

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.

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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3, Test principle

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

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

Principle of measuring device



4, Technical parameters

Number of samples tested

Range of force

12 pcs Max. sample width: 1.3 mm

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 $200°C \pm 1\%$ Measurement accuracy up to $201°C$ to $260°C \pm 1,5\%$ 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 $\pm 0,1\%$ Resolution (display) 0,1%
Maximum preload	to 2000 cN
Zero test length width Connection to sources	250 mm 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 roo

MAIN SCREEN

F1 – Decription



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

<u>F2 – test parameters, start</u>

Nastavení parametrů zkoušky		KOPÍROVAT OZNAČENÍ V	ZORKU A ZÁVAŽÍ			
Popis 1		Označení vzorku	Závaží [cN]		Výsledek efektivní fáze	Výsledek residuální fáze
text A	Vzorek 1	K123456	450	Vzorek 1	0.0	0.0
Popis 2 text B	Vzorek 2	K123456	450	Vzorek 2	0.0	0.0
Popis 3 text C	Vzorek 3	K123456	450	Vzorek 3	0.0	0.0
Zákaznické nastavení	Vzorek 4	K123456	450	Vzorek 4	0.0	0.0
AAHA Teplota zkoušky Skutečná teplota	Vzorek 5			Vzorek 5	0.0	0.0
¹⁸⁰ 0.1	Vzorek 6	K987654	120	Vzorek 6	0.0	0.0
Typ zkoušky • SMRŠTĚNÍ (konstantní síla)	Vzorek 7	K987654	120	Vzorek 7	0.0	0.0
 SÍLA SMRŠTĚNÍ (konstantní délka) 	Vzorek 8	K987654	120	Vzorek 8	0.0	0.0
Délka efektivní fáze [min] (nahřívání) 2.0	Vzorek 9	K987654	120	Vzorek 9	0.0	0.0
Délka residuální fáze [min] (chládnutí)	Vzorek 10			Vzorek 10	0.0	0.0
2.0	Vzorek 11			Vzorek 11	0.0	0.0
a 🤌	Vzorek 12			Vzorek 12	0.0	0.0
etadt zvoučvy		Čas do konce zkoušky [mín : sec]			TI	ev

- 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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<u>F3 – graphs</u>

- 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 prematuraly end the test - buttons for manual extension and

insertion of heating plates

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F5 – protocol

- protocol printing with or without graph
- the protocol contains :

- Test parameters
- Measured results
- statistics
- ev. graph

САНИЕ	F1 ПАРАМЕТРЫ ИСПЫТАНИЙ – ПУСК	F2 ГРАФИКИ	F3 ТЕХНОЛОГИЯ – ПУСК	F4 ПРОТОКОЛ	F5	СИГНАЛЫ, КАЛИ	БРОВКА F9 СЕРВИСНЫЕ НАСТРОЙКИ	
			polymertest MCT	ЫТАНИЯ ТЕРМИЧЕСКОГО	Polymertest PT 1 СЖАТИЯ КОРДОВ I	2.250 1 НИТЕЙ		
			OTIVICAHUE 1 POLYMERTEST		ДАТА 11/11/2	721		
			OTIVCAHUE 2 868		BPEMR 1:31:40	PM		
			CURICAHINE 3 PPP					
			TEMПEPATYPA 160	ПРОД. ЭФФЕКТИ	IEHOЙ ØA3bi (миж.)	2.0		
					PION GASE [MHH.]	1.0		
				[cH]	[%]	[%]		
			GEPASEL 1		0.000	0.000		
			05PA3ELL 2 05PA3ELL 3		0.000	0.000		
			OEPAGEL 4 TEST 3	200 g	2.810	0.538		
			OSPAJELLS TEST 3	200 g	2.851	0.524		
			OSPASELL6 TEST 3	200 g 200 g	2.783	0.484		
			OSPAJELI 8 TEST 3	200 g	2.864	0.551		
			OSPASELL 9 TEST 3	200 g	2.824	0.524		
			OEPA3EL 10		0.000	0.000		
			OEPASEL 12		0.000	0.000		
			Э количество		6	6		
			СРЕДНЯЯ СТОИМОСТЬ	AVG	2.845	0.540		
			аксимальный максимальный	MAKC.	2.945	0.619		
			СРЕДНЕКВАДРАТИЧНОЕ ОТК	IOHEHME SD	0.056	0.045		
			КОЭФФИЦИЕНТ ВАРИАЦИИ	CV	0.020	0.082	РАСПЕЧАТКА С ГРАФИКО	22
			3.0		٩		ГАСПЕ ЧАТКА С ГГАФИКС	1
			0.0	-			РАСПЕЧАТКА БЕЗ ГРАФИ	K/
			•	время испытаний (с)	107	100		
								2 PM

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 performer 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

Zkouška tepelného smrštění kordů a nití				_ 0 X
Popis F1 Parametry zkoušky - start F2 Grafy	F3 Technologie - start/stop F4 Protokol	F5 Signály, kalibrace F9 Servisní nastavení	F10	CZ EN GE
Kantuala a kalibuaga animažů	TENZOMETR	KALIBRACE TENZOMETRU	ROTAČNÍ SNÍMAČ	
Kontrola a Kalibrace shimacu	0.0 mV 1 0,0 cN	zakej 1000 závaží 0 1 MIN ulož	-0 imp 1 RESET	
SPOLEČNÁ KALIBRACE MINIMA (NULY) VŠECH TENZOMETRŮ	0.0 mV 2 0,0 cN	závali 1000 2 MAX stiskem závali 0 2 MIN ulož	-0 imp 2 RESET	
MIN 1 - 12	0.0 mV 3 0,0 cN	zaidaj 1000 závaž 0 3 MAX stuskem (cN) 0 3 MIN stuskem	-0 imp 3 RESET	
	0.0 mV 4 0,0 cN	zakari zhvaži (cht) 0 4 MAX MEN ukož	-0 imp 4 RESET	
	0.0 mV 5 0,0 cN	zalvaží 0 5 MAX strikem ulož	-0 imp 5 RESET	
	0.0 mV 6 0,0 cN	zadej 1000 6 MAX závaží 0 6 MIX ulož	-0 imp 6 RESET	
	0.0 mV 7 0,0 cN	zadej 1000 závaži 0 7 MAX strikem [CN] 0 7 MIN ulož	-0 imp 7	
	0.0 mV 8 0,0 cN	zadej 1000 8 MAX strikem ulož	-0 imp 8 RESET	
	0.0 mV 9 0,0 cN	zadej 1000 9 MAX stiskem ułoż	-0 imp 9 RESET	
	0.0 mV 10 0,0 cN	Zavati 1000 10 MAX ethokem	-0 imp 10 ****	
	0.0 mV 11 0,0 cN		-0 imp 11 RESET	
	0.0 mV 12 0,0 cN	źkrafi 0 12 MEN ułoż	-0 imp 12 RESET	

<u>F10 – service settings</u>

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 cange 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 temperatur eis outside the set tolerance range.

- elements for checking the communication of the program with the OMRON temperature controller

Service settings screens



Popis F1 Parametry zkoušky - start	F2 Grafy	F3 Technologie - start/stop	F4 Protokol	F5 Signály, kalibrace	F9 Servisní nastavení	F10		CZ EN GE
Samianí nastavaní						LOGIC	KÉ SIGNÁLY	
Servisni nastaveni						POZOR	ZDE NEFUNGUJÍ	
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	_					Tezerva	FALSE	
						8	U	
ZÁKLADNÍ NASTAVENÍ		RIZENI TEPLOTY				rezerva	signálka	
						₩ 8	TED V	

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Z	ÁKLADNÍ NAST	AVENÍ		POUŽÍVANÉ ZÁKAZI a	NICKÉ NASTAVENÍ						PO VÝRJ SM	UŽÍVANÝ AZ PRO VÝ IRŠTĚNÍ (POČET	dL 50 + dl	* 100		
UŽIVANÝ	POZICE 1	2	3	4	5	6		7	8		9	_	10		11	1	2
ADKY nm]	21.009	21.002	21.003	21.004	21.005	21.006	21.	.007	21.0	800	21.00	9	21.010	2	1.011	21.	012
	iázev zákaznickéj	HO NASTAVENÍ			VÝRAZ PRO VÝPO SMRŠTĚNÍ (%	DČET PRÔMĚR K] 1	GLADKY [mm	1	4	5	6	7	8	9	10	11	12
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c	:				dL	100				1		0					
c	đ				dL =	100	1	1	1	1	1	0	1	1	1	1	1
e	5				d	100		1	1			1		1		1	1
					200	(nominal	diameter 21.	0 mm]				-	_				
		_											Ð	7	FALSE	. 9	\rangle

6, Test procedure

The tests are automated. The operator clamps the test sample (maximum number of 12 pieces),m 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.

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



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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 wether 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.

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Check the pulley

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	242.3 mV 7 0,0 cN	a 7 mm	184 imp 7	
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	323.9 mV 9 -0,0 cN	a 9 ar	201 imp 9	
	310.4 mV 10 0,0 cN	a 10 a a	175 Imp 10	
	258.3 mV 11 0,0 cN	a 11 a a	174 imp 11	
	1162.7 mV 12 -0,1 cN	🗐 🙃 12 🧱 🛨	176 imp 12	



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 by 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

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 $300 \,^{\circ}$ 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



Variant of 3 pieces of cords



Front part

PULLEY

Clamping lever







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 **POLYMERTEST**

Company name:

Ing.Bohdan Kadlecek

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