



MANUAL

MECHANICAL LOAD TEST BENCH

for photovoltaic modules testing for resistance against mechanical loads

INTRODUCTION

This data sheet, combined with technical description and operating manual, is the document, verifying main parameters and specifications of the bench for photovoltaic modules testing for resistance against mechanical loads.

The document also contains description of the device, operation principle, specifications, operation guidelines and other information, required for complete usage of the bench capabilities.

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1 PURPOSE

The bench is intended for photovoltaic modules testing for mechanical loads impact in accordance with the requirements of the following standards:

- GOST R 56980-2016 (IEC 61215:2005)
- GOST R IEC 61646-2013
- IEC 62759-1:2015
- IEC 61215-2:2016
- IEC/TS 62782:2016
- IEC 61730-2:2016

2 SPECIFICATIONS

GENERAL	
Serial number	SIMN-1/10
Manufacture date	31.12.2018
Installation (commissioning) date	
Weight	700 kg
Control unit weight	Maximum 105 kg
Dimensions	2,390 (3,040 including electrical cabinet) x x 1,798x2,680 mm (length x width x height)
MECHANICAL LOAD CONTROL	
Work area size	1 module with size of 2,000x1,000 mm maximum
Number of independently controlled groups	3 rows of 5 groups
Applied pressure range	Pressing: 1,000–7,200 Pa Drawing: 1,000–5,400 Pa
Minimum cycle time	10 seconds
Maximum amount of cycles	10,000
Pressure heterogeneity along module area	10% maximum
Pressure maintenance accuracy	± 5%
Pressure presentation accuracy	± 5%
Strain gauge signal meter	MV110-224.1TD
Limit of allowable basic percentage error of signal meter	± 0.1%
Strain gauge	Zemic H3-C3-200kg-3B-D41
Strain gauge sensitivity	2 mV / 2V

Power supply connection points

Power supply connection points are presented in **Figure 1**.

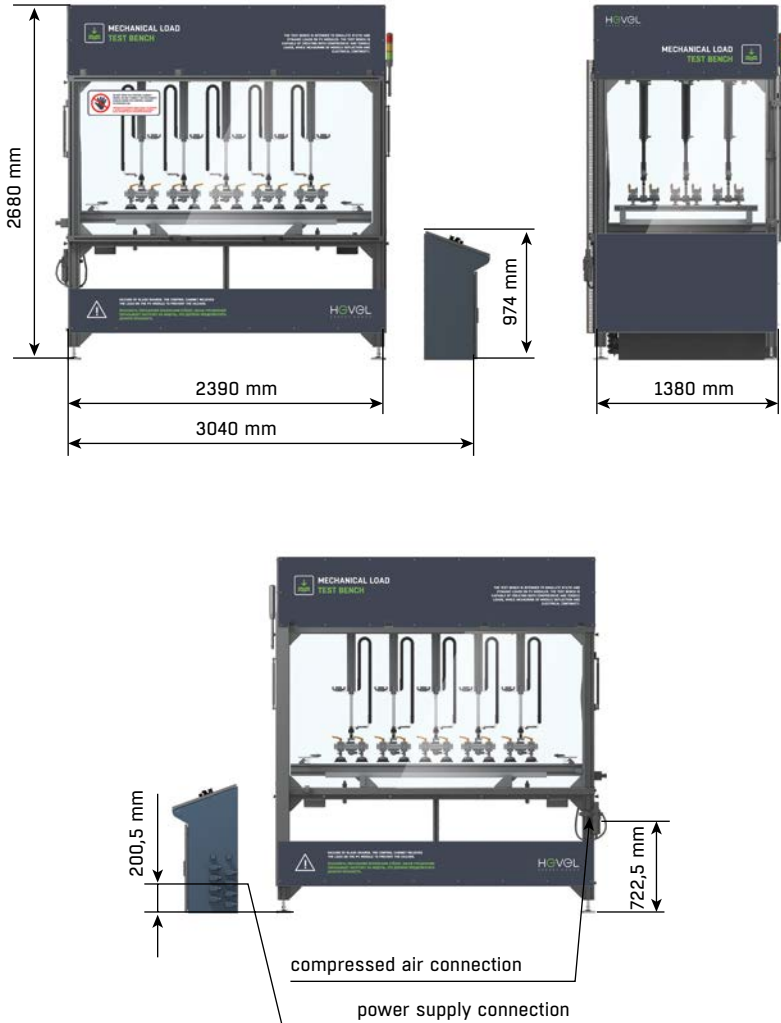
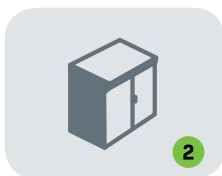


Figure 1

3 SERVICE CONDITIONS

Environmental temperature	From + 5 to + 35 °C
Relative air humidity	60% maximum at temperature of plus 20 °C
Power supply	220 ± 5 V with frequency of 50 ± 0.5 Hz
Pneumatic system operating pressure	0.6–0.9 MPa
Compressed air consumption under 0.6 MPa pressure	250 l/min
Compressed air	Class 7 as per GOST 17433-80 (content of solids under 40 µm is 4 mg/m ³ maximum, water and oil content is not allowed)

4 SCOPE OF DELIVERY


1

2

3

THE BENCH IS SUPPLIED COMPLETE WITH:

1) Frame with mounted ten independent groups, providing “pressing” and “drawing” load on module under test, and each group consists of:

- Pneumatic cylinder – 1 pc.
- Pressure regulator – 1 pc.
- Pneumatic cylinder upper portion valve – 1 pc.
- Pneumatic cylinder lower portion valve – 1 pc.
- Suction tool control valve – 2 pcs.
- Strain gauge – 1 pc.
- Suction tools vacuum control relay.

2) Cabinet with control electronics, including:

- PLC – 1 pc.
- Strain gauge signal input module – 12 pcs.
- Relay control module – 1 pcs.
- Analog output module (pressure selector control) – 2 pcs.
- Operator panel – 1 pc.
- Power supply module 24 V – 3 pcs.

3) Data sheet, operating manual – 1 pc.

5 STRUCTURE AND OPERATING PRINCIPLE

5.1. BENCH DESCRIPTION

Bench structure is based on bearing frame (**pos. 2.1**) with mounted vacuum suction tools lifting/lowering unit (**pos. 2.2**). Along the outline the bench is covered with polycarbonate safety fencing (**pos. 2.3**). Bench operation is controlled from a panel installed on electric cabinet (**pos. 2.4**). Before operation start the module (**pos. 2.5**) is installed on supporting profiles (**pos. 2.6**).

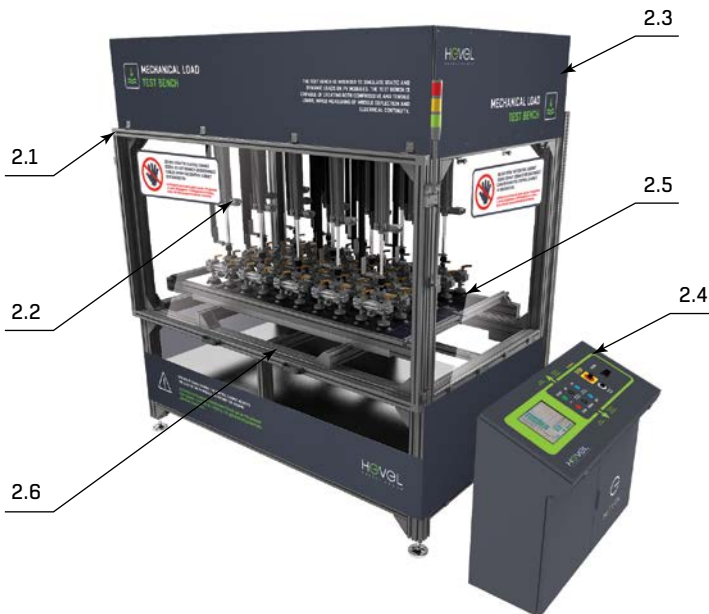


Figure 2

Vacuum suction tools lifting/lowering unit

consists of two rows of five pneumatic cylinders (**pos. 3.1**), located on load frame.

For applied pressure control each pneumatic cylinder contains strain gauge (**pos. 3.2**).

Operating pressure in pneumatic cylinders chambers is controlled using individual pressure sensors (**pos. 3.5**) and pneumatic valves.

Actuator fixation to photovoltaic module under test is performed using vacuum suction tools (**pos. 3.4**), 4 pcs. per each group, allowing to apply both "pressing" and "drawing" load.

Each vacuum suction tools outline has pressure relay (**pos. 3.3**), controlling suction tool fixation to photovoltaic module.

Module deflection value is fixed with five sensors installed below module.

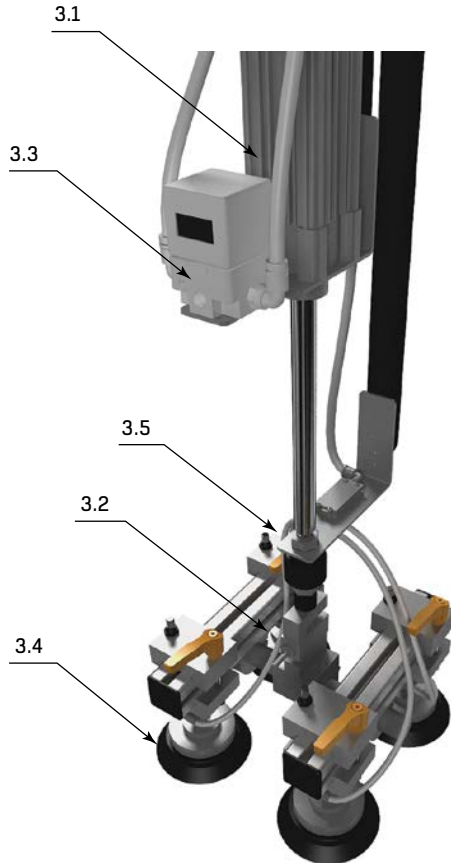


Figure 3

5.2. CONTROL UNIT DESCRIPTION

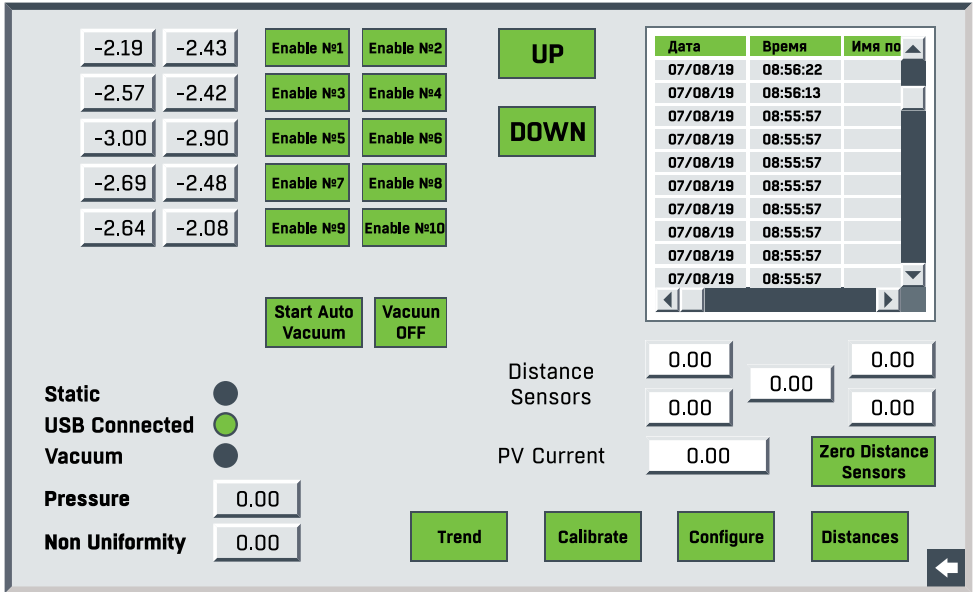
Bench operation modes control is performed by programmable logical controller along with operator panel, allowing to set modes (profiles) of applied pressure, as well as to change cycling parameters – duration and amount of cycles, applied pressure rate.

The bench has 2 operation modes:

- **Static** – pressure is applied for a protracted period of time, bench pressure regulation for photovoltaic module is performed continuously.
- **Dynamic** – short-term application of pressing and drawing pressure, within one cycle the bench pressure regulation is performed only once and transferred for the following cycle.

5.3. CONTROL PROGRAM DESCRIPTION

The bench is controlled using panel located on control unit.



Buttons

Enable №1-10 – activation/deactivation of selected group (all groups are deactivated by default)

Start Auto Vacuum – vacuum enabling

Vacuum OFF – vacuum disabling

UP – activated groups lifting up

DOWN – activated groups lowering down

Zero Distance Sensors – distance sensors reset to zero

Trend – transition to “Automatic testing” tab

Calibrate – transition to “Calibration” tab

Configure – transition to “Configuration” tab

Distances – transition to parameters change graphic representation tab

Indicators

Static – represents operation mode (if cycle duration is more than 1 minute, then load is considered static, otherwise – dynamic)

USB Connected – availability of connected USB drive

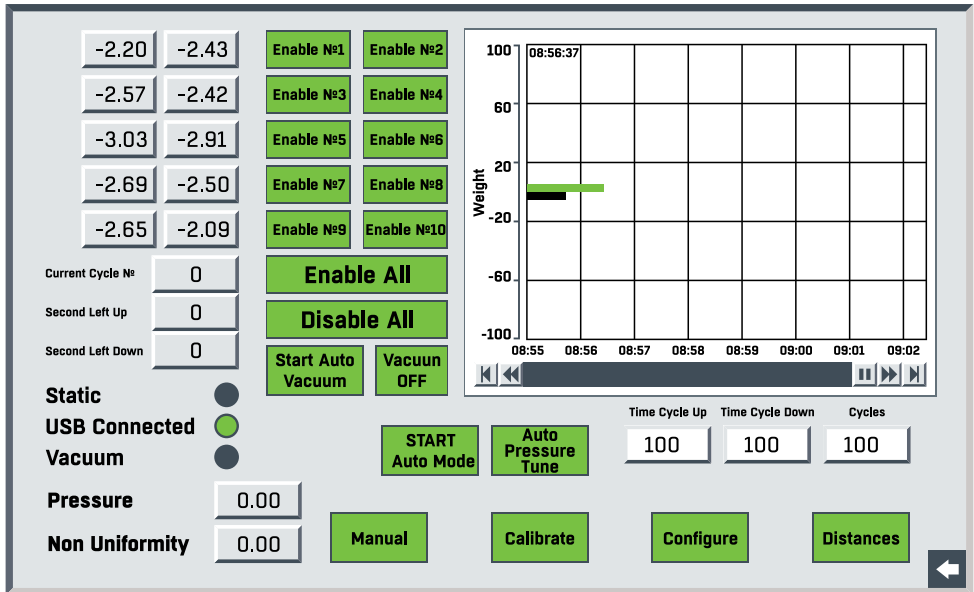
Vacuum – vacuum on/off

Pressure – overall pressure, from all groups (Pa)

Non-Uniformity – pressure heterogeneity along area (%)

Distances Sensors – Indication of the PV module deformation at the sensors location

PV Current – PV forward current



Buttons

Enable №1-10 – activation/deactivation of selected group (all groups are deactivated by default)

Enable All – activation of all groups

Disable All – deactivation of all groups

Start Auto Vacuum – vacuum enabling

Vacuum OFF – vacuum disabling

Start Auto Mode – specified mode start in automatic mode

Auto Pressure Tune – automatic tuning of pressure

Time cycle Up – time of pressure upward application

Time cycle Down – time of pressure downward application

Cycles – number of cycles (one cycle is one iteration down and one – up)

Manual – transition to “Manual control” tab

Calibrate – transition to “Calibration” tab

Configure – transition to “Configuration” tab

Distances – transition to parameters change graphic representation tab

Indicators

Current cycle № – number of current cycle

Seconds Left Up – duration of upward pressure

Seconds Left Down – duration of downward pressure

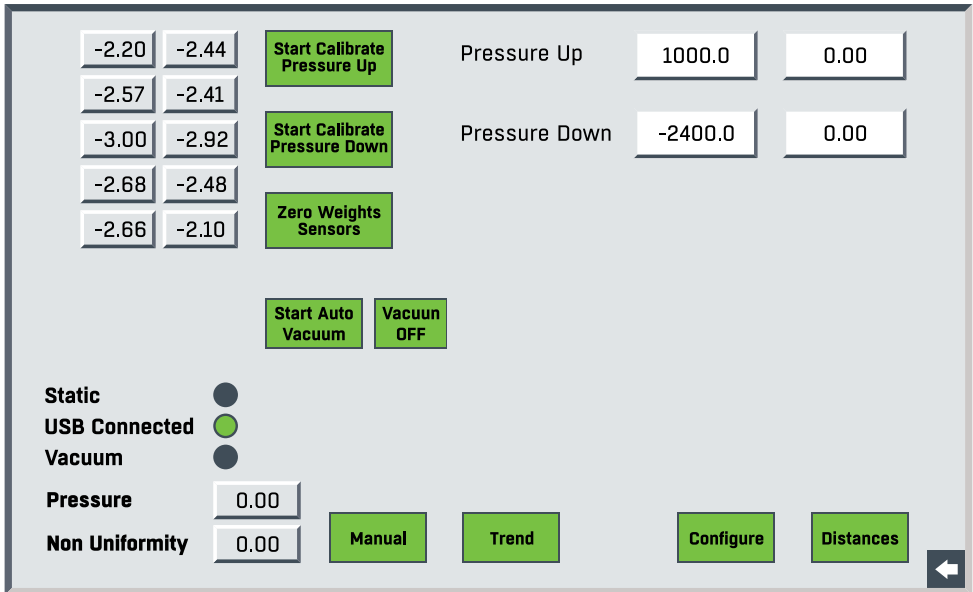
Static – represents operation mode (if cycle duration is more than 1 minute, then load is considered static, otherwise – dynamic)

USB Connected – availability of connected USB drive

Vacuum – vacuum on/off

Pressure – overall pressure, from all groups (Pa)

Non-Uniformity – pressure heterogeneity along area (%)



Buttons

Start Calibrate Pressure Up – upward pressure calibration start

Start Calibrate Pressure Down – downward pressure calibration start

Zero Weights Sensors – weight sensors reset to zero

Start Auto Vacuum – vacuum enabling

Vacuum OFF – vacuum disabling

Manual – transition to “Manual control” tab

Trend – transition to “Automatic testing” tab

Configure – transition to “Configuration” tab

Distances – transition to parameters change graphic representation tab

Indicators

Static – represents operation mode (if cycle duration is more than 1 minute, then load is considered static, otherwise – dynamic)

USB Connected – availability of connected USB drive

Vacuum – vacuum on/off

Pressure – overall pressure, from all groups (Pa)

Non-Uniformity – pressure heterogeneity along area (%)

Pressure Up – Indication of pressure UP

Pressure Down – Indication of pressure DOWN

The screenshot displays a control interface with the following elements:

- Module Area:** 1.600 M²
- Limit Pressure:** 600 steps
- Pressure Speed:** 100.0 steps/sec
- Safe Up Pressure:** 45 steps
- Manual Up Pressure:** 50 steps
- Manual Down Pressure:** 10 steps
- SW Version:** 20190706
- Buttons:** Manual, Trend, Calibrate, Distances
- Navigation:** A back arrow button is located at the bottom right.

Buttons

Manual – transition to “Manual control” tab

Trend – transition to “Automatic testing” tab

Calibrate – transition to “Calibration” tab

Distances – transition to parameters change graphic representation tab

Indicators

Module Area – setting an area of the module under test

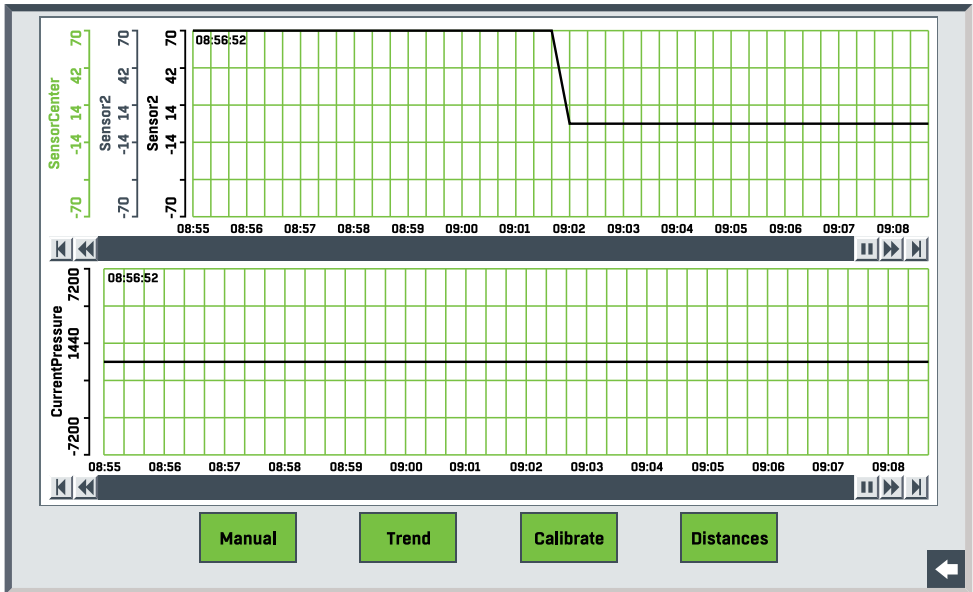
Limit Pressure – pressure limiting

Pressure Speed – pressure rate

Safe Up Pressure – safe pressure rate

Manual Up Pressure – sufficient pressure for groups uplifting

Manual Down Pressure – sufficient pressure for operating groups lowering



Buttons

Manual – переход во вкладку «Ручное управление»

Trend – переключение во вкладку «Автоматическое проведение испытания»

Calibrate – переход во вкладку «Калибровка»

Distances – переключение во вкладку графического отображения изменения параметров

Graphic representation

- Module deflection during testing
- Pressure change during testing

Test report file is saved on USB drive connected to operator panel.

6 PREPARATION TO WORK

- Perform visual inspection of the bench and ensure mounting security of components, grounding, lack of broken wires, lack of compressed air leaks.
 - Connect the bench to electrical grid by turning the main switch located on electrical cabinet wall.
 - Connect the bench to compressed air source and open the stop valve.
 - Open the safety fencing and mount photovoltaic module on supporting profiles. Secure the module using profile screws. Then close the safety fencing.
- **It is strictly prohibited to start bench operation without securing the module with screws.**
 - **It is prohibited to activate bench operation mode with open fencing.**



7 MAINTENANCE

List of main periodic inspections of technical condition

TO BE INSPECTED	SPECIFICATIONS	INSPECTION METHOD	INSPECTION FREQUENCY
1. Operating pressure	0,6 МПа	Visually using manometer	Before the start of operation
2. Interlocking devices	100%	Create corresponding tripping events for interlocking devices at least 5 times	Before the start of operation
3. Suction tool integrity	100%	Pressure drop on pressure sensor, pressure relay indications	During the shift
4. Suction tool integrity	100%	Visually	After module breakdown
5. Strain gauge integrity	100%	Indications on control panel	Before the start of operation
6. Grounding availability	100%	Visually	Before the start of operation
7. Pneumatic cylinders seals integrity	100%	Strain gauges indications on control panel	During the shift

8 STORAGE AND TRANSPORTATION REGULATIONS

During bench storage and transportation the measures shall be taken to prevent it from mechanical damages, under the conditions, preventing from moisture and other liquids ingress.

- During transportation the suction tools unit shall be demounted from strain gauges and fixed separately in the lower section of the bench.
- Easily removable fencing shall be fixed during transportation.
- The bench shall be transported only in the package. It shall be secured to prevent movement during transportation.
- Goods shall be stored at dry and ventilated area. Storage temperature shall be 5–35 °C and relative humidity shall be 60%. There shall be no excessive dryness and high temperature inside the buildings. It is prohibited to store and operate the bench in unheated premises.

9 WARRANTY LIABILITY

The manufacturer guarantees bench operation within **12 months** from the moment of commissioning if operating conditions are met.

Electric diagram, pneumatic equipment circuit, list of pneumatic elements are supplied with the delivery of mechanical load test bench



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