

Ing.Bohdan Kadlecek
POLYMERTEST

K.H.Machy 350, 765 02 Otrokovice Czech Republic



Equipment for testing the thermal shrinkage of cords

norm ASTM D4974, D5591 a EN 13844



Photo design for the company KORDARNA (CORDS) Velka nad Velickou Czech Republic,

Video: the current version - for information

<https://youtu.be/MyYFNbbKRYM>

1, Purpose of the test

It is used for automated determination of thermal shrinkage. Length change at a given tension force, or force change at a constant length.

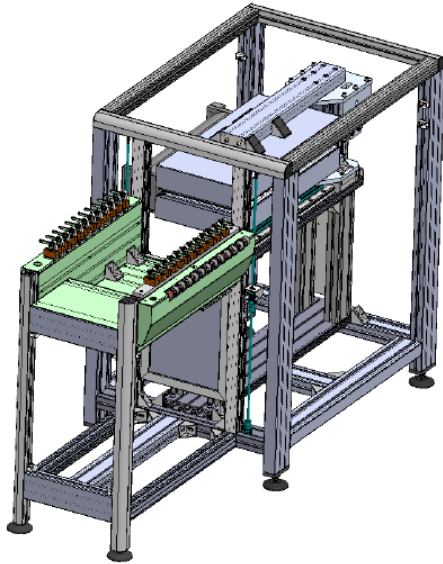
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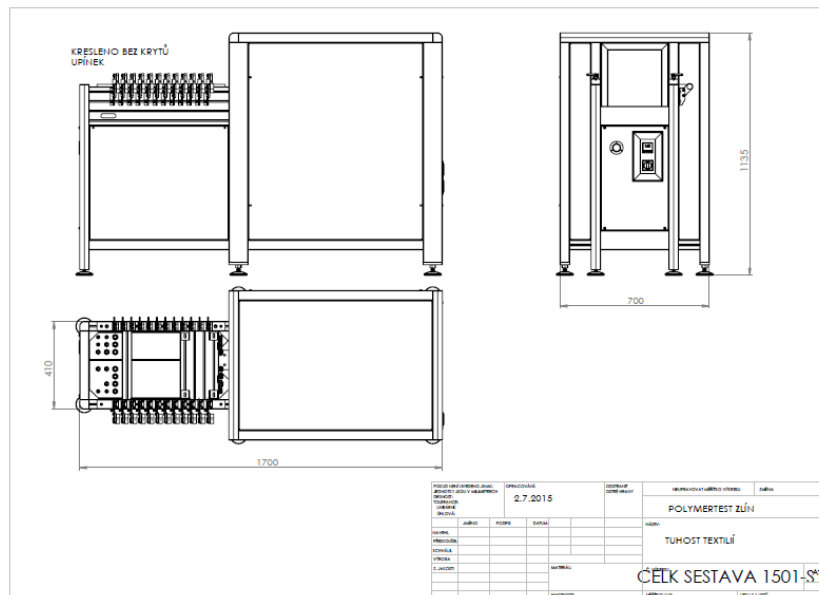
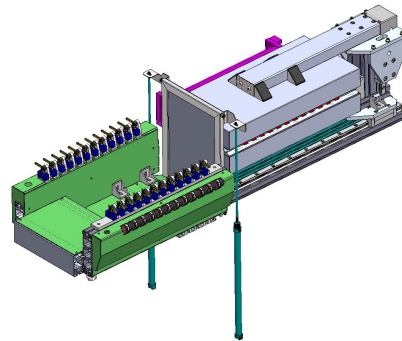
2, Construction description

The base is formed by a rigid frame made of A1 profiles. The jaws are moved and opened using pneumatic elements.

General view without covers



Detail of jaws with inserted heated plate



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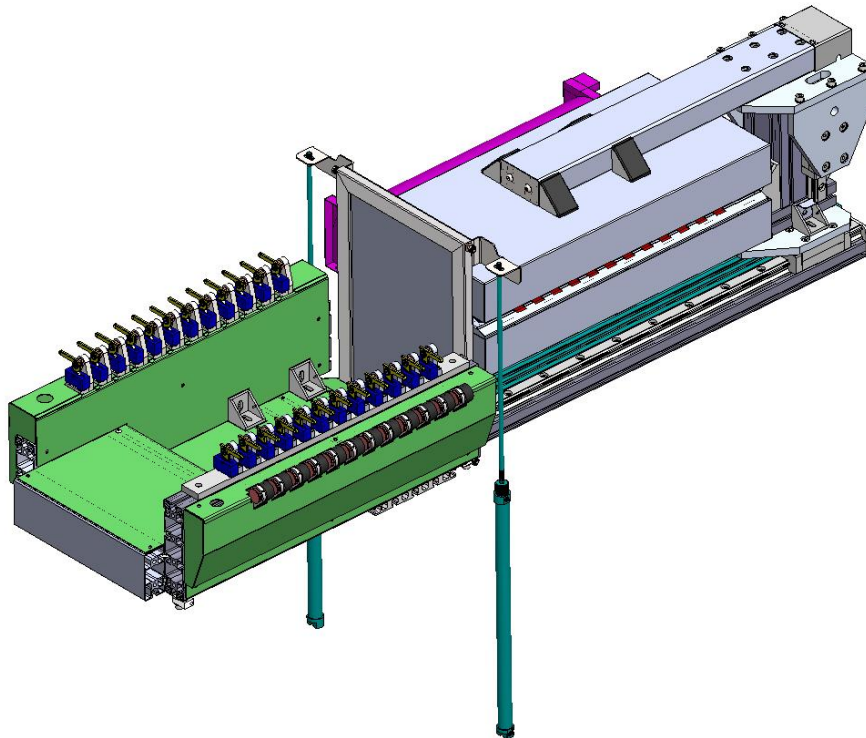
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3, Test principle

The test sample is exposed to a given temperature for a specified time. The change in length or force is measured.

The test is performed automatically by a PC without operator intervention.
Software in **INDIA**.

Principle of measuring device



4, Technical parameters

| | |
|--------------------------|--|
| Number of samples tested | 12 pcs Max. sample width: 1.3 mm |
| Range of force | 1 to 2000 cN Calibration weights 10 N Measurement accuracy less than 0,2% up to 2000 cN Resolution (display) 0,1 cN |

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| | |
|-------------------------------|--|
| Clamping cord | Lever |
| Test temperature | 45°C to 260°C Measurement accuracy up to 200°C ± 1% Measurement accuracy up to 201°C to 260°C ± 1,5% Resolution (display) 0,1°C Temperature distribution in the heating furnace of the samples to 1% |
| Cooling | The heating plates are cooled by a fan |
| Length | to 500% Measurement accuracy ± 0,1% Resolution (display) 0,1% |
| Maximum preload | to 2000 cN |
| Zero test length width | 250 mm |
| Connection to sources | Compressed air + el. energy Electro: 230 V / 50 Hz (2,3 kVA, 10 A) Compressed air: 6 bar |

5, PC + Software

PC – WINDOW

Software in **India**

The software can be modified according to the customer's requirements – especially the test report. It records the measured values (force, length and temperature) and at the same time controls the moving parts of the test room.

Software

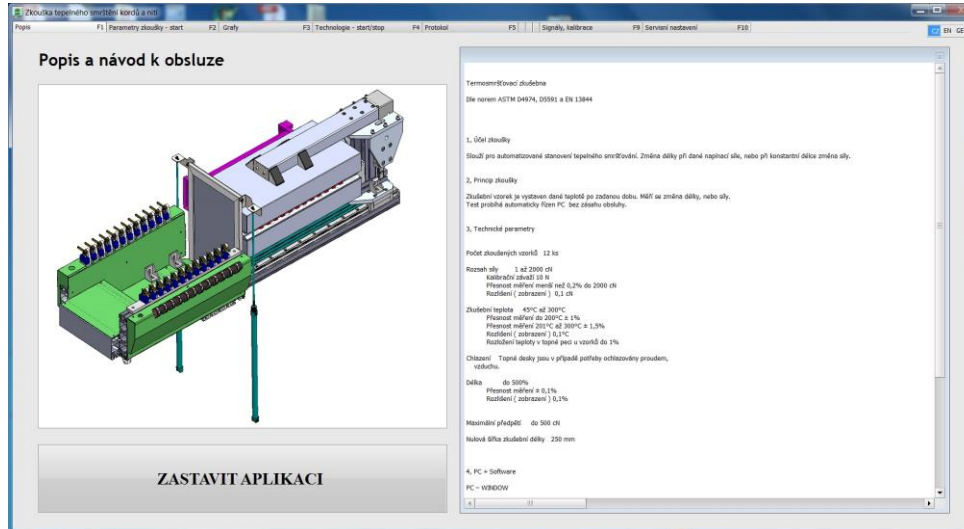
It records the measured values (force, length and temperature) and at the same time controls the moving parts of the test room

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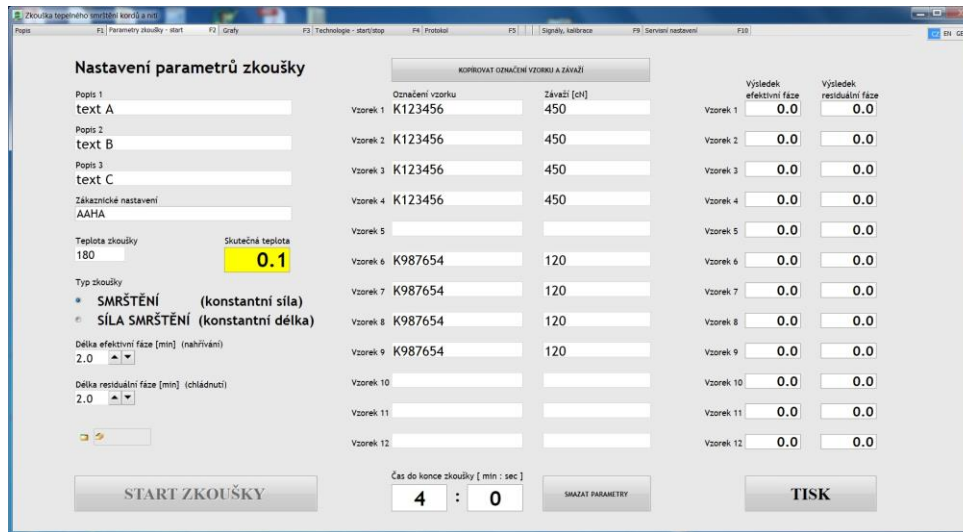
MAIN SCREEN

F1 – Description



- diagram of the machine part
- description + operating instructions
- the "STOP APPLICATION" button closes (switches off) the control program

F2 – test parameters, start



- ev. display of test parameters : Description 1,2,3 – three text lines
- Used customer settings
- Set and actual temperature
- Type of test
- 12 x sample designation and weight value
- Copy button label samples and weights

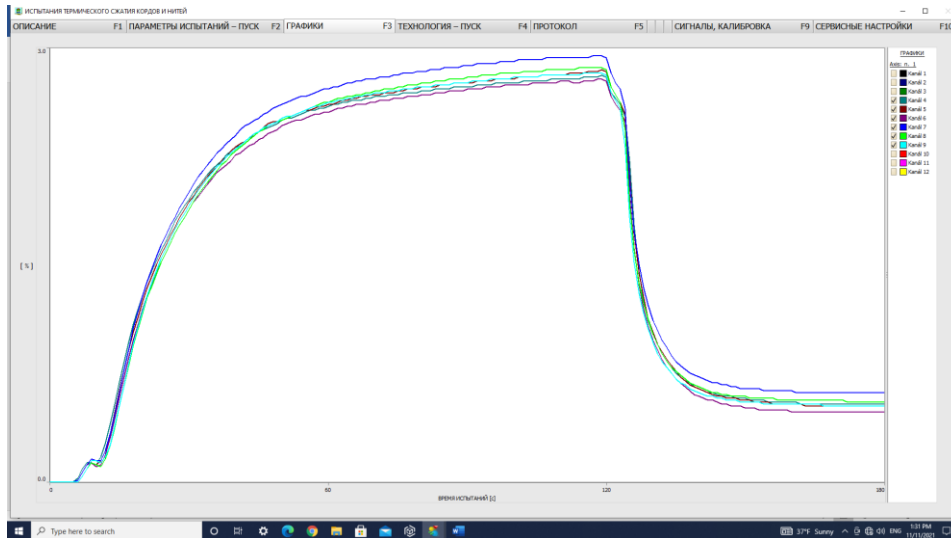
Button for deleting test parameters
Results of the effective and residual phase
"PRINT" button to go to the log screen
Test start button

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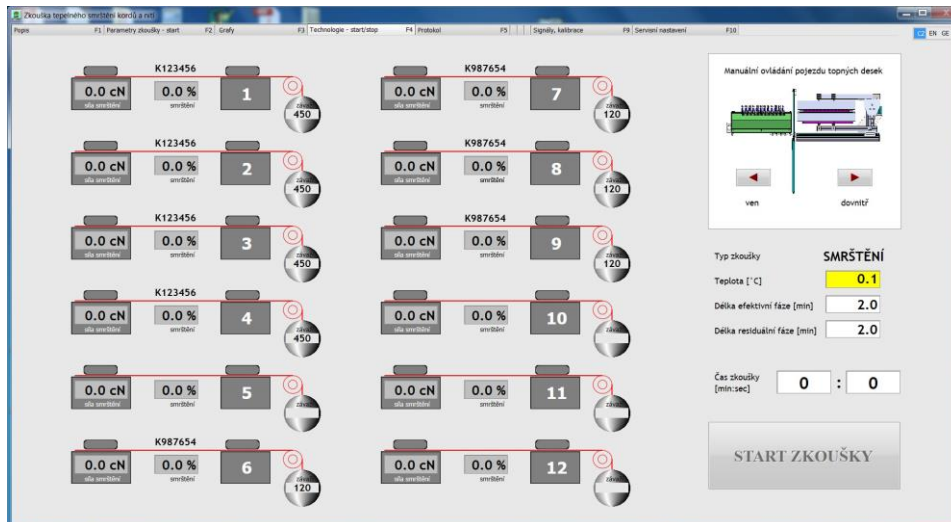
F3 – graphs

- the graphical course of measured quantities during the whole test is displayed here
- the horizontal axis adapts to the set test length
- the vertical axis automatically adjusts to the maximum measured force / shrinkage value during the test



F4 - technology, start/stop

- a schematic view of the technology showing :
Test parameters
Current values of measured quantities



- Test time
- button to start or prematurely end the test
- buttons for manual extension and insertion of heating plates

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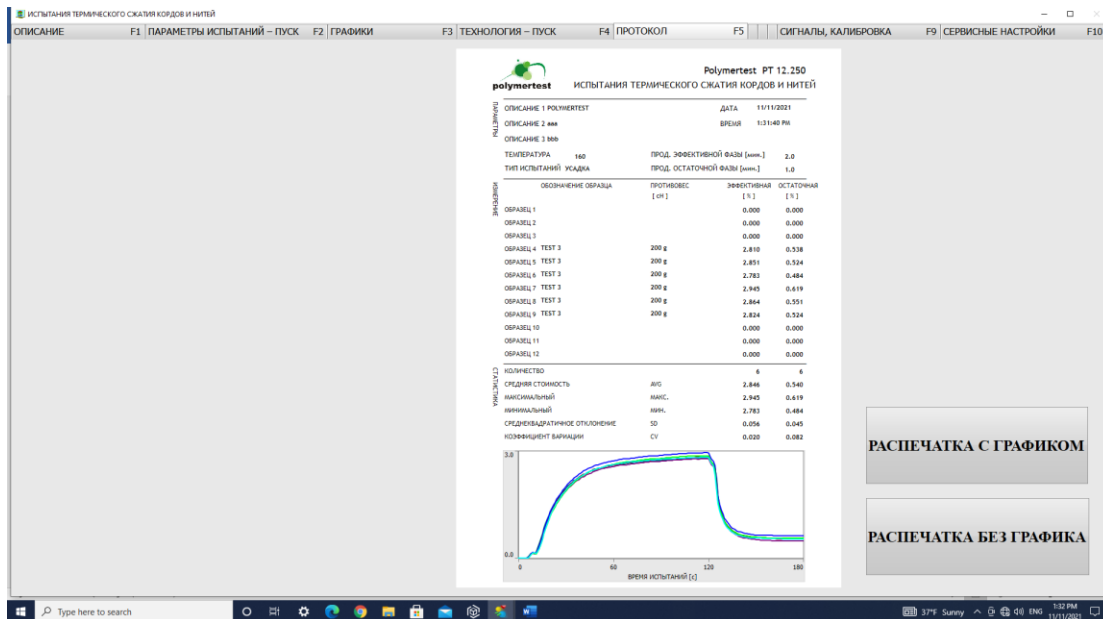
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F5 – protocol

- protocol printing with or without graph

- the protocol contains :

Test parameters
Measured results
statistics
ev. graph



F9 – signals, calibration

screen for checking and calibrating force and extension length sensors

a) force measurement – strain gauges

- signal display in mV and cN by number and bargraph

the calibration of each strain gauge is performed independently at two points

- windows for entering the size of calibration weights

- buttons for calibration in zero without load "MIN" and with calibration weight eg 1000 cN "MAX"

- button for common calibration in zero of all strain gauges (acceleration)

- the button for co-calibration with the weight can be added but requires hanging 12 calibration weights (usually not available)

b) shrinkage measurement – rotary sensor

- "RESET" buttons for resetting the counters of incremental rotary encoders

- displays of rotation of rotary sensors in pulses

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Screen F9



F10 – service settings

a) logic signals section

- control of two-state signals for control of individual elements of technology (travel, doors, clamping of heating plates)
- signaling of the status of end sensors

b) section "BASIC SETTINGS"

- 5 sets of custom parameter settings for calculating the shrinkage length, each set allows:
 - choice of two formulas for calculating the percentage of shrinkage (dL – change in length in mm, heated thread length 250 mm)

a) $dL/250 * 100$

b) $dL/(250+dL) * 100$

- setting diameter of each pulley.

Multiple sets of pulley diameters can be used to refine the shrinkage calculation by taking into account the position of the middle thread of the yarn according to its thickness.

The change in length is calculated from the diameter of the pulley (possibly taking into account the position of the middle fiber) and the angle of rotation of the pulley.

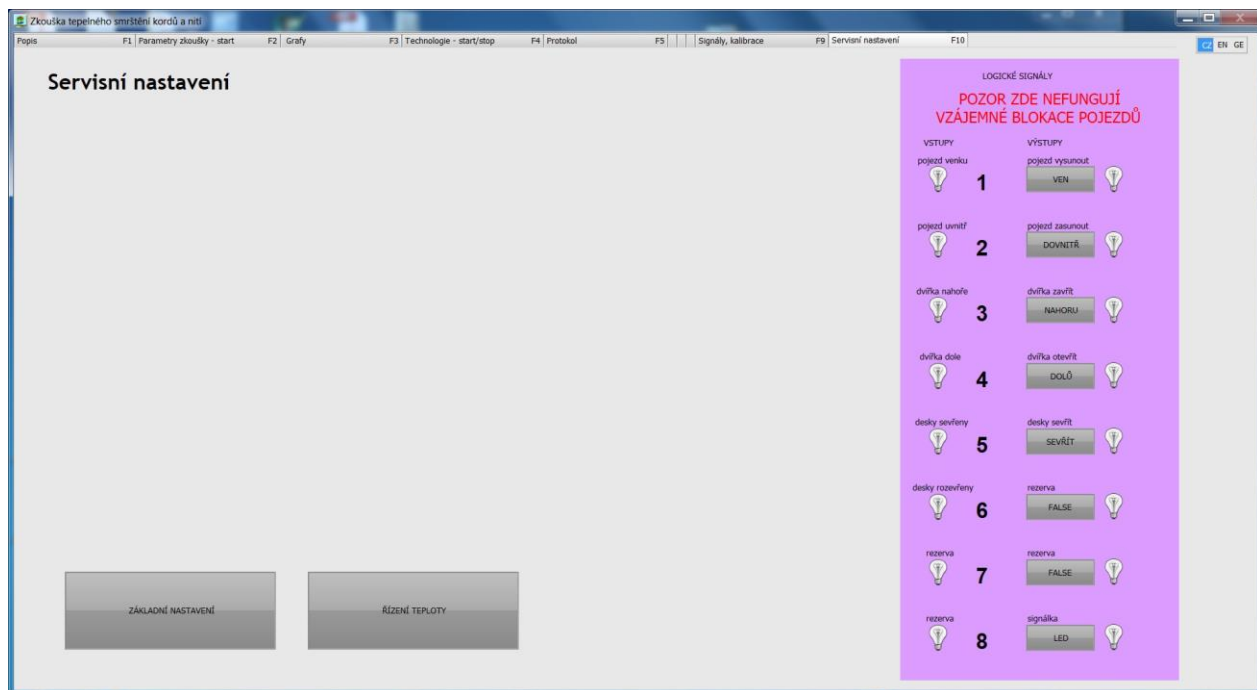
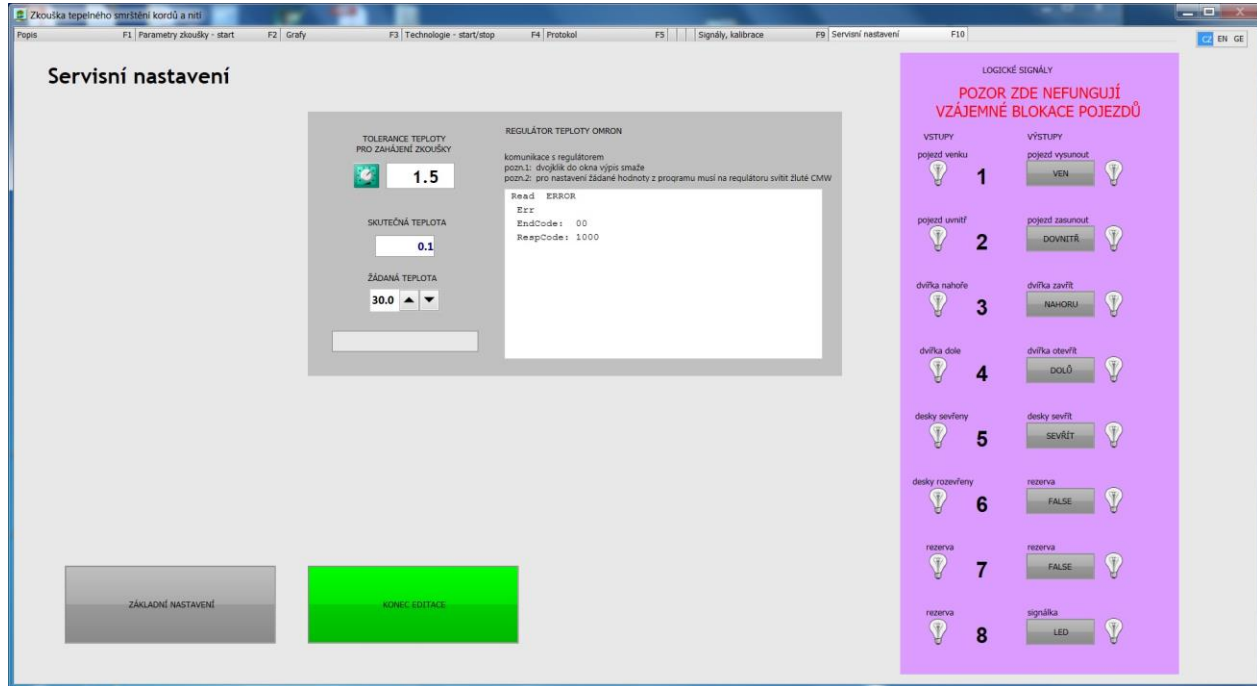
c) section "TEMPERATURE CONTROL"

- setting the temperature tolerance for starting the test. The test start is blocked until the temperature is outside the set tolerance range.
- elements for checking the communication of the program with the OMRON temperature controller

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Service settings screens



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6, Test procedure

The tests are automated. The operator clamps the test sample (maximum number of 12 pieces), sets the selected variant on the PC and the test room performs the specified technology. Sliding the temperature plates is automatic. The board moves to the working position. When the measurement is completed, it slides in again.

A, Constant length variant

The operator clamps the test specimen in the fixed jaws. The left jaw is equipped with a strain gauge. During heating, a stress occurs and the strain gauge records the force.

B, Constant force variant

The left jaw is fixed and the right is an incremental encoder with a pulley. The pulley rotates due to the elongation of the test specimen due to temperature and the software converts everything to the actual length change.

The operator sets the required parameters: sample name, preload, temperature, etc. And selects the type of test – screen F5.

Switches to the F2 screen, checks the set parameters and starts the measurement by pressing the **START TEST** button.

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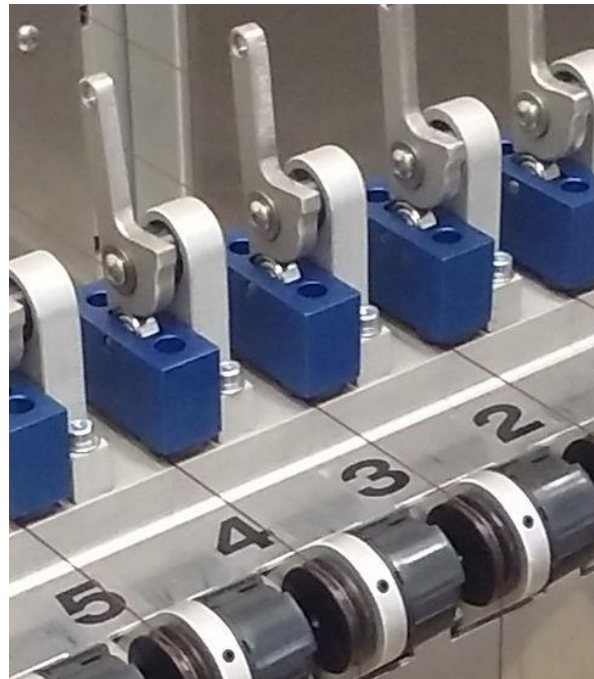
Clamping

Cord clamping is mechanical. It is a cam that pushes over the bearing onto two rubber rollers and they grip the cord.

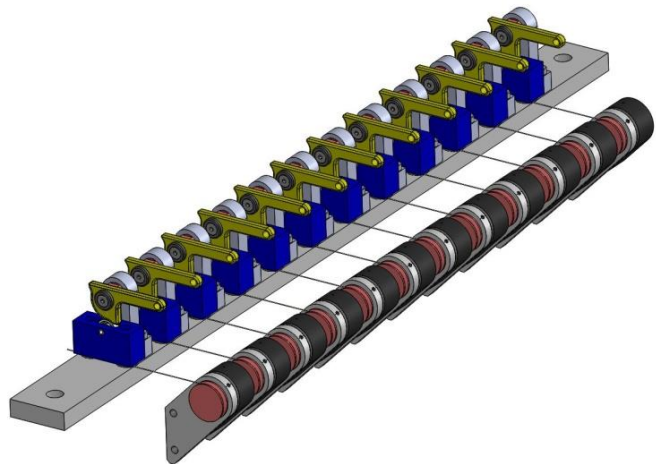
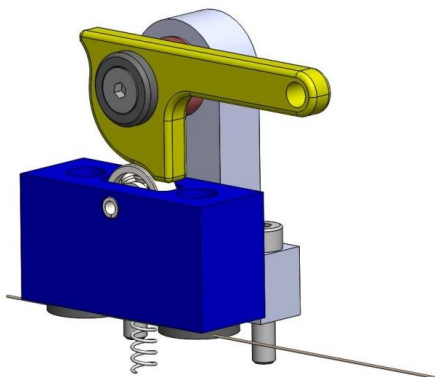
Current design



right mechanical clamps



right mechanical clamps
right pulleys for measuring length

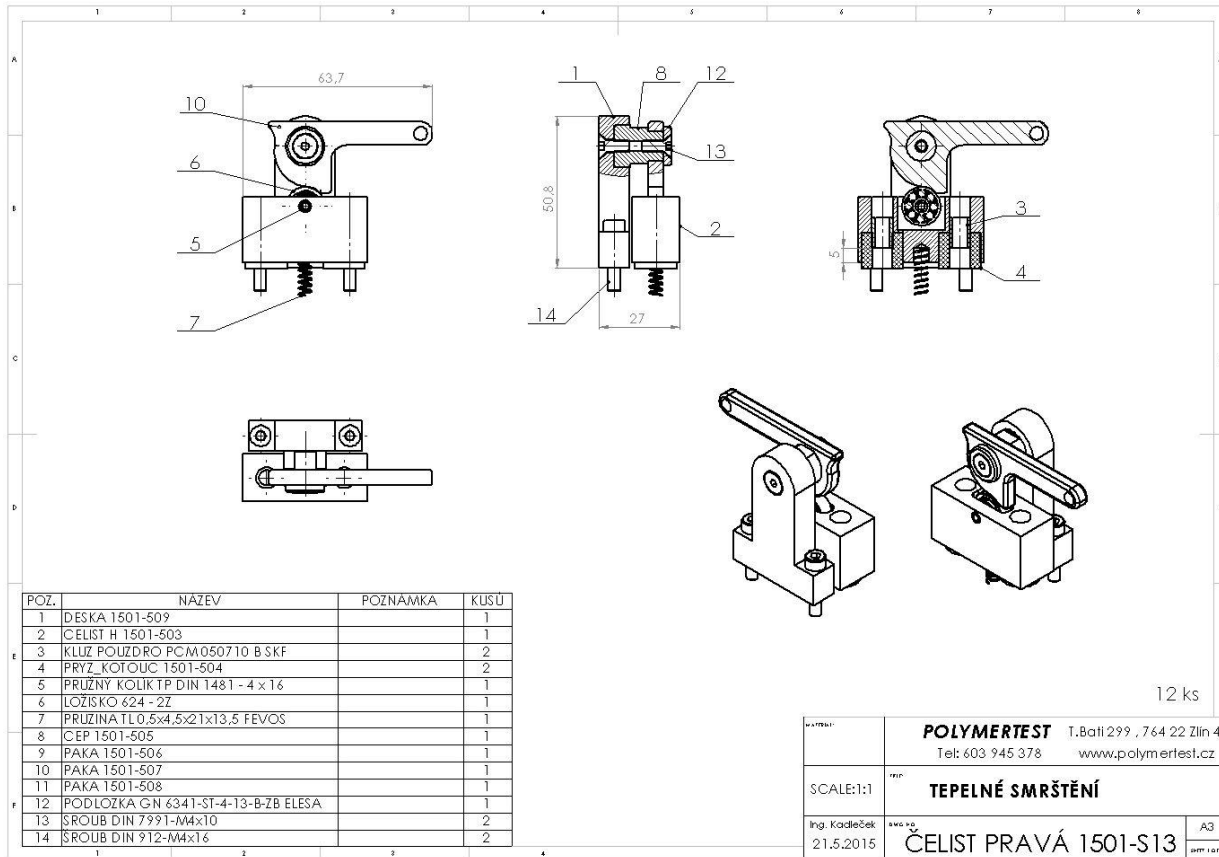


right mechanical clamps

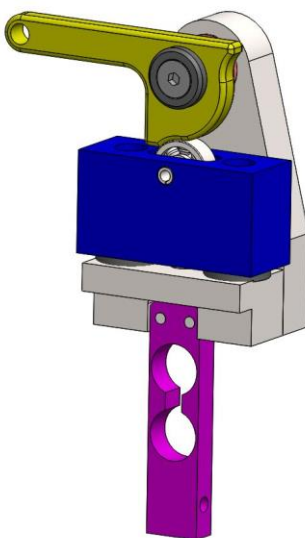
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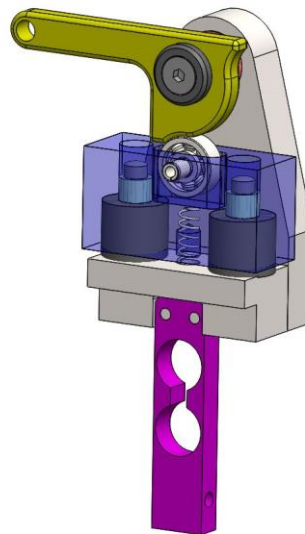
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Left mechanical clamps (purple strain gauge – tenzometr now max 2000 cN)



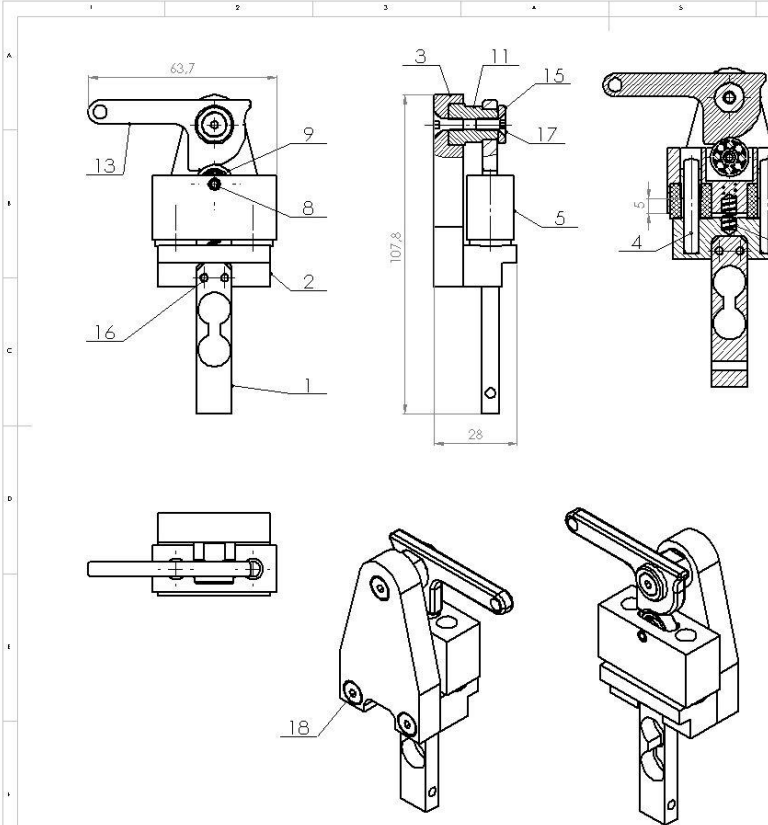
Left mechanical



clamps

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12 ks

| POZ | NÁZEV | POZNÁMKA | KUSŮ |
|-----|-------------------------------------|----------|------|
| 1 | TENZOMETR 1501-046 | | 1 |
| 2 | ZAKLAD 1501-501 | | 1 |
| 3 | DESKA 1501-502 | | 1 |
| 4 | KOLIK DIN-6325-5h6x32 | | 2 |
| 5 | ČELIST H 1501-503 | | 1 |
| 6 | KLUZ POUZDRO PCM 050710 B SKF | | 2 |
| 7 | PRYZ KOTOUČ 1501-504 | | 2 |
| 8 | PRUŽNÝ KOLIK TP DIN 1481 - 4 x 16 | | 1 |
| 9 | LOŽISKO 624 - 2Z | | 1 |
| 10 | PRUŽINA TL 0,5x4,5x21x13,5 FEVOS | | 1 |
| 11 | ČEP 1501-505 | | 1 |
| 12 | PAKA 1501-506 | | 1 |
| 13 | PAKA 1501-507 | | 1 |
| 14 | PAKA 1501-508 | | 1 |
| 15 | PODLOŽKA GN 6341-SI-4-13-B-ZB ELESA | | 1 |
| 16 | ŠROUB DIN 912 M3 x 12 | | 2 |
| 17 | ŠROUB DIN 7991-M4x10 | | 2 |
| 18 | ŠROUB DIN 7991-M4x16 | | 2 |

| | | |
|----------------------------|-------------------------|----------------------------|
| POLYMERTEST | | T. Bati 299, 764 22 Zlín 4 |
| Tel: 603 945 378 | | www.polymertest.cz |
| SCALE:1:1 | TEPELNÉ SMRŠTĚNÍ | |
| Ing. Kadlecěk 21.5.2015 | ČELIST LEVÁ 1501-S11 | A3 DPPY 1001 |



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Extended heating



The testing laboratory will automatically perform measurements according to the standard, the course is recorded in the graph – see. Screen F3.

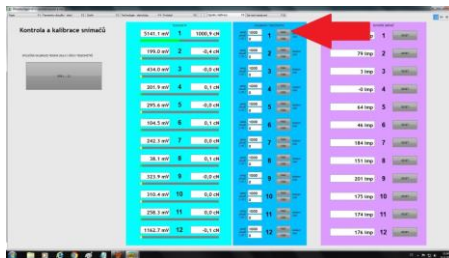
After measurement, the results are displayed in the right part of the F5 screen.

The operator decides whether to save or delete the test result .

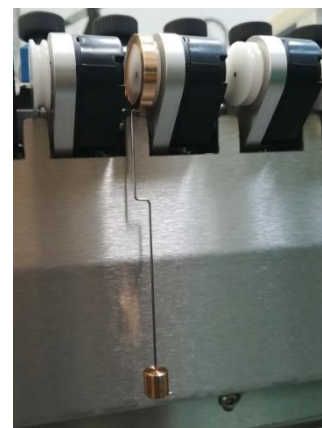
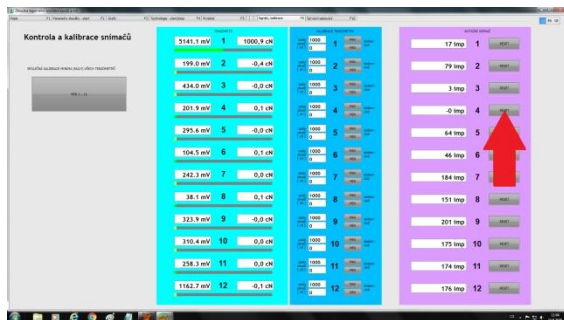
7, Callibration



The operator calibrates the strain gauge. It does this by resetting the strain gauges to the F9 screen in the unloaded state. Then they load them with a weight of **1000 cN** and press the max.



Check the pulley



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Safety features

A, Signaling of door movement, heating plates and the presence of hot heating plates. The indicator light flashes when moving, it illuminates when the heating plates are extended.

B, Safety button STOP TRAVEL. It is used to stop the movement of doors and heating plates. After printing, the movement stops. The operator must then insert the heating plates using a PC. This is done on the F2 screen by pressing the button in the technology image. A similar button is for extending the heating plates – outside the test, for example during calibration.



10. Safety components – residual risks

The testing apparatus may be operated only by the operator at the age of above 18 years who has been trained for the demanded procedure, made familiar with the safety regulations for work and work site safety instructions. The other persons are not allowed to use the apparatus and the user has the duty to undertake any measures for ensuring observance of this principle. It is necessary to keep the apparatus clean and monitor tightness of connections during operation. The operator should work only using the method which has been demonstrated and specified as the correct and safe one.

Forbidden methods of work:

- Reaching in the working area during apparatus operation (during automatic testing cycle)
- Work with protective covers removed
- Work with deactivated safety devices
- Any interventions in the electric system of the apparatus if such intervention is not carried at least by a qualified person.
- Any interventions in the structure without previous notification of the supplier

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Residual risks:

Risk of squeezing



- A. Between the door and frame at door extending and retracting.
- B. Between the heating plates and frame at heating plates extending and retracting.



Risk of burning – The heating plates can be heated up to the temperature of 300 °C so that there is a risk of burning. It means that the operator may not intervene in the working area while the heating plates are present here.

6, Terms and Conditions

Variant of 12 pieces of cords



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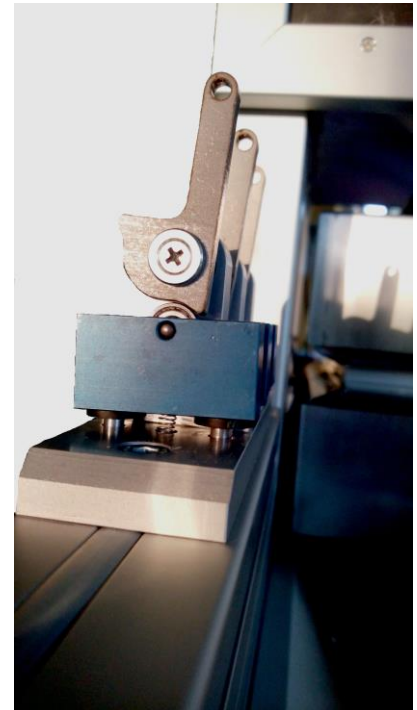
Variant of 3 pieces of cords



Front part

PULLEY

Clamping lever



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Part of delivery:

Calibration weight 1000 cN ... 1 pc

(calibration by an accredited state testing laboratory)

+ basic optional sets of 12 weights (calibration by the manufacturer),.



The weight is hexagonal
For stability when placed on the table

Special software – can be modified according to customer requirements (protocol, etc.)

PC + printer

Set of spare parts for 2 years, including spare strain gauges

We are looking forward to mutual cooperation.

With regards

Ing. Bohdan Kadleček
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