B

The stand is a versatile base construction with integrated measuring system, control module and work surface for the installation of the investigated blocks. Software and methodological support are supplemented to the stand. Featured investigations:

- thermal conductivity of materials using plate method;
- heat transfer by air natural convection around horizontal and vertical cylinder;
- heat transfer of forced air movement in tube;
- adiabatic gas flow through a narrowed nozzle;
- determination of emissivity for electroconductive materials using calorimetric method;
- thermal process in the exchanger of «pipe-in-pipe» type;
- determination of the air viscosity coefficient;
- determination of heat capacity ratio at constant pressure and constant volume;
- technological heat exchanger..



NTC-22.05.1B
Heat engineering
and thermodynamics



Liquid thermal engineering
NTC-22.05.2.B

A universal (basic) design. Being complemented with corresponding modules, it allows students to conduct the following experiments:

- heat transfer in «pipe-in-pipe» liquid movement;
- heat exchanger of «pipe-in-pipe» type;
- operation of heat exchanger with parallel flow and counter flow;
- technical heat exchanger.

NTC-22.05.2.B
Liquid thermal engineering

Energy-saving technologies. Heat supply with MPMS NTC-14.50

The product provides visibility in studying structure and operation of heating systems. The heated chamber is equipped with exhaust ventilation with variable speed, internal and external temperature sensors, and the controller for automatic temperature control. The stand provides the conduction of the following experiments:

- study of the basic characteristics of the devices and the construction of the heating system;
- determination of thermal energy loss in its transportation;
- determination of heat transfer of heating devices;
- experimental study of electric boiler efficiency;
- study of the programmable microcontroller in heat supply system;
- study of automated control system of heat supply;
- experimental research of the efficiency of heat supply system;
- improving the efficiency of heating system by means of the introduction of additional loop with circulation pump.



NTC-14.50
Energy-saving technologies.
Heat supply with MPMS



NTC-14.51
Heating system

Heating system NTC-14.51

The complex heat supply unit is mounted on a mobile platform and includes: aluminum radiators, balancing valves with pressure measuring units, radiator valves and thermostat, circulation pumps, pressure and temperature security group with expansion tank, air valve, an electric water heater.

The measuring system includes a digital thermometer with a remote sensors, differential pressure gauges, thermometers, flow meters, heat meters, meters-analyzers of electrical energy.

The unit is ready for operation; the connection of external heating devices and additional modules is possible.

Energy-saving technologies.
Heat pump with MPMS
NTC-14.52

The heat pump (NIBE FIGHTER) efficiency in heating, hot water supply and ventilation is investigated. The measuring system consists of electronic electric meter and heat meter. The heat meter allows user to measure the temperature of the coolant at the inlet and outlet of the circuit as well as the number of generated or used electric heat. The stand includes software and methodological support.



NTC-14.52

Energy-saving technologies.
Heat pump with MPMS



NTC-14.52.1

Heat pump operating model.
Water-water system

Heat pump operating model.
Water-water system
NTC-14.52.1

A unit for studying the transfer of thermal energy from a source of low-potential heat energy to the consumer (heat transfer fluid) with a higher temperature.

Heat exchangers (evaporator and condenser) are made in the form of copper coils placed in vessels with water. The unit diagram is depicted on the panel.

Heat pump. Industrial design
NTC-14.52.2

The stand allows user to examine the issues of energy conservation by recycling exhaust air heat of the ventilation, the capacity control of air-to-water heat pump and the efficiency of the heating system.

The plant is a monoblock heat pump of air-water system mounted on a mobile trolley and having no front panels for demonstrating the internal structure. The heat pump is connected to mobile platform with mounted heating nodes and distribution units by means of flexible connector.

The measuring system allows user to control the pressure and temperature of the coolant, heat carrier consumption, energy consumption, energy conversion efficiency.





NTC-14.52.2
Heat pump. Industrial design



Heating system controller NTC-14.53

The stand provides studying the possibilities of setting parameters and functions of heating system control using special programmable controller.

NTC-14.53
Heating system controller



NTC-14.62
Air conditioning





NTC-14.57
Thermodynamics.
Reverse thermodynamic cycles (devices)

Thermodynamics. Reverse thermodynamic cycles (devices) NTC-14.57

Recommended experiments:

- heat transfer during freon boiling and condensation;
- refrigerating machine operating cycle;
- operation and the main characteristics of the air conditioner, heat pump and split systems.

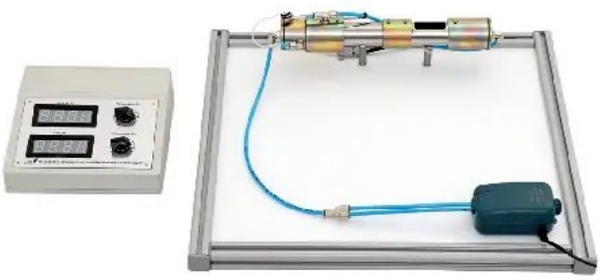


NTC-14.82
Energy-saving technologies.
Study of vortex generator

Energy-saving technologies. Study of vortex generator NTC-14.82

The stand is intended for:

- studying the construction and main characteristics of the heating system devices;
- studying microprocessor temperature control meter;
- determination of heat transfer of heating devices;
- studying vortex heat generator;
- studying the efficiency of the vortex heat generator in the heating system;
- studying heat supply system using vortex heat generator and the ways of regulating its performance.



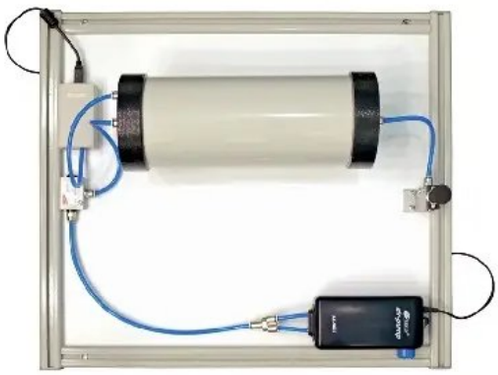
NTC-22.05.3
Determination of air viscosity coefficient

Determination of air viscosity coefficient NTC-22.05.3

The stand is designed for laboratory work in physics. Measuring and control system allows user to measure two differential pressures for determining air flow rate and coefficient of viscosity. Software and methodological support are supplemented to the stand.

Determination of heat capacity ratio at constant pressure and constant volume NTC-22.05.4

The laboratory stand is designed for laboratory work in physics and allows students to determine the ratio of air specific heats using the method of adiabatic expansion.



NTC-22.05.4
Determination of heat capacity ratio
at constant pressure and constant volume

AUTOMOTIVE (CAR-AND-TRACTOR) ENGINEERING

NTC-15.00

The intensive development of the automotive industry, a strong tendency to improving comfort, speed and vehicle performance is accompanied by an unavoidable complication of their electronic and mechanical components. Maintenance and repair of modern vehicles require a high level of staff training in both electrical and mechanical profiles.

This section presents a wide range of training equipment, which provides theoretical and practical knowledge of both basic vehicle schemes and sophisticated electronic control systems and control of the engine and other components. The stands allow user to diagnose both vehicles and farm machinery, to troubleshoot and simulate the process of fault handling.



NTC-15.02
Electrical systems of modern «Belarus» tractor

Electrical systems of modern «Belarus» tractor NTC-15.02

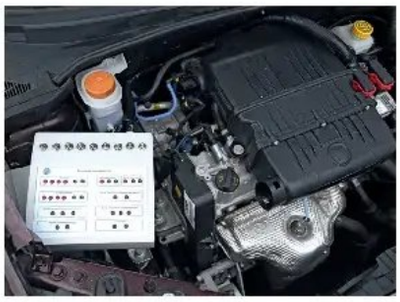
The stand is intended for studying electrical equipment, lighting and sensors and enables staff training for the use of tractors. A fault simulation block provides the simulation of breakage and short circuit of plus wire for all the sensors not included in separate systems.

Electronic system of external consumers distributor section EHS control (BELARUS-3022.1) NTC-15.06

The stand provides training staff for tractor use with joystick control of hydraulic attached equipment, programming, operations, control of EHS hydrodistributor sections on the operating model of one-way plough.



NTC-15.06
Electronic system of external consumers distributor section EHS control (BELARUS-3022.1)



NTC-15.20
Training vehicle with embedded troubleshooting regulator

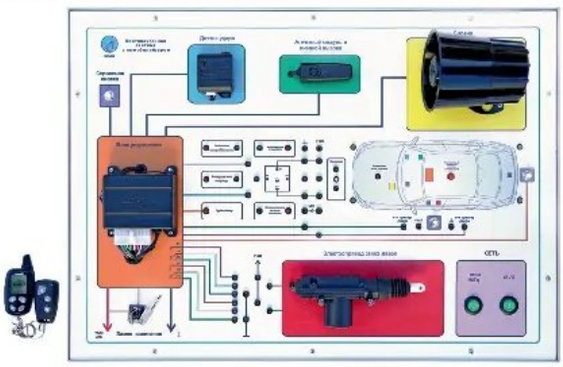
Training vehicle with embedded troubleshooting regulator NTC-15

The stand allows student to examine the device and the operating principle of basic units, components and systems of the vehicle. Inspection openings are designed for visual examination of the components. Built-in fault simulator allows user to simulate various faults of the vehicle electrical system and read the sensor characteristics of the engine control system. A diagnostic scanner provides the diagnosis of systems and components of the vehicle. Additional access to the components is provided by an electrohydraulic elevator.



Antitheft system with immobilizer NTC-15.21

The stand is a panel with structural diagram drawing: antitheft alarm control unit, shock sensor, antenna module with call button, service button, horn, power door, ignition switch and two key fobs.



NTC-15.21
Antitheft system with immobilizer

NTC-15.24
Passenger door with power mirrors and power windows







NTC-15.25
Airbag and seat belt

Airbag and seat belt
NTC-15.25

The stand allows students to conduct multiple tests of the air bag, which is filled using an air compressor. Belt tightener has turning device, which provides the monitoring of its operation in different planes. The stand realizes security system work for different types of shock: frontal, lateral and diagonal. Fault block allows student to study the behavior of security system in case of breakage, shock sensor circuit malfunction, driver and passenger airbags failure, shock sensor short circuit.

Injection system FSI
NTC-15.26

The equipment allows students to study, diagnose and troubleshoot the FSI (Fuel Stratified Injection) gasoline engine injection system:

- engine control by torque;
- engine running with charge stratification;
- engine running on poor homogeneous mixture;
- engine running on homogeneous mixture of stoichiometric
- composition.



NTC-15.26
Injection system FSI



NTC-15.39
Test and diagnosis of tractor steering contrl with hydraulic booster of integral type

Test and diagnosis of tractor steering contrl with hydraulic booster of integral type
NTC-15.39

The following items are mounted on frame construction:

- the front axle of the tractor with hubs and controlled wheels;
- hydraulic booster of integral type and drive with steering wheel.

The stand completely represents tractor MTZ-80 steering control.

In order to represent real operating modes of steering control there is a special simulator of resistance to wheels turn installed on the stand. It allows user to change load on the steering control infinitely and within wide range. A hydraulic booster fault simulator is installed on the stand. It is possible to perform work connected with the verification and adjustment of steered wheels.

The stand control and displaying the results of measurements are carried out using a special console installed on the frame of the stand.

Data measuring system is adapted for work with a PC.

Testing and diagnosis of tractor steering control with hydraulic booster of integral type and hydraulic control system of differential lock NTC-15.39.1

In comparison to the model NTC-15.39 the stand has the following additional features to provide:

- research of hydraulic control of differential lock;
- controling impacts with specified characteristics to the steering wheel and provide their reproducibility.



NTC-15.39.1
Testing and diagnosis of tractor steering control with hydraulic booster of integral type and hydraulic control system of differential lock

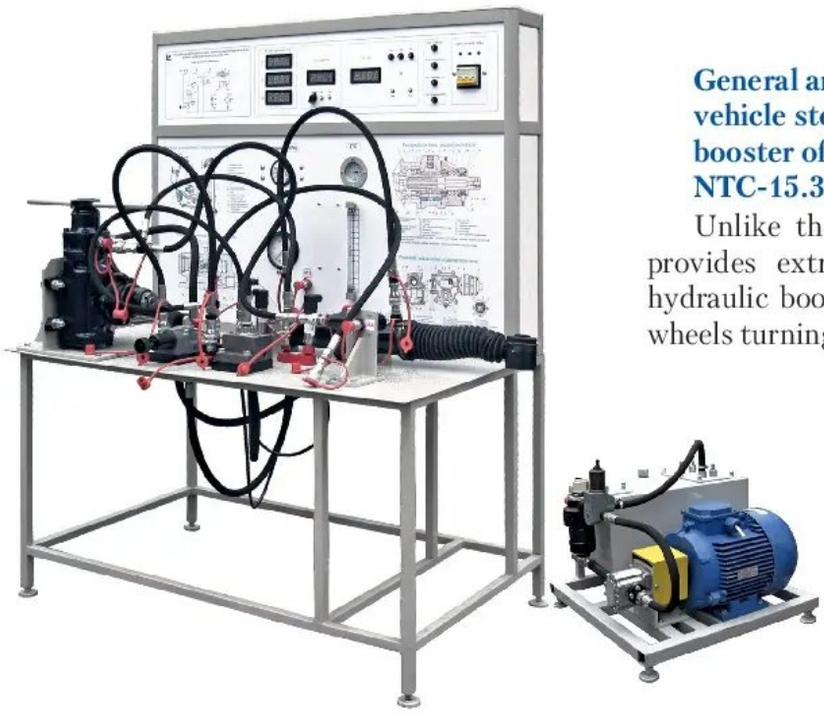
Element testing and diagnosis of steering control with hydraulic booster of semiintegral type NTC-15.39.2

The following items are mounted on frame construction: hydraulic control panel and electromeasuring and control panel. The stand investigates the construction of hydraulic booster MAZ-64229 (other types of devices can be installed on customer's request).

The hydraulic station is implemented as a separate module. The main device installed on the stand are: gear pump, three-phase AC asynchronous motor, pressure filter, pressure hydraulic valve, controlled throttle, hydrocylinder, steering mechanism with hydraulic control, three way flow control. The required configuration of the subsystem is assembled using elastic tubing with quick-disconnecting joints (QDJ).



NTC-15.39.2
Element testing and diagnosis of steering control with hydraulic booster of semiintegral type



General and element test and diagnosis of vehicle steering control with hydraulic booster of semiintegral type
NTC-15.39.3

Unlike the model NTC-15.39.1, this stand provides extra work with common tests of hydraulic booster (with simulated resistance to wheels turning).

NTC-15.39.3
General and element test and diagnosis of vehicle steering control with hydraulic booster of semiintegral type



MPI engine control system
NTC-15.40

The stand provides the following tests:

- engine startup;
- open and closed loop modes;
- modes of braking and accelerating;
- fuel stop control;
- reading characteristics of coolant temperature sensor;
- studying the oxygen concentration sensor output signal;
- reading the characteristics of mass air flow sensor and throttle position sensor;
- studying the output vehicle speed sensor and crankshaft position sensor.

NTC-15.40
MPI engine control system



NTC-15.40.1
MPI engine supply system

MPI engine supply system NTC-15.40.1

Stand can be used for diagnosis and registering the operating characteristics of the elements of the injection engine control system. The stand allows for direct electrical measurements in circuits of studied systems as well as faults introduction with their subsequent diagnosis and adjustment of parameters using any known diagnostic equipment. The product has the option of electronic diagnosis and troubleshooting by using a diagnostic scanner SCANMATIC and its analogues. There is also an option of forced fault introduction and subsequent diagnosis and localization.

MPI engine control system M1 NTC-15.40.2

The bench envisages the opportunity of direct electrical measurements in the circuits of the studied systems, as well as faults introduction with their subsequent diagnostics and parameters control using any known diagnostic equipment of the studied systems of automobile engines. Faults are introduced not from the bench panel (like in NTC-15.40) but using specialized software on a PC.

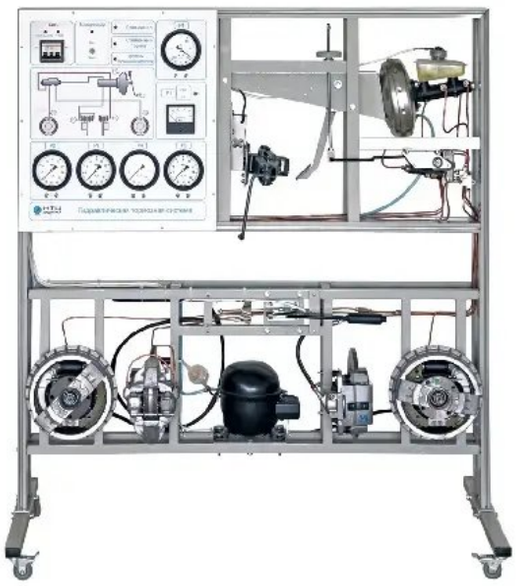


NTC-15.40.2
MPI engine control system M1

Hydraulic brake system
NTC-15.41

The stand includes the hydraulic brake system for the vehicle VAV-2109, including brake master cylinder with vacuum booster, force regulator of the rear wheels, front and rear wheels brake of VAZ-2106 and parking brake system.

On the front panel of the stand there are pressure gauges measuring pressure in servo cylinders and a dynamometer measuring the force formed by the load mechanism and applied to the brake pedal.



NTC-15.41
Hydraulic brake system



NTC-15.41.1
Hydraulic brake system of vehicle with anti-lock brake system (ABS)

Hydraulic brake system of vehicle with anti-lock brake system (ABS)
NTC-15.41.1

The stand contains the hydraulic brake system of VAZ-2109, consisting of the front wheel brake mechanism of VAZ-2106, rear wheel brakes, brake master cylinder with vacuum booster, hydraulic ABS of the vehicle VAZ-2118.

Hydraulic brake system of vehicle with anti-lock braking system (ABS) with MPMS
NTC-15.41.2

The stand has digital indicators showing the average values of pressure in servo cylinders and in two chambers of the master cylinder, vacuum pressure in booster vacuum chamber, the force on the brake pedal, which is generated by a special load mechanism. Instantaneous values of the measured parameters, as well as the ABS hydraulic valve condition, are displayed on the PC monitor. The stand also has wheel speed sensors located near two modulating pulleys. Rotation speed can be set for one of them and the degree of slippage in relation to the first pulley can be set for the other one.

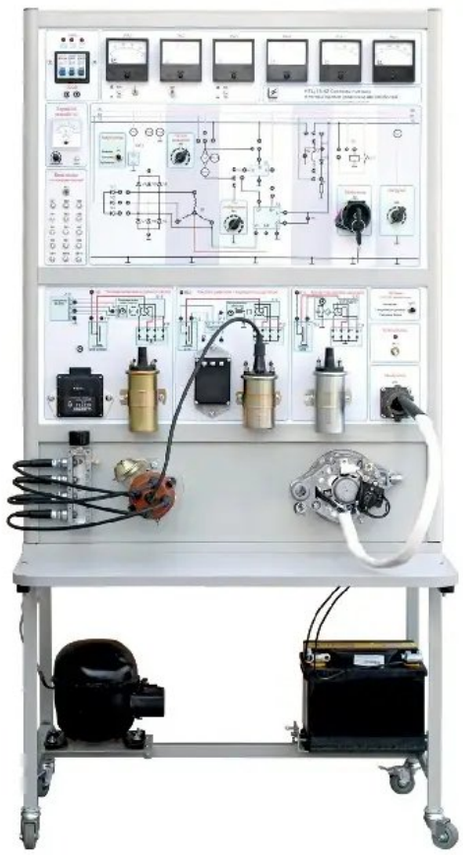


NTC-15.41.2
Hydraulic brake system of vehicle with anti-lock braking system (ABS) with MPMS

Ignition systems and generators of vehicles
NTC-15.42

The technical basis of the unit is thematically and structurally divided into two sections:

- carrying out laboratory and practical training studying the construction and operation of vehicle power supply system based on vehicle VAZ-2109 generator unit with electronic voltage adjuster-relay EE 14V3 Bosch and automotive lead-acid battery 6CT-55;
- carrying out laboratory and practical trainings studying the construction and operation of various types of ignition systems of gasoline engines on the technical basis of engine ignition systems of vehicles VAZ-2106-2109, VAZ, UAZ-469.



NTC-15.42
Ignition systems and generators of vehicles



NTC-15.42.2
Ignition systems and generators of vehicles M1

Ignition systems and generators of vehicles M1
NTC-15.42.2

The stand design allows students to study the functioning of systems in real conditions, the product is a complete emulation of the related systems of motor-vehicle engines. The product provides the possibility of direct electrical measurements in the circuits of studied systems, and the emulation of real faults with their subsequent diagnosis and adjustment of parameters using any known diagnostic equipment for vehicle engine systems.

Unlike NTC-15.42 fault introduction is implemented not from the stand panel but from a PC using specialized software.

Vehicle lighting and light-signalling system
NTC-15.43

The stand allows students to study the operation and troubleshooting of:

- headlight, horn, rear lights, illuminated trafficators, alarm systems;
- power supply for the lighting and signalling devices of the vehicle;
- measuring and control systems and devices.



NTC-15.43
Vehicle lighting and light-signalling system



NTC-15.43.2
Vehicle lighting and light-signalling system

Vehicle lighting and light-signalling system
NTC-15.43.2

Unlike NTC-15.42 fault introduction is implemented not from the stand panel but from a PC using specialized software.



NTC-15.69
Vehicle air conditioning
and climate control systems with MPMS

Vehicle air conditioning and climate control systems with MPMS NTC-15.69

The product entirely represents vehicle air conditioning system with standard hydraulic and electric connections. The stand provides visibility when examining device and the functioning of the system of air-conditioning of the vehicle.

In the measurement system there are digital devices that display the current temperature at the inlet and outlet of the condenser and the evaporator.

Integrated electronic transmission control system (IETCS) of tractor Belarus 3022.1 NTC-15.98

Fault injection unit provides means to simulate the follwing four cases:

- IETCS solenoid wring breakage;
- IETCS pressure sensors disconnection;
- IETCS pressure sensors short circuit;
- power supply overvoltage.



NTC-15.98
Integrated electronic transmission control system (IETCS) of tractor Belarus 3022.1

BUILDING AND CONSTRUCTION EQUIPMENT

NTC-16.00

The training stands of this section is demo-experimental equipment, allowing user to acquire practical skills in the maintenance and repair of the water supply and sanitary engineering equipment of buildings, components and control and measuring i nstrumentation of gas and ventilation systems.



NTC-16.12
Gas distribution point

Gas distribution point
NTC-16.12

A gas pipeline of steel pipe with household gas counters of different types is represented on a mobile installation platform.

There are house gas pressure regulator, gas valves, gas filters, thermo-shutoff valve, flexible gas pipes (steel and rubber) on the stand. Pressure gauges are used in order to control gas pressure in the regulator inlet and outlet. The kit includes an air compressor.

Controlled ventilation of living quarters
NTC-16.22

The stand allows user to examine the system of residential ventilation. The ventilation unit is mounted on a mobile platform and includes an adjustable ventilation unit with cross-heat exchange and electric heater; a mounted piping system with temperature and pressure measurement points; control panel. The kit includes Pitot anemometer.





Automation of building materials manufacture
NTC-16.35

The stand provides the conduction of the following labs:

- measurement of pressure and flow rate of liquids and bulk materials;
- temperature measurement, determination of measurement errors (expansion thermometers of gauge type with a bimetallic sensor element, single-channel meter-controller);
- study of temperature and pressure controllers;
- study of automatic temperature control system;
- study of the system of automatic pressure regulation.

Software and methodological support is supplemented to the stand.



Automation of water supply and water discharge
NTC-16.46

The stand is intended for experimental studies of the two basic types of automatic control systems currently used in water supply: regulation by level; regulation by pressure.

NTC-16.46
Automation of water supply and water discharge

Water supply and water treatment
NTC-16.47

The unit is equipped with nodes of feeding from water mains, measuring devices for hot and cold water flows, electric pump, expansion tanks, batteries, protective equipment for pressure and overheating. Pressure regulator, back-flushing filter, electric water heater 30 l, sink with mixer and drain devices, valves, and check valves for regulating and redirecting the liquid flow are installed on the stand. The measuring system includes digital thermometers with remote sensors, water flow meters, and electric energy meter-analyzer.



NTC-16.47
Water supply and water treatment



NTC-16.48
Electronic plumbing fixtures

Electronic plumbing fixtures
NTC-16.48

The unit is mounted on a mobile platform and includes 3 elements: simulation of a urinal unit with radar electronics, non-contact flushing device, sink mixer with an optical sensor.



NTC-16.49
Isolation valves testing

Isolation valves testing
NTC-16.49

The unit verifies shut-off and adjustment characteristics of cold and hot water valves.

LIFE SAFETY

NTC-17.00

The quality of training the future specialists in the field of professional safety is closely linked with the practical component of this discipline as it allows students to visualize and model the processes that simulate all sorts of dangerous and harmful production factors, which need to be controlled and reduced in order to avoid injury risks in production conditions. The suggested laboratory stands allow students to conduct the full testing of individual and collective protection devices, to familiarize with the rules for their application, and to examine their functioning in different modes.



NTC-17.54.2
Lighting. Inspection of workplace lighting conditions

Lighting.
Inspection of workplace lighting conditions
NTC-17.54.2

The front panel of the stand is implemented as separate fragments of electrical circuits investigated during laboratory experiments: study of linear fluorescent lamps with starter and antistroboscopic scheme for two fluorescent lamps. For registering the dependency of the working surface illuminance on its inclination angle a luxometer-pulsometer is used together with a photometric unit.

Lighting. Lighting equipment
NTC-17.54.3

The circuit of the laboratory experiment is obtained by switching the individual elements of the equipment and measuring devices within the stand experimental area by means of jumpers. The measuring system digitally displays all electrical parameters: voltage, current, active power and angle between current and voltage.



NTC-17.54.3
Lighting. Lighting equipment



NTC-17.55.1
Life safety. Lighting

Life safety. Lighting
NTC-17.55.1

The stand allows user to evaluate the effectiveness of various light sources by two indicators: the value of illuminance and the power consumed by the source of light, which is important in terms of energy conservation. The investigated objects are the effectiveness of the filament light source, with fluorescent and energy-saving lamp.

Life safety. Fire safety
NTC-17.55.2

The stand provides visibility when examining device and operation of fire alarm systems and automatic sprinkler.

The stand panels show the functional diagram of the unit, the description of the most common types of fire extinguishers and fire fighting systems. On the front panel there are fire detectors (thermal, manual, smoke, flame, protective, combined), the control device, access device, banner.

Alarm sensor actuation can be caused by both direct impact (smoke, temperature, radiation) and by using the toggle switches on the panel. The installed equipment provides studying the operation of both individual devices for fire alarm and the system as a whole in various situations: normal operation, fire notification, malfunction, alarm reset, etc.



NTC-17.55.2
Life safety. Fire safety



NTC-17.55.3
Life safety. Electrical safety

Life safety. Electrical safety
NTC-17.55.3

The laboratory stand is designed for studying two basic systems for electrical safety: protection earthing and neutral earthing together with the protective shut-down devices.

There are two types of stand power supply system: three-phase with earthed neutral and three-phase with isolated neutral. The study of electrical safety is conducted with phase wire ground fault of the electric appliance. The physical model of a human is in the contact with the electric appliance body.

The stand provides changing the electrical resistance of earthing circuit, earthed and insulated neutral and human model. This allows students to investigate the effects of these parameters on the strength of the current passing through the human physical model in order to determine the voltage on the body of the electric appliance, as well as to assess the value of the short-circuit current during the actuation of neutral earthing system and shut-down device.

Life safety. Vibration protection
NTC-17.55.4

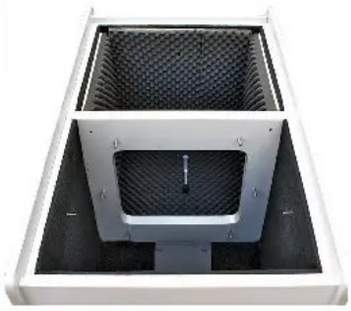
The stand is designed for studying the effects of vibration on different objects. It is performed as a vibration unit mounted on a mobile table with the measurement device. Measurements are recorded by digital vibrometer. Software and methodological support are supplemented to the stand.



NTC-17.55.4
Life safety. Vibration protection

Life safety. Sound insulation and sound absorption NTC-17.55.5





NTC-17.55.5
Life safety. Sound insulation and sound absorption

Life safety. Burglar alarm and video surveillance NTC-17.55.6

The stand provides collaboration and two-way signal exchange between control alarm system and video surveillance system as well as conducting the following experiments:

- study of construction and operation of non-addressable security alarms and detectors;
- study of construction and the programming of advanced control panel A6. Connection of additional modules and devices;
- access devices. Contact groups of programmable relays CONTROL PANEL;
- study of operating principle and features of a separate signaling loop of A6 unit;
- study of the system and its components;
- combined operation of burglar alarm and video surveillance system.



NTC-17.55.6
Life safety. Burglar alarm and video surveillance

Life safety. Methods of air cleaning from gaseous impurities
NTC-17.55.8

The laboratory stand provides the demonstration of various systems of air cleaning from gaseous impurities and studying the methods for the assessment of air quality. The stand is equipped with an aspirator and a set of indicator tubes for measuring concentrations of gasoline, acetone, ammonia, acetic acid in the air.



NTC-17.55.8
Life safety.
Methods of air cleaning from gaseous impurities

Dust chamber for determining dust content of air using mass method
NTC 17.55.10

The bench provides the conduction of the labs to determine the dust content in the dust chamber using mass method. The dust chamber is used to simulate the production area. By means of a special metering unit dust portions are injected into the chamber. Spread by the air flow from the fan, they form dustiness. There is an opportunity of visual control of dust in the chamber. Air sampling is carried out by an electrical aspirator swinging air from the chamber through the filter.



NTC-17.55.10
Dust chamber for determining dust content of air using mass method

HEAT AND HEAT TRANSFER THEORY
NTC-18.00

The laboratory equipment of this section is dedicated to studying the processes of heat transfer for various building materials and thermal energy loss during energy transportation, as well as studying the production and heat transfer and instruments for thermal processes measurement and control. The models are equipped with a microprocessor-based measuring system MPMS allowing user to work both autonomously and in dialog with PC, as well as to process experimental results using a PC.

Basis Series



NTC-18.74.B
Investigation of heat transfer processes with MPMS

Investigation of heat transfer processes with MPMS NTC-18.74.B

The stand consists of the basis case, in which the electrical equipment, the front panel and the integrated desktop with four interchangeable test modules are installed. The front perforated steel panel is intended for the installation of interchangeable modules with heating elements and temperature sensors, providing the following experiments:

- determination of the coefficient of building materials thermal conductivity and its dependence on temperature;
- study of convective heat transfer coefficient on the horizontal and vertical pipes;
- determination of emissivity factor, its dependence on temperature and emissivity for surfaces of two different materials.

Heat engineering and thermodynamics NTC-22.05.1.B

The universal laboratory stand is a basis construction with integrated measuring system, control module and work surface for the installation of the units. The laboratory unit enables the following studies:

- thermal conductivity of materials by the plate method;
- heat transfer with natural air convection around horizontal and vertical cylinder;
- heat transfer of forced air movement in pipe;
- adiabatic process of the gas flow through narrowed nozzle;
- determination of emissivity for electroconductive materials .by the calorimetric method;
- thermal process in heat exchanger of «pipe-in-pipe» type;
- determination of the coefficient of air viscosity;
- determination of heat capacity ratio at constant pressure and constant volume;
- study of technological heat exchanger.



NTC-22.05.1.B
Heat engineering and thermodynamics



NTC-22.05.2.B
Liquid heat engineering

Liquid heat engineering NTC-22.05.2.B

The equipment enables the following experiments:

- study of heat transfer for liquid flowing in pipe;
- study of technological heat exchanger and heat exchanger of «pipe-in-pipe» type;
- study of heat exchanger operation with parallel flow and counter flow.

Standard Series

Energy-saving technologies. Heat supply with MPMS NTC-14.50

The unit provides visibility when studying devices and operation of heating systems. The heated chamber is equipped with exhaust ventilation with variable speed, internal and external temperature sensors, and the controller for automatic temperature control. The stand provides conducting the following laboratory experiments:

- study of the construction and basic characteristics of heating system devices;
- determination of thermal energy loss in energy transportation;
- determination of heat transfer of heating devices;
- experimental study of electric boiler heat efficiency;
- study of programmable microcontroller in heat supply system;
- study of heat supply automated control system;
- experimental investigation of the efficiency of heat supply system;
- improving the efficiency of the heating system by means of introducing the additional loop with circulation pump.



NTC-14.50
Energy-saving technologies. Heat supply with MPMS



NTC-18.54
Study of thermal processes of material heating

Study of thermal processes of material heating NTC-18.54

The stand is designed for laboratory experiments in «Theory of heating and heat transfer» and allows students to investigate:

- characteristics of thermo-EMF of thermocouple;
- energy characteristics of loaded and unloaded furnace;
- softening temperature of various materials.

AERODYNAMICS AND VENTILATION

NTC-19.00

The section is dedicated to the study of the features of ventilation systems for residential and industrial buildings. The laboratory equipment consists of various facilities and devices used in ventilation systems, in particular: centrifugal fan, axial fan, series-connected and in parallel-connected axial fans, speed transducers and pressure transducers.



NTC-16.22
Controlled ventilation of living quarters

Controlled ventilation of living quarters NTC-16.22

The stand provides the study of living quarters ventilation system.

The ventilation unit is mounted on a mobile platform and includes an adjustable ventilation unit with cross-heat exchanger and electric heater; the piping system with temperature and pressure measurement points; the control panel. The kit includes Pitot anemometer.

Study of centrifugal and axial fans with INES NTC-19.83

The stand measuring system allows user to register static and dynamic pressure in the measured area, the fan blading speed, voltage, current, the active power of electric motors. Differential pressure transducers are used for measuring static and dynamic pressure. Software and methodological support are supplemented to the stand. Featured experiments:

- registering the centrifugal fan universal characteristic;
- registering the axial fan universal characteristic;
- study of the axial fans series operation;
- study of the axial fans parallel operation.



NTC-19.83
Study of centrifugal and axial fans with INES

The series NTC-19.83.1, NTC-19.83.2, NTC-19.83.3, NTC-19.83.4
is intended for studying the structure and universal characteristics of centrifugal and axial fans. The study of parallel and sequential operation of fans is carried out using the bench equipment. The measurement system allows the user to record static and dynamic pressure on the dimensional plot, impeller rotational speed, voltage, current, and active power of electric motors.



NTC-19.83.1
Study of centrifugal fan universal characteristic



NTC-19.83.2
Study of axial fan universal characteristic



NTC-19.83.3
Investigation of series operation of centrifugal fans



NTC-19.83.4
Investigation of series operation of axial fans

ALTERNATIVE AND UNCONVENTIONAL POWER SOURCES
NTC-20.00

The equipment presented in the section is dedicated to the experimental research studying energy-saving properties of different heating systems and heating devices: vortex heat generator, solar unit, gas generator unit. Not only does the stand equipment demonstrate the studied objects, but also helps to visualize processes in systems, model experiments, conduct the necessary calculations and process the results using a PC.



NTC-14.82
Energy-saving technologies.
Study of vortex generator

Energy-saving technologies. Study of vortex generator NTC-14.82

The stand is intended for studying:

- construction and the main characteristics of heating system devices;
- microprocessor temperature control meter;
- heat transfer of heating devices;
- vortex heat generator and its efficiency in the heating system;
- heat supply system using vortex heat generator and the ways of regulating its performance.



NTC-20.01
Ways of managing
energy-efficient lighting

Ways of managing energy-efficient lighting NTC-20.01

The bench investigates the following methods of lighting control: via radio channel, via dedicated line based on the DALI protocol, with the use of electric power, and on the basis of ZigBee modules. LED lamps, luminaires with electronic ballasts, and lighting with LED strips are used for laboratory work. Labs envisaged:

- managing via dedicated line on the basis of DALI protocol;
- managing via radio channel;
- managing on the basis of PLC technology;
- managing on the basis of ZigBee modules.

Energy saving technologies in lighting engineering NTC-20.02

The bench is designed for studying "Energy conservation" and "Lighting engineering" subjects in particular section of "Energy conservation". The bench is used for studying the characteristics of: incandescent, halogen, LED, linear fluorescent lamps of low pressure with electronic control gear, compact fluorescent lamps of low pressure. The bench design provides the comparison of the energy efficiency of different light sources, the study of compensation of reactive power consumption and energy saving effect when using motion sensors, photoelectric relays, timers.



NTC-20.02
Energy saving technologies in lighting engineering

Energy-saving technologies. Gas generator unit with MPMS NTC-20.51

One of the concepts in energy conservation is the use of waste products (e.g., wood waste) for heat generation. The stand provides the study of gas generator units, the determination of fuel calorific capacity and efficiency factor, allowing students to evaluate the effectiveness of gas generator unit.



NTC-20.51
Energy-saving technologies.
Gas generator unit with MPMS

Energy-saving technologies. Solar unit with tube collector
NTC-20.82

Energy-saving technologies. Solar unit with flat-plate collector
NTC-20.83

The stands allow user to study the effectiveness of solar energy conversion into heat and the efficiency of solar unit in the heating system. The unit investigates the technology of the use of direct solar radiation for heat generation and its subsequent use for heating and hot water supply. A tube (or flat-plate) solar collector and a water heater (boiler) are mounted on a mobile platform.



NTC-20.82
Energy-saving technologies.
Solar unit with tube collector



NTC-20.83
Energy-saving technologies.
Solar unit with flat-plate collector

ENERGY SAVING
NTC-21.00

This section performs the stands for studying modern ways and means of energy resources conservation: the efficiency of frequency converters, reactive power compensation, the impact of semiconductor converters on power factor, the energy efficiency of different lighting sources, special attention is paid to energy saving technologies on the base of heat pumps and the use of waste products for producing heat energy. The software for stands with MPMS provides:

- **control over all stand embedded systems directly from PC;**
- **checking students' knowledge for work authorization;**
- **performing mathematical calculations with measured electrical values and their graphical real-time display as well as exporting data in Office programs for reporting.**



NTC-10.48
Energy-saving technologies.
Autonomous energy system
DCM-SG with MPM

Energy-saving technologies.
Autonomous energy system DCM-SG with MPMS
NTC-10.48

The laboratory experiments are possible both in manual mode or in dialog with PC. The studied objects:

- autonomous power plant with a mixed load;
- three-phase power unit connected in the parallel operation with network;
- efficiency factor and loss of voltage power plant;
- the way of synchronize power plants among themselves and with the network;
- parallel operation of two power plants.

Energy-saving technologies.
Autonomous energy system ICE-SG with MPMS
NTC-10.48.1

The stand provides conducting laboratory experiments studying the autonomous energy system containing two three-phase generators with internal combustion engine (ICE) operating on liquid fuel. A mixer for operation on generator gas is installed one of the generators.

The generators can operate individually and together with load device in the autonomous system or in parallel with the network. Voltage and current waveforms of the autonomous electrical system can be registered.



NTC-10.48.1
Energy-saving technologies.
Autonomous energy system
ICE-SG with MPMS



NTC-10.49
Energy-saving technologies.
Power supply with MPMS

Energy-saving technologies. Power supply with MPMS NTC-10.49

The stand provides feeding, control and distribution of primary energy resources for different types of industrial load. The power system represents the reduction of input power going from transmission line through the transformer substation to internal network. The loading block consists of electric machine units (DCM-AM) with frequency inverter and pulse-width converter, adjustable active-inductive load, block of lighting devices and thyristor rectifier. Reactive power compensation is implemented by a synchronous machine and capacitor bank. The stand is equipped with measuring-computing system based on PC. The represented industrial power system is adjusted and controlled using a PC with the program-methodical software.

Energy-saving technologies. Heat supply with MPMS NTC-14.50

The product provides visibility in studying the construction and operation of heating systems. The heated chamber is equipped with exhaust ventilation with variable speed, internal and external temperature sensors, and the controller for automatic temperature control. The following experiments are provided:

- study of the construction of the heating system and basic characteristics of its devices;
- determination of thermal energy loss in its transportation;
- determination of heat transfer of heating devices;
- experimental study of electric boiler heat efficiency;
- study of the programmable microcontroller in heat supply system;
- study of automated control system of heat supply;
- experimental research on the efficiency of heat supply system;
- improving the efficiency of the heating system through the introduction of additional loop with circulation pump.



NTC-14.50
Energy-saving technologies.
Heat supply with MPMS



NTC-14.52
Energy-saving technologies.
Heat pump with MPMS

Energy-saving technologies. Heat pump with MPMS NTC-14.52

The heat pump (NIBE FIGHTER) efficiency in heating, hot water and ventilation systems is investigated. The measuring system consists of the electronic meter and heat meter. The heat meter allows user to measure the temperature of the coolant at the inlet and outlet of the circuit, as well as the amount of generated or used electric heat. Software and methodological support are supplemented to the stand.

Energy-saving technologies. Gas generator unit with MPMS NTC-20.51

One of the concepts of energy conservation is the use of waste products (e.g., wood waste) for heat generation. The stand provides studying gas generator units, the determination of fuel calorific capacity and efficiency factor, allowing user to evaluate the effectiveness of gas generator unit.



NTC-20.51
Energy-saving technologies. Gas generator unit with MPMS

PHYSICS
NTC-22.00

The section performs laboratory equipment allowing students to conduct experimental research in all fields of classical physics. The stands are easy to use, clear and provide valid physical experiments with processing results on the PC. Digital indicators and multimeters are used for the registration of measurements.

Basis Series

Electricity and magnetism NTC-22.03

Electricity and magnetism with MPMS NTC-22.03.B

The stand can be completed with different sets of interchangeable panels, allowing students to configure it for specific thematic plan of educational institution, as well as in the subsequently complement it with necessary modules when changing the list of necessary laboratory experiments.

The laboratory stands of "Basis" series are structurally composed of basis-stands and sets of interchangeable panels.



NTC-22.03.B
Electricity and magnetism with MPMS

Molecular physics and thermodynamics NTC-22.05

Heat engineering and thermodynamics NTC-22.05.1.B

The universal laboratory stand is a basic construction with integrated measuring system, control module and work surface for the installation of the investigated units. Software and methodological support are supplemented to the stand. The unit provides the following studies:

- thermal conductivity materials by the method of plate;
- heat transfer with natural air convection around horizontal and vertical cylinder;
- heat transfer of forced air movement in pipe;
- adiabatic process of gas flowing through narrowed nozzle; .
- determination of electroconductive materials emissivity using the calorimetric method;
- process in heat exchanger of «pipe-in-pipe» type;
- determination of air viscosity coefficient;
- determination of heat capacity ratio at constant pressure and constant volume;
- study of technological heat exchanger.



NTC-22.05.1.B
Heat engineering and thermodynamics

Liquid thermal engineering NTC-22.05.2.B

The unit allows students to study the processes of heat exchange fluid in a pipe or heat exchanger:

- study of the heat transfer with fluid movement in the pipe;
- study of the technological heat exchanger and heat exchanger of «pipe-in-pipe» type;
- study of heat exchanger operation in parallel flow and counter flow.



NTC-22.05.2.B

Liquid thermal engineering

Standard Series

Quantum physics and the structure of substances NTC-22.01



NTC-22.01.1

Study of blackbody

Study of blackbody NTC-22.01.1

The stand allows students to acquire the skills in measuring the energy of thermal radiation, as well as to measure the dependence of the power emitted by the body on its temperature.

During the operation the hollow cylinder is heated to a temperature of 400°C. Radiation from the cylinder goes through the hole in the thermal screen and enters the window of radiation receiver. The temperature is measured by the thermocouple using a multimeter.

Study of the external photoelectric effect NTC-22.01.2

The stand allows students to study the light characteristic of photocell and register its current-voltage characteristics. The plant is an optical bench of 500 mm length with a light source and a vacuum photocell. The light source has a collecting lens and optical filters for obtaining the desired wavelength of light. Control and measuring block included, provides adjusting the intensity of the light source, controling and measuring the voltage of the vacuum photocell anode within 0 ... 300V, measuring photocell current.



NTC-22.01.2

Study of the external photoelectric effect



NTC-22.01.3-H

Study of the spectrum of the hydrogen atom

Study of the spectrum of the hydrogen atom NTC-22.01.3-H

The stand allows students to study the spectrum of atomic hydrogen and calculate the Rydberg constant. Constructively the stand is a base of aluminum profile with a computerized spectrometer and gas-discharge light source with power supply. Computerized spectroscope allows user to watch line spectra of diluted gases on the PC and measure the length of the light waves of gas radiation.



Study of the temperature dependence of the electrical conductivity of metals and semiconductors NTC-22.01.4

The unit consists of an electric furnace with the samples (metal and semiconductor) installed in it. Resistance and temperature are measured using terminals on the side of the unit. Software and methodological support are supplemented to the stand.

Determination of the ratio between electron charge and his mass using method of magnetron NTC-22.01.5

The key element of the circuit is a double-electrode electronic lamp with a cylindrical anode consisting of three metal cylinders of the same size. The last two cylinders are electrically insulated from the middle one with gaps being used to eliminate edge effects of the middle cylinder with a milliammeter, which measures the anode current, connected to it. Thin tungsten wire located on the axis of the three cylinder anode system is used as the cathode. Constant voltage is supplied to the lamp anode. The cathode warms up with alternating current generated by a stabilized source. The lamp is placed in a uniform magnetic field generated by Helmholtz coils. The adjustment of the magnetic field values is carried out with electric power supply unit with current stabilization.



NTC-22.01.5

Determination of the ratio between electron charge and his mass using method of magnetron

Optics NTC-22.02



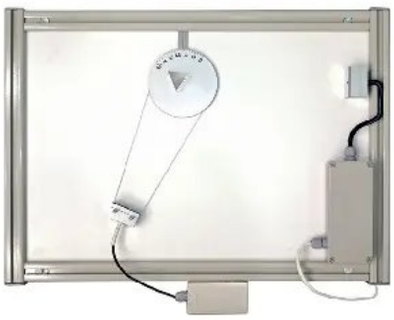
Determination of grating constant NTC-22.02.1

Preparation and investigation of polarized light
NTC-22.02.2

The stand is designed for studying the polarized light of semiconductor laser, the determination of Brewster's angle of the laser light on the glass plate, the refractive index of the glass and verification of Malus' law.



NTC-22.02.2
Preparation and investigation of polarized light



Light reflection from dielectric surface at different angles
NTC-22.02.3

The unit is intended for studying the phenomena of light reflection from the interface of two substances.

Electricity and magnetism NTC-22.03



NTC-22.03.1
Study of solenoid magnetic field using Hall sensor

Study of solenoid magnetic field using Hall sensor
NTC-22.03.1

The stand provides studying the magnetic induction method of magnetic field by using Hall sensor and learning the distribution of the magnetic field along the centre line of the solenoid.

Determination of condenser capacity using discharge method
NTC-22.03.2

The stand provides:

- verification of the law of capacitor discharge;
- determination of relaxation time of the system;
- determination of capacitor capacity.



NTC-22.03.2
Determination of condenser capacity using discharge method

Study of resonance in alternating current circuits
NTC-22.03.3

The stand provides the following experiments:

- resonance in the parallel and series oscillatory circuit;
- free oscillations.



NTC-22.03.3

Study of resonance in alternating current circuits



Study of magnetic field in Helmholtz coils
NTC-22.03.4

The stand provides the following experiments:

- study of dependence of magnetic induction on current flowing to Helmholtz coils;
- experimental study of magnetic induction distribution along or across the axis of the area enclosed between two coaxial circular coils with the same currents of constant value.

Study of ferroelectric properties NTC-22.03.5





NTC-22.03.6

Determination of ferromagnetic material Curie point

Determination of ferromagnetic material Curie point
NTC-22.03.6

Constructively the stand consists of the core of the transformer and the thermometer, voltmeter, on/off switches for heating and voltage of the transformer primary winding. The analyzed transformer with ferromagnetic core consists of two windings – magnetizing and measuring. The core temperature is measured by a high-precision digital temperature sensor located on the core. The temperature sensor signal is fed to the analog-to-digital converter and recorded with an accuracy of ± 0.5°C.

Study of electric current in electrolytes
NTC-22.03.7

The equipment allows students to study electrical conductivity of water, solutions of salt and copper sulphate. The stand includes: a measuring device (voltmeter and ammeter), a power source, a vessel with a cap and electrodes. The kit includes a set of electrodes (copper, zinc, graphite) and solution of salt and copper sulphate.



NTC-22.03.7

Study of electric current in electrolytes



NTC-22.04.1
Atwood's machine

Atwood's machine
NTC-22.04.1

The stand allows students to study rectilinear uniformly accelerated motion of bodies. The unit is a base with a vertical rod on which an optical sensor with adjustable height is fixed, as well as a block with a thread with loads. In the initial position one of the loads is fixed in the lower position with electromagnet fixed on the base and on the opposite load a required number of balance weights is installed. During the experiment the electromagnet is being turned off and, at the same time, the countdown is starting. The loads start to move and the heavier load is quickly descending. When the heavier load passes the optical sensor, the countdown stops.

Study of string natural oscillations
NTC-22.04.2

The stand allows students to determine the shape and the frequency of string vibrations and the velocity of cross wave transmission in a string.



NTC-22.04.2
Study of string natural oscillations



NTC-22.04.3
Oberbeck's pendulum

Oberbeck's pendulum
NTC-22.04.3

The stand allows students to study the rotational motion of a solid body, determine the moment of inertia of the cross-shaped pendulum and friction torque. The unit is a base with a vertical rod on which an optical sensor with adjustable height is fixed, as well as a block with a thread with a load on the end. The second end is attached to a pulley on the cross pendulum axis of rotation. A cylinder that can be fixed with a screw at a distance from the pendulum axis of rotation is put on each pin. In the initial position the thread is wound on the pulley and the cross pendulum is fixed with the electromagnet. During the experiment the electromagnet is being turned off and, at the same time, the countdown is starting. The load starts to move and subsequently the cross pendulum unwinds. Once the load block passes the optical sensor, the countdown stops and the pendulum magnet is fixed again.



Universal pendulum
NTC-22.04.4

The stand allows students to study mathematical pendulum harmonics, determine the gravity acceleration using the method of reversible pendulum. The unit is a base with a vertical rod on which an optical sensor with adjustable height and a support bracket are fixed. The center edge of physical pendulum leans against one of the bracket arms and a ball of mathematical pendulum suspended on the other arm.

NTC-22.04.4
Universal pendulum

Collision of balls NTC-22.04.5

The stand allows students to verify experimentally the law of conservation of momentum, determine the impulses of colliding bodies before and after the collision, kinetic energy recovery factor, average collision force, speeds of colliding bodies.



NTC-22.04.5
Collision of balls



Maxwell pendulum
NTC-22.04.6

The bench provides the determination of the moment of inertia of a solid cylindrical body, the acquaintance with complex motion, and the study of the law of conservation of energy. The bench is a base with a vertical rod on height-adjustable legs. The rod is equipped with an optical sensor, the position of which is height-adjustable. On the upper bracket a rotor with a replaceable ring, which is fixed by an electromagnet, is suspended on the threads. An electronic stopwatch is used for timing the fall of the cylindrical body.

NTC-22.04.6
Maxwell pendulum

Inclined pendulum NTC-22.04.7

The stand allows students to determine the coefficient of rolling friction.



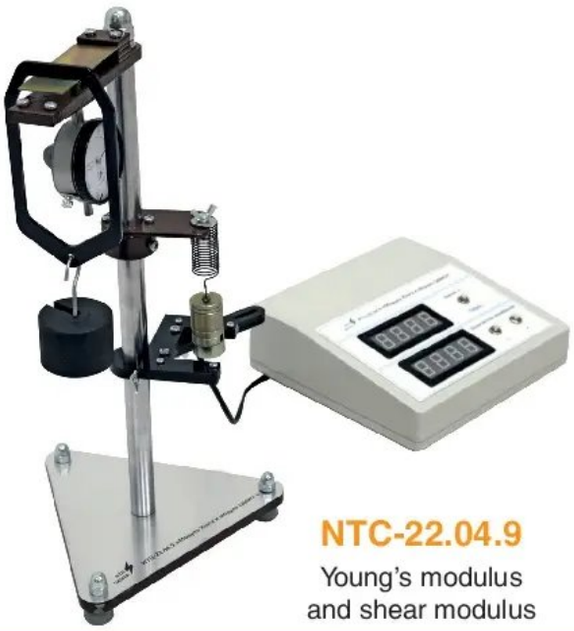
NTC-22.04.7
Inclined pendulum

Unifilar suspension NTC-22.04.8

The stand allows students to determine the speed of contrivance flight using the method of ballistic pendulum and solid body moment of inertia using the method of torsional vibrations.



NTC-22.04.8
Unifilar suspension



NTC-22.04.9
Young's modulus and shear modulus

Young's modulus and shear modulus NTC-22.04.9

The bench is a base with a vertical rod on height-adjustable legs. The rod is equipped with an optical sensor. A beam to determine the Young's modulus is fixed on the upper bracket. The beam deflection is detected by a dial indicator. A spring hung on the bracket is used to determine the shear modulus. An electronic stopwatch is used for timing the pendulum oscillations.

Physical and mathematical pendulums
NTC-22.04.11

The bench provides the study of the harmonic oscillations of the mathematical pendulum and determine the acceleration of gravity.

A vertical rack with an optical sensor moving along it is fixed on the base. A bracket is mounted on the rack. The edge of the physical pendulum is supported by one arm of the bracket. The edge can freely move on the rod after loosening the fixing screw. Loads are fixed on the rod. A ball is suspended on the second arm of the bracket. An electronic stopwatch is used for timing the pendulum oscillations.



NTC-22.04.11

Physical and mathematical pendulums



NTC-22.04.12

Study of damped oscillations

Study of damped oscillations
NTC-22.04.12

A vertical rod is fastened on the bench foundation. At the upper end of the rod a vibration sensor, which is intended for detecting the rod angular deviation, is mounted. The rod is secured in the bearing, which is the axis of rotation. A load, a dry friction element (brush), and a viscous friction element (thin disk) are fixed along the rod. The rod itself can change the point of rotation, changing thereby the moment of inertia.

An electronic module is used to connect the unit to a PC.

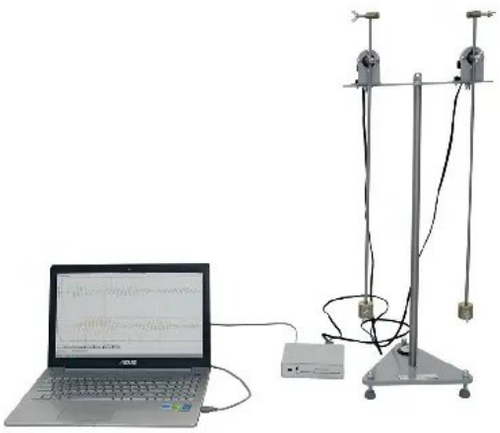
Study of inert properties of solid bodies
NTC-22.04.13

The bench provides the determination of the moment of inertia of solid bodies, using the method of torsion oscillations. A vertical rod with an optical sensor is fastened on the foundation. A rotating frame is suspended on a steel thread on the upper bracket. A clamping plate of the rotating frame can freely move along the rails, changing the area necessary for fixing the test pattern. The thread tension can be adjusted. An electronic stopwatch is used for timing the pendulum oscillations.



NTC-22.04.13

Study of inert properties of solid bodies



NTC-22.04.14
Study of oscillations of coupled pendulums

Study of oscillations of coupled pendulums NTC-22.04.14

The bench provides the study of damped oscillations of physically coupled pendulums.

A vertical rod is fastened on the foundation. A bracket with supports for physical pendulums is fastened at the upper end of the rod. The distance between the axes of the pendulums is adjustable. The angular deviation of the pendulum rod is detected by the oscillation sensor.

A load is fixed along the rod at different distances from the axis, which allows the user to change the period of oscillations. The rod itself can change the point of rotation, changing thereby the moment of inertia. The mechanical connection between the pendulums is performed by a tension spring. An electronic module is used to connect the unit to a PC.

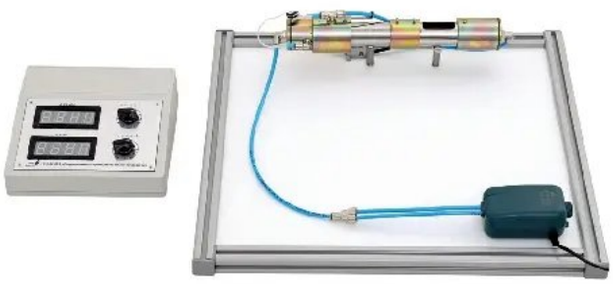
Study of oscillations of thin plates NTC-22.04.15

The bench provides the study of resonant oscillations of a thin metal plate. An oscillation exciter and a bracket for fixing plates are fastened on the foundation. A frequency generator connected to the vibration exciter is used as the source of oscillations.



NTC-22.04.15
Study of oscillations of thin plates

Molecular physics and thermodynamics NTC-22.05



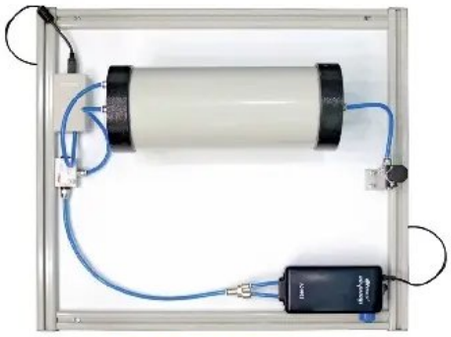
NTC-22.05.3
Determination of air viscosity coefficient

Determination of air viscosity coefficient NTC-22.05.3

The stand allows students to determine experimentally the coefficient of air viscosity using the capillary method. The measuring and control system allows user to measure two differential pressures simultaneously in order to determine the air flow rate and the coefficient of viscosity.

Determination of heat capacity ratio of air at constant pressure and constant volume NTC-22.05.4

The stand allows students to determine the ratio of air specific heats by adiabatic expansion. On the base there are the following items installed: a cylindrical tank, an intake valve, a draining button, a compressor for creating excess pressure and measuring and control equipment. Fittings for pipe connection and differential pressure sensors are installed.



NTC-22.05.4
Determination of heat capacity ratio of air at constant pressure and constant volume



Determination of thermal conductivity of air NTC-22.05.5

The bench provides the visual demonstration of the experiment that determines air thermal conductivity. The software processes the data of multiple measurements and displays information as a graph. The physical process is accompanied by animation in real time.

NTC-22.05.5
Determination of thermal conductivity of air

Determination of sound speed in air NTC-22.05.10

The bench is designed for the experimental determination of sound speed using the method of standing waves. The experimental unit is a transparent plexiglas tube of 1m long. On one side of the tube a speaker is installed, on the opposite side – the plug that performs the role of a sound waves reflector. Along the entire length of the tube microphones are installed at regular intervals.

When the sound source is switched on, the waves passing through the tube are reflected from the plug and create counter fluctuations, which form a standing wave. The graphs of sound vibrations are displayed on the PC screen in real time mode. When changing the radiation frequency between 0 and 500 Hz, the program registers various periods of the standing wave. The laboratory unit is equipped with a computer-animated model synchronized with the experiment.



NTC-22.05.10
Determination of sound speed in air

Measurement of heat capacity of bodies NTC-22.05.12

The bench is designed for the study of the process of heating materials and measurement of their heat capacity. The heating module is a metal housing in which a cylindrical volumetric heater with a tapered bore for mounting the metal test sample is placed. The temperature of metal is measured by a thermocouple mounted in the heater. In the process of operation the power consumption and amount of heat used for heating the sample are displayed on the PC screen. The laboratory unit is equipped with a computer-animated model that fully reflects the stages of work.



NTC-22.05.12

Measurement
of heat capacity of bodies



NTC-22.05.13

Study of first order phase transition – melting

Study of first order phase transition – melting NTC-22.05.13

The bench is designed for studying the processes of metal heating and. A vessel with the investigated metal is placed inside a cylindrical heater. Solder PIC 60 is used as the metal pattern. The heating temperature is measured by an embedded thermocouple. The change of the pattern temperature and the heating element power is displayed in real time in graph form on the PC screen. Using the results of the work, the temperature and the specific heat of fusion of the test pattern is determined. The laboratory unit is equipped with a computer-animated model of the experiment.

Study of thermal characteristics of metals NTC-22.05.15

The bench is designed for studying the heat transfer processes in metal and determining its thermal conductivity.

The heating unit consists of a heating module, cooler, electromagnetic and mechanical clamps, three insulated patterns with mounted thermocouples, and metal foundation.

To perform the experiment, the pattern is placed between the heater and the cooler. The required heating power is set by the regulator, and the pattern's heating starts from one side simultaneously with its cooling from the other side. Along the entire pattern length at regular intervals temperature sensors are installed. The information from them is transmitted to the PC. The software detects the temperature distribution along the rod at equal time intervals. Thermal conductivity is calculated when processing of the obtained measurement results.

The laboratory unit is equipped with a computer-animated model of the experiment.



NTC-22.05.15

Study of thermal characteristics of metals

REFRIGERATING AND CLIMATE CONTROL EQUIPMENT

NTC-23.00

The laboratory stands, presented in this section are designed for studying the construction and operation of industrial refrigerating and air conditioning systems for vehicles and industrial buildings. The stands contain the industrial models of air conditioners, refrigerators, temperature sensors, humidity sensors, pressure sensors and digital devices. The information displayed on the stand panels can be displayed and processed on the PC.



NTC-14.57
Thermodynamics.
Reverse thermodynamic cycles
(devices)

Thermodynamics.
Reverse thermodynamic cycles (devices)
NTC-14.57

The stand measuring system includes electricity meter, anemometer and digital devices that display the current pressure on the inlet and outlet of the compressor, the temperature at the inlet and outlet of the condenser and the evaporator, the temperature and humidity in a removable box, which covers the indoor air conditioner unit. The stand allows students to study:

- operation cycle of refrigerating machine;
- operation and the main characteristics of air conditioner, heat pump and split system;
- heat transfer during freon boiling and condensation;.

Air conditioner remote control and 485 interface for communication with the PC are installed on the panel.

Air conditioning and climate control of vehicle with MPMS
NTC-15.69

The product entirely represents vehicle air conditioning system with standard hydraulic and electric connections. The front panel of the product contains the functional diagram of the vehicle air-conditioning system, power switch, measuring system indicators. The visibility in studying the construction and operation of air conditioning systems is provided. The measurement system contains digital devices displaying the current temperature at the inlet and outlet of the condenser and the evaporator.



NTC-15.69
Air conditioning and climate control
of vehicle with MPMS



NTC-23.63
Study of refrigeration unit with MPMS

Study of refrigeration unit with MPMS NTC-23.63

The stand provides visibility when studying the construction and operation of industrial refrigerating systems.

The product consists of a control and measuring system and a testing unit.

The system of measurement contains electricity meter and digital devices displaying the current pressure at the inlet and outlet of the compressor, the temperature at the inlet and outlet of the condenser and the evaporator, temperature in the sliding box. Pressure and temperature sensors embedded in coolant motion loop. On the measurement and control system panel a USB-connector is installed for communication with the PC.

Study of climate control circuit in greenhouse and vegetable store NTC-23.68

The stand is composed of flowing fan with heater and valve, split system, air dryer, ultrasonic air humidifiers, humidity and temperature sensors, two dual-channel meters-controllers, digital voltmeter, control panel and heat chamber.

Featured investigations:

- characteristics of humidity and temperature sensor;
- devices for maintaining room temperature;
- systems of air conditioning, humidifying and drying;
- temperature control circuit for vegetable store and greenhouse.



NTC-23.68
Study of climate control circuit
in greenhouse and vegetable store

THEORY OF COMBUSTION PROCESSES
NTC-24.00

The laboratory equipment suggested in this section allows students to conduct the experimental investigation of combustion processes, properties and the mechanism of burnout by means of cooling. The units can be safely used while conducting experiments in laboratory conditions in order to simulate potentially hazardous processes for theoretical and practical training of specialists for the Ministry of emergency situations.

Study of flame structure NTC-24.01

The unit provides experiments associated with investigating flame zones at different heights in diffuse and kinetic combustion.

The stand is a set of desktop equipment. The gas burner is equipped with mixer for mixing fuel gas with air. Air and gas consumption is regulated by means of valves. The flame zone temperature is measured by a thermocouple mounted on a tripod and height adjustable along the flame front. Readings are recorded using the measuring instrument. Gas is supplied to the mixer from a balloon, the air is supplied from a compressor receiver. The stand is equipped with a compressor.



Study of flame structure **NTC-24.01**

Investigation of burnout by means of cooling NTC-24.04

The equipment is intended for experiments related to studying the mechanism of burnout with cooling, and it consists of a pumping unit and a pallet. The pumping unit is an automatic pump with hydraulic accumulator and pressure switch. The unit is additionally equipped with a water meter, a tap at the outlet and a check valve on the suction line. The pallet is a steel grid intended for simulating the fire. The pallet is equipped with drainage for fire-extinguishing fluid.



NTC-24.04
Investigation of burnout by means of cooling

LABORATORIES











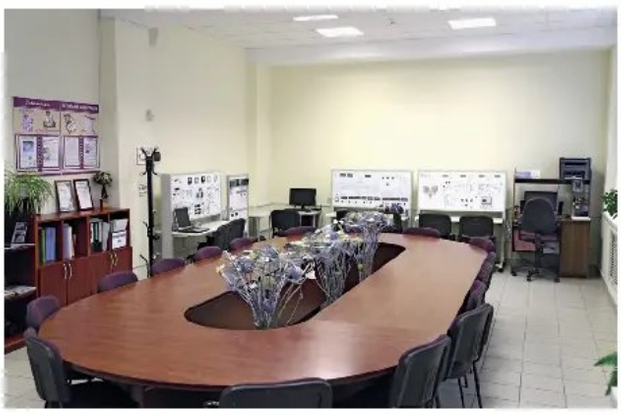




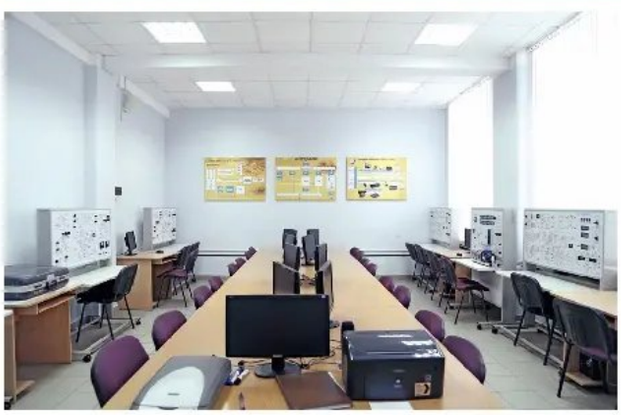




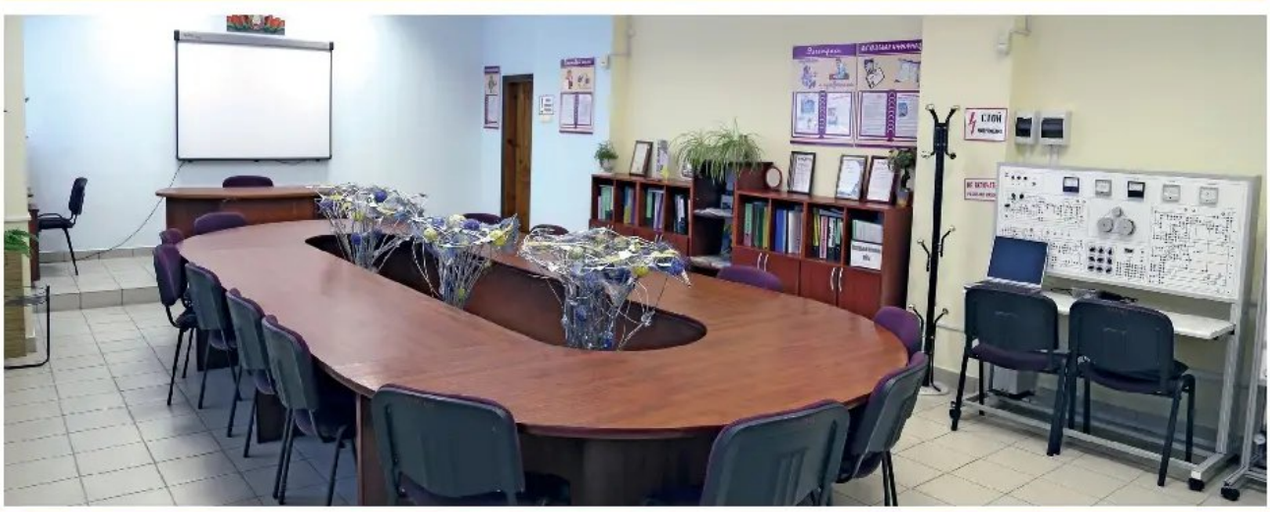












SALES GEOGRAPHY (MAP)



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