

Dynamic system

LABOTRIX DYNAMO K1

PRODUCT PASSPORT

Kyiv

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1. General Information about the Product

- 1.1. **Product name** — Dynamic system.
- 1.2. **Trademark** — Labotrix.
- 1.3. **Model** — Dynamo K1; full trade designation — LABOTRIX DYNAMO K1.
- 1.4. **Manufacturer** — Labotrix Group Limited, China.
- 1.5. **Intended use:** a set of equipment for conducting practical and demonstration experiments in physics on the topics of kinematics and dynamics of rectilinear motion in general secondary education institutions. Using the system, students study the uniform and uniformly accelerated motion of a body on an inclined plane, the effect of forces on motion in accordance with Newton's first and second laws, the conservation of momentum and energy, as well as elastic and inelastic collisions. Reduced friction in the “cart — track” pair increases measurement accuracy and brings the experimental results closer to theoretical calculations.
- 1.6. **Design features:** the base of the system is an aluminum guide track of rectangular cross-section, 1.3 m long, with a millimeter measuring scale (graduation value 1 mm) and an adjustable tilt angle from 0 to 45 degrees. Two plastic carts move along the track on low-friction wheels, ensuring smooth and uniform motion. The set includes a pulley, a stationary support (column) for track fixation, a fixed block, springs, and additional weights to extend the range of experiments. The design allows external digital sensors to be connected — force, position, and optical photogates.
- 1.7. **Digital learning support:** together with the product, the right of access to an online teaching support course is transferred; the course is hosted in a learning management system (LMS) and is designed for 70 academic hours of lessons. The course is compiled to match the current curricula of general secondary education institutions of Ukraine. The materials are grouped into research modules in the subjects of physics, biology, chemistry, STEM, and every topic contains a lesson plan, a list of the required equipment, an experiment scenario, a step-by-step laboratory work instruction with an explanation of the expected result, a video demonstration of working techniques, interactive exercises and tasks for independent study, suitable both for individual and for group work. All modules are compiled for this very equipment and have been tested on it, therefore the course works along the direct chain “equipment → methodology → learning outcomes”. A language-model-based assistant with retrieval over the course knowledge base (Retrieval-Augmented Generation) is built into the course: for the topic of the lesson it selects appropriate experiments, sets out the sequence of conducting the study in methodological terms, examines typical student errors and gives personal advice on how to get rid of them, changes the level of difficulty to match the preparation of a particular class and helps to draw up a report on the study and to organize the conclusions. The knowledge base of the assistant is localized and aligned with the Ukrainian curriculum. The license for the course and the accompanying software is valid for 12 months from the date on which access is transferred; the content, the interface and the answers of the assistant are provided exclusively in Ukrainian.

2. Technical Specifications

- Brand — Labotrix
- Model — Dynamo K1
- SKU — LTX-DYNAMO-K1
- Equipment type — demonstration and laboratory setup for studying mechanics
- Material of the guide track — aluminum
- Length of the guide track — 1.3 m
- Measuring scale on the track — millimeter, graduation value 1 mm, for determining the distance traveled
- Material of the carts — reinforced plastic
- Number of carts in the set — 2 pcs
- Maximum tilt angle — from 0 to 45 degrees
- Locks for stopping the cart included — yes, 2 pcs
- Photogate sensor holders (pcs) — 2
- Signal transmission to the photogates — light barriers (flags) on the carts
- Ability to connect external digital sensors — photogates, force sensors, and position sensors
- Method of cart movement along the track — on wheels, with reduced friction
- Material of the pulley and block — metal with a plastic coating
- Springs included in the set — yes, 2 pcs of different stiffness
- Additional weights — 250 grams, 500 grams (set)
- Nylon thread — included in the set for attaching weights
- Power — not required
- Operating conditions — premises of an educational institution, air temperature from +5 to +40 °C, relative humidity from 40 to 60 % without condensate
- Digital learning support — online course in a learning management system (LMS)
- Course volume (academic hour) — 70
- Course subjects — physics, biology, chemistry, STEM
- Composition of the materials — research modules, experiment scenarios, step-by-step laboratory work instructions, video demonstrations, interactive exercises and tasks
- Compatibility of the materials with the equipment — full, along the chain "equipment → methodology → learning outcomes"
- Language-model-based assistant — built into the course, with retrieval over a localized knowledge base (Retrieval-Augmented Generation)
- Validity period of the license for the course and the software (month) — 12
- Language of the course, of the interface and of the answers of the assistant — Ukrainian
- Language of marking and operating documentation — Ukrainian
- Product marking — includes the trademark, model name, and space for an inventory number
- Product packaging — individual corrugated cardboard box with content fixation
- Documentation supplied — product passport with warranty card and operating manual

- Installation method — on a laboratory or demonstration table in the physics classroom
- Care of equipment surfaces — wiping with a dry or slightly damp cloth is allowed
- Organization of learning activities — suitable both for demonstration in front of the class and for an individual student workstation
- Service life (year) — 5
- Warranty period (month) — 12

3. Package Contents

- Guide track made of aluminum profile with a millimeter measuring scale — 1 pcs
- Carts (carriages), plastic — 2 pcs
- Adjustable pulley mount — 1 pcs
- Tilt angle regulator — 1 pcs
- Stationary support (column) for track fixation — 1 pcs
- Pulley for systems with hanging weights — 1 pcs
- Fixed block — 1 pcs
- Attachment for studying elastic and inelastic collisions — 1 pcs
- Bumper ring for collisions — 1 pcs
- Light barriers (flags) for photogate sensors — 1 set
- Photogate sensor holders — 2 pcs
- Locks for stopping the cart — 2 pcs
- Calibrated springs of different stiffness — 2 pcs
- Additional weights (250 grams per unit) — set of 4 units
- Set of hanging weights — 8 pcs of different mass
- Counterweights for balancing the system — 1 set
- Nylon thread for building systems — 1 reel
- Case for storing the thread — 1 pcs
- Assembly connection set — 1 set
- Product Passport and Warranty Card — 1 pcs
- Individual transport packaging — 1 pcs
- Right of access to the online course with a language-model-based assistant (license) — 1 pcs

The system is supplied fully assembled. No assembly is required before first use. Sensors and measuring equipment are purchased separately.

4. Safety Precautions

4.1. General requirements

- Before starting work, read this passport carefully and keep it together with the setup and the proof of purchase.
- Work with the setup is performed by a physics teacher or another specialist with practical knowledge of mechanics. Students work only under the direct supervision of a teacher who has given them occupational safety instruction.
- The unpacked system must be inspected for mechanical damage, cracks in the plastic, and loose connections. All defects must be eliminated before first use.
- Make sure the track is installed on a level surface and does not wobble during operation.

4.2. Mechanical safety

- Beware of carts rolling down the inclined plane; do not keep your hands in the movement zone around the track during operation.
- Do not allow hanging weights to fall from a height onto feet and hands. Make sure the floor under the system is free of debris and foreign objects.
- Do not change the tilt angle of the track while the carts are moving on it. Stop the system, let the carts come to a stop, and only then adjust the angle.
- Never put your hand under the track during the experiment — you may injure your fingers.

4.3. Safety when working with springs and weights

- Deformed or cracked springs should be replaced immediately. Do not attempt to use damaged springs.
- When installing the weights, carefully place them on the cart to avoid dropping them onto specific parts of the equipment.
- Do not subject the springs to excessive compression; excessive load leads to loss of elastic properties and breakage.
- The nylon thread for attaching weights is always checked for strength before the experiment.

4.4. It is strictly prohibited

- Modifying the equipment, removing the locks, or changing the design without the manufacturer's permission.
- Placing weights on the track without locks that prevent them from falling.
- Leaving the system unattended during experiments.
- Heating the metal parts of the track, drying the system on radiators, or leaving it in the sun during prolonged hot weather.
- Immersing the system in water, washing it with high-pressure water, or washing it in a dishwasher.
- Using unapproved or uncalibrated additional weights of unknown origin.

5. Preparation for Use

- 5.1. Unpack the setup and place it on a flat, stable surface of the laboratory table. Check the completeness of the package contents against Section 3 of the passport.
- 5.2. Make sure all connections are secure: gently press the black locks on the track and let them hold the level.
- 5.3. Set the tilt angle regulator to the zero position (the track is horizontal). If an inclined plane is needed, gradually raise one end to the desired angle.
- 5.4. Position the locks at both ends of the track to stop the carts at the desired points.
- 5.5. Place one cart near the lower end of the track and the other near the upper end, and make sure they slide freely along the track without skewing.
- 5.6. If a pulley will be used, attach it firmly to the end of the track using the adjustable mount and check that it rotates freely.

- 5.7. When hanging the weights, use nylon thread of equal length for both sides of the system and make sure the pulley is stable under load.

6. Operating Procedure

6.1. Investigation of uniform motion and Newton's first law

- Set the track horizontally (tilt angle 0°) and check the horizontality using the tilt regulator.
- Attach two photogate sensor holders to the track at a set distance from each other, gently push the cart, and measure the time it takes to pass between the holders over two consecutive sections.
- Compare the cart's speed on both sections: with minimal friction and no other forces, it remains practically unchanged, which demonstrates Newton's first law (the law of inertia) and uniform rectilinear motion.

6.2. Investigation of acceleration on an inclined plane

- Set the track at an angle from 5° to 45° depending on the purpose of the experiment.
- Place the cart near the upper lock, release it, and measure the time it takes to reach the lower lock using a stopwatch.
- Repeat the experiment for 5–7 different tilt angles and plot a graph of acceleration versus the sine of the angle.

6.3. Verification of Newton's second law

- Set the track horizontally and attach the pulley at the end.
- Tie the nylon thread to the first cart, run it over the pulley, and tie on the hanging weights.
- Release the system and measure the time it takes for the cart to cover a fixed distance.
- Repeat the experiment, varying the mass of the weights and the mass of the carts, and check the relation $F = ma$.

6.4. Studying conservation of momentum and energy

- Place two carts next to each other; attach a compressed spring to one of them.
- Release the spring and observe how the carts move apart in opposite directions.
- Measure the distances traveled by each cart and verify that they are inversely proportional to the masses of the carts.

6.5. Investigation of elastic and inelastic collisions

- For an elastic collision, install the bumper ring on the carts: launch one cart into the other and observe how they separate after impact; measure the velocities of the carts before and after the collision and verify the law of conservation of momentum.
- For an inelastic collision, set up the collision-testing attachment so that after impact the carts continue moving as one body, and repeat the velocity measurements and the check of the law of conservation of momentum.

6.6. Finishing the work

- Stop all movement using the locks or by reducing the tilt angle.

- Remove the additional weights and springs from the setup.
- Clean the track of dust and debris.
- Set the track to a horizontal position and place the equipment in its storage location.

6.7. Work with the online course

- Obtain an account at the educational institution and activate the right of access to the course; the validity period of the license is counted from the date on which access is transferred.
- Select the topic of the lesson in the course list: every topic is accompanied by a plan, a list of equipment, an experiment scenario, a step-by-step instruction, a video demonstration and interactive tasks.
- Formulate a query to the assistant on the topic of the lesson — it will suggest appropriate experiments, set out the sequence of actions, examine typical errors and advise how to correct them.
- Set the level of difficulty of the tasks to match the preparation of the class; on the basis of the results of the work the assistant will help to draw up the report and to organize the conclusions.

7. Care, Maintenance and Troubleshooting

7.1. Cleaning

- Wipe the guide track with a dry, soft cloth once a week to remove dust and dirt.
- Clean the plastic carts of dirt with a dry brush; if necessary, dampen a cloth with a neutral soap solution and wipe dry.
- Inspect the springs for rust and remove any rust using a soft brush or fine-grit sandpaper.
- Do not use abrasive powders, organic solvents (alcohol, acetone), or chlorinated substances; they may damage the materials.

7.2. Periodic inspection

- Every month, check the reliability of all connections, screws, and locks; tighten any loose parts.
- Every quarter, check the sliding of the carts; they should move smoothly without sticking.
- Regularly check the springs for deformation and loss of elastic properties; replace damaged springs.
- Conduct a trial experiment before studying a new section to make sure the equipment works properly.
- Repairs to the system are performed only by an authorized service center. The user is prohibited from disassembling the equipment.

7.3. Possible malfunctions and methods of their elimination

Symptom	Possible cause	User actions
The cart moves unevenly or too slowly	Dust has accumulated on the surface of the track; the friction coefficient has increased	Clean the track with a dry cloth; check the cleanliness of the cart's sliding surfaces

Symptom	Possible cause	User actions
One cart moves faster than the other	The masses of the carts are different; one of them is damaged	Make sure both carts have the same mass and design; if necessary, equalize the masses with additional weights
The spring does not return to its initial position	The spring is deformed or was overcompressed	Replace the spring with a working one; check that it is not overstretched
The pulley does not rotate freely	Dust has accumulated on the axle; the load is too heavy	Clean dust from the axle; check that the mount is not too tight; a less massive weight may be needed
The thread broke during the experiment	The thread is old or damaged; the thread has frayed	Replace the thread with the nylon thread from the set; check the strength of the thread before starting work
The experimental results do not fit the theory	The track is not completely horizontal; high friction; incorrect distance measurement	Check the horizontality with a spirit level; clean the surfaces; re-measure with greater accuracy

8. Storage and Transportation Conditions

- Store the equipment in a dry, enclosed room at a temperature not lower than +5 and not higher than +40 °C and relative humidity up to 80 % without moisture condensation.
- Place the track in a horizontal position; do not place heavy objects on the track, as this may cause deformation.
- Protect the system from direct sunlight, dust, and aggressive substances; store it in the original packaging or a similar container.
- Transport the equipment in rigid packaging by any type of enclosed transport, leaving the internal fasteners in place.
- Do not place weight on the packaging and do not stack other objects or tools on top.
- The storage period before commissioning is unlimited, provided all the stated requirements are met.

9. Warranty Obligations

- 9.1. The warranty period of operation of the product is 12 months from the date of sale specified in the warranty card.
- 9.2. The manufacturer guarantees that the product conforms to the declared technical specifications provided that the transportation, storage and operating rules set out in this passport are observed.
- 9.3. During the warranty period, defects of the product that have arisen through the fault of the manufacturer are remedied free of charge. The method of remedy (repair, replacement of a component or replacement of the product) is determined by the service center.

- 9.4. Warranty service is provided on presentation of a correctly and completely filled-in warranty card and of a document confirming the fact and the date of purchase.
- 9.5. The warranty does not cover cases where the malfunction is caused by:
- mechanical damage, in particular cracks, chips and deformation of the housing and of the components of the product;
 - violation of the operating, storage or transportation rules set out in this passport;
 - ingress of liquid or foreign objects into the product, and also the action of insects and animals;
 - independent disassembly, repair or modification of the product, in particular repair at unauthorized workshops;
 - use of the product other than for its intended purpose;
 - force majeure circumstances (fire, flood, earthquake, etc.).
- 9.6. The warranty does not cover the natural wear of the coating and of the appearance of the product, nor consumables.

10. Product Disposal

- The product must not be disposed of together with unsorted municipal waste. This is indicated by the marking in the form of a crossed-out container on the product or its packaging.
- After the end of the service life, hand the product over to a collection point for the corresponding waste or to an organization holding the appropriate permit.
- Hand over the packaging elements (cardboard, polymer materials) to the corresponding streams of recyclable materials.

Contacts

LABOTRIX GROUP LIMITED

Room 910, Isteeasia 1 No. 18 Fu'an Blvd, Pinghu Subdistrict,
Longgang District, Shenzhen City,
Guangdong Province, China 518111
Phone: +86 13925261264
E-mail: salesmanager@labotrix.com
Website: <https://labotrix.com/>

Address in Ukrainian:

LABOTRIX GROUP LIMITED

Room 910, Istilazia 1, Fuan Boulevard No. 18,
Pinghu Subdistrict, Longgang District,
Shenzhen, Guangdong Province, China 518111
Telephone: +86 13925261264
E-mail: salesmanager@labotrix.com
Website: <https://labotrix.com/>

Conditions of use and storage of the product

The product is intended for educational work in general secondary education institutions and is used only under the control and supervision of a teaching staff member; the recommended age of students — from 10 years, that is, students of grade 5 and of higher grades. Keep the product in a dry, clean and ventilated room at a temperature from +5 to +40 °C and relative air humidity up to 80 % without condensation, separately from heat sources and out of direct sunlight, moisture and dust. Use the product exclusively for its intended purpose and do not allow drops, impacts or other mechanical damage. If you notice damage, a crack or any malfunction, stop working with the product immediately and inform the teacher or the responsible person of the educational institution; repairing the product on your own is prohibited.

WARRANTY CARD

Name:	Dynamic system
Product model:	LABOTRIX DYNAMO K1
Serial number:	
Date of sale:	
Warranty period:	12 months from the date of sale
Trading organization:	
Signature of the seller:	

The goods have been received in working order, without visible damage, complete, and have been checked in my presence. I have no claims regarding the quality of the goods; I have read and agree to the operating and warranty service conditions.

Full name of the buyer _____

Telephone of the buyer _____ Signature of the buyer _____

Dear Customer!

Thank you for choosing Labotrix products. After-sales service of this product is provided in accordance with the regulations of the company and the legislation of the country of sale. So that we can serve you quickly and without unnecessary formalities, check that this warranty card is filled in correctly at the moment of purchase and keep it together with the payment document throughout the entire warranty period. When applying for repair, hand the product over to the seller or to the service center together with the filled-in card.

Procedure for applying

1. The right to free warranty service of the product is valid for 12 months from the date of sale specified in the warranty card. Within this period, components that have failed because of a manufacturing defect are repaired or replaced at no cost to the buyer.
2. Before applying, make sure that the malfunction is not caused by the reasons listed in section 9 of this passport and, if possible, use the table of possible malfunctions in subsection 7.3.
3. After the end of the 12-month warranty period, repairs are performed on a paid basis; the cost of the work and of the spare parts is determined depending on the nature of the malfunction.

Grounds for refusal of warranty service

The company reserves the right to refuse free service or to perform the work on a paid basis if at least one of the following circumstances is established:

- absence of the warranty card, its incomplete or corrected completion, and also the absence of a document confirming the purchase;
- non-conformity of the serial number of the product with the number specified in the card, or damage to the factory marking;
- traces of independent disassembly, repair or modification of the product;
- damage caused by violation of the operating rules, connection to an unsuitable power source or external mechanical impact;
- damage as a result of force majeure circumstances.

Service Records

Date of entry	Description of the malfunction	Work performed	Position, signature, full name of the responsible person