DASFOS CZr, s.r.o. – Technology-innovation center
Bozkova 45 14, 702 00, Ostrava 2-Privoz, Czech Republic
Phone: + 420 59 6612092 Fax: + 420 59 6612094
E-mail: dasfos@dasfos.com Web: http://www.dasfos.com

Technical Information

to the

DF-7 Dilatometer and DL-7Automatic Press

Measuring system for determining of
swelling properties of hard coal

DASFOS CZr s.r.o., Ostrava August 2017

General

The DF-7 Dilatometer is a fully automated device for determination of swelling properties of hard coal heated under specified conditions that are defined by the Standards ISO 349, ISO 23873, ISO 8264, ASTM D 5515, and DIN 51739. Piston's movement during the test is the measure of swelling properties of coal under changing temperature. Coal samples for the dilatometric tests are prepared using the DL-7 Automatic Press. The DF-7 Dilatometer enables testing of 7 samples at a once.

The system performs, in accordance with the chosen Standard, dilatometric testing which includes measurement of contraction and dilatation of prepared coal samples. Measurement of sample dilatation and contraction is contactless.

An industrial-type computer controls all the course of testing. Documentation to the performed test as well as the results are generated and printed automatically.

The operator first prepares test samples using automatic press with measurement of pressing force, then inserts each sample into a testing tube and places the tubes with pistons at individual positions of the tube holder. All next activities, including insertion of tubes into the furnace, testing and removing tubes from the furnace, are fully automated.

After the test is started, system's control program switches the furnace preheating process on, in accordance with the chosen Standard. Then, at requested initial temperature, tubes are inserted into the furnace and heating continues with the prescribed temperature gradient. Measuring of pistons' shifting is then carried out during the whole duration of testing.

During the test, measured data e.g. temperature, contraction or dilatation (%) are displayed on the screen, and recorded. Archives data are kept on a hard disc and can be backed up, when needed. Functioning of the dilatometer is checked automatically during the course of testing. At the test end, tubes are automatically removed from the furnace.

Measured data and results of all executed tests are written into archive files on the computer's hard disk and can be later called out and displayed on screen, printed, or transferred via Ethernet to another computer. Software for the remote access via Internet is available. So, displaying and printing the data and graphs on remote computer is also possible.

After performing a test, dilatation curves are printed together with numerical results of the test. The test reports show also temperature course during heating, temperature gradient, temperature at the beginning of coal softening, temperature for maximum contraction, temperature for maximal dilatation, values of maximum contraction and maximum dilatation.

The operating personnel communicate with DF-7 Dilatometer by a keyboard and colour screens where actual states of testing and its results are displayed. Messages, warnings, results of self-diagnostics and instructions for the personnel are also displayed on the screen.

The DF-7 Dilatometer with DL-7 Automatic Press are establishing new approaches and techniques for dilatometric measurements

Here are the most significant features of the equipment:

1) Coal samples for dilatometric testing are prepared by use of the DL-7 automatic press. The DL-7 automatic press operates according to requirements of ISO 23873, ISO 8264, and DIN 51739 Standards.
2) The automatic press DL-7 is equipped with continuous electronic measurement of the pressing force. Time course of the pressing force is computer controlled. Compression of coal sample is stopped when the pressing force has achieved and remains on15 kN value.
3) Volume density of the test sample after first pressing step is monitored by the decrease of pressing force in a given time interval. If the decrease is greater than allowed, pressing is automatically repeated until the desired volume density is reached.
4) Before manufacturing the test samples, homogenisation of coal for up to 8 samples is done in an electronically controlled mixer DM-7. This homogenisation ensures defined and stable conditions for all samples prior to the pressing itself.
5) Preparation of the test sample of coal shall be defined in a single cycle.
6) Complete documentation to the preparation procedure of coal test sample is included in the test report.
7) Our original contactless method of measuring of dilatometric pistons movement ensures stability and high accuracy of measuring of coal dilatation in seven dilatometric tubes at once. This is an original way of measuring dilation developed by DASFOS.
8) Ensuring balanced temperature profiles in dilatometric tubes during the test. There are three heating sections in the test furnace. The control computer, by use of a special algorithm, regulates the temperatures in the furnace.
9) In the archived database, there are stored detailed time courses of measured temperatures and dilations for each dilatometric tube (retort).
10) Temperatures are measured at all important locations in the test furnace. The dilatometric system is equipped with detailed and automatic operational diagnostics. All operator's interventions and other information related to the test are registered.
11) The whole course of examinations, including inserting and pulling out of measuring tubes from the furnace is fully automated. The system can be remotely controlled from a central computer. Thus, there is no need for permanent operator's presence during the test.
12) High working productivity of the DF-7 measuring system. In one eight hour working shift, on up to (3 x 7 =) 21 coal samples can be measured thanks to the use of an automatic cooling system.
13) Automatic checking and calibration of the system is performed before each new measurement cycle,
14) Clean and safe operation of the DF-7 system thanks to a built-in exhaust device.

Technical parameters of the DF-7 Dilatometer

Working range of sample heating	200 to 600 °C
Accuracy of temperature control	± 1 °C / 10 min.
Step change of temperature	0.1 to 10 °C/min
Temperature gradient	3 °C / min
Accuracy of gradient control	± 0.5 °C / min
Setting of temperature alarm	500 to 600 °C
Measurement of piston shifts	contactless
Pipe movement	fully automatic
Dilatation measurement range	-50 % to +400 % (normal samples)
Resolution of measured dilatation	0.5 %
System diagnostics	automatic during whole test duration
Cooling system	automatic
Remote checking and diagnostics	by Internet connection
Duration of one measuring cycle	l20 min (up to 7 samples in parallel)
Control computer	industrial type PC with 19" colour TFT flat display
Software	WIN XP + RTX.62 DELPHI environment Test control according to the Standards IS0 349, ISO 23873, ISO 8264, ASTM D 5515, DIN 51739 including data archiving and printing.
Archiving of data	automatic storage on the PC hard disk and by DVD-RW unit
Network interface	Ethernet

Technical parameters of the DL-7 Automatic Press

Pressing of samples	automatic
Measurement of pressing force	by strain gauges
Control of pressing process	by control computer
Pressing force range	0 to 15 kN (0 to 20 kN)
Accuracy of setting	0.2 %
Sample ejecting	automatic
Homogenization device	with automatic control

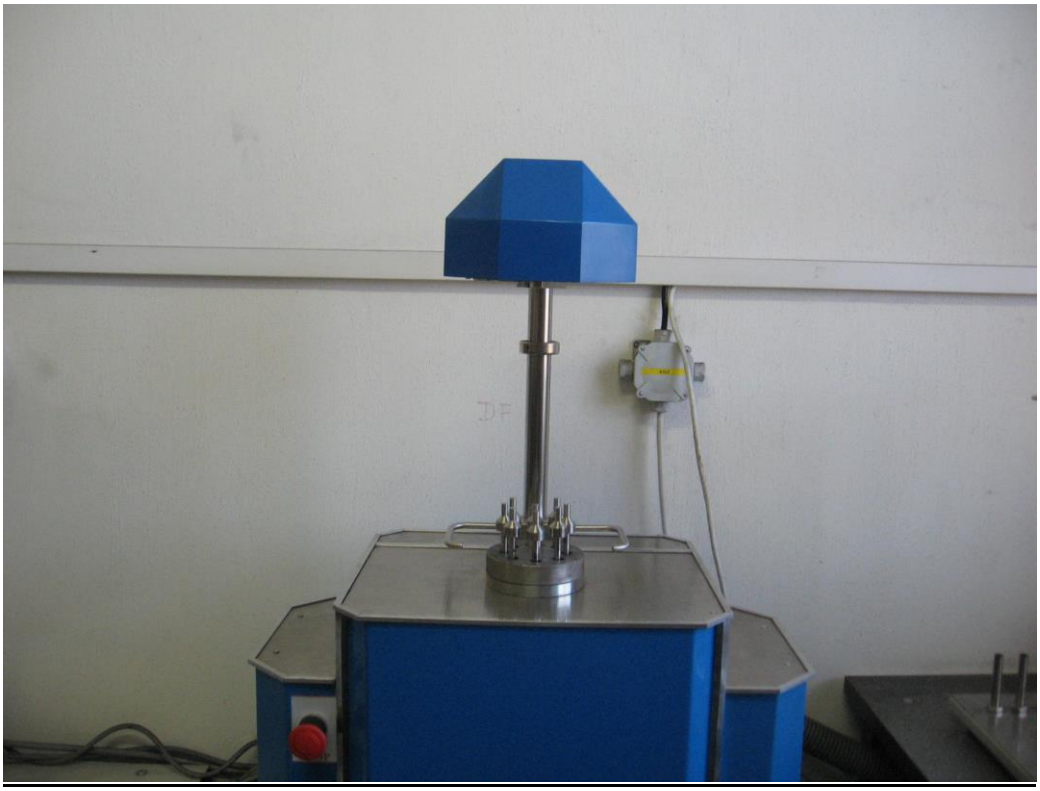
Note: Also the **D-7 Manual Press** by ISO 349 Standard with manual sample tamping and ejecting can be delivered

Dimensions of the individual components

DF-7 Dilatometer	700 x 250 x 900 mm (pipe up – 1450
Control computer	430 x 250 x 500 mm
DL-7 Automatic press	550 x 300 x 500 mm
Printer	450 x 420 x 220 mm

Power supply	230 V, 50 Hz
Power input	max. 3 000 VA

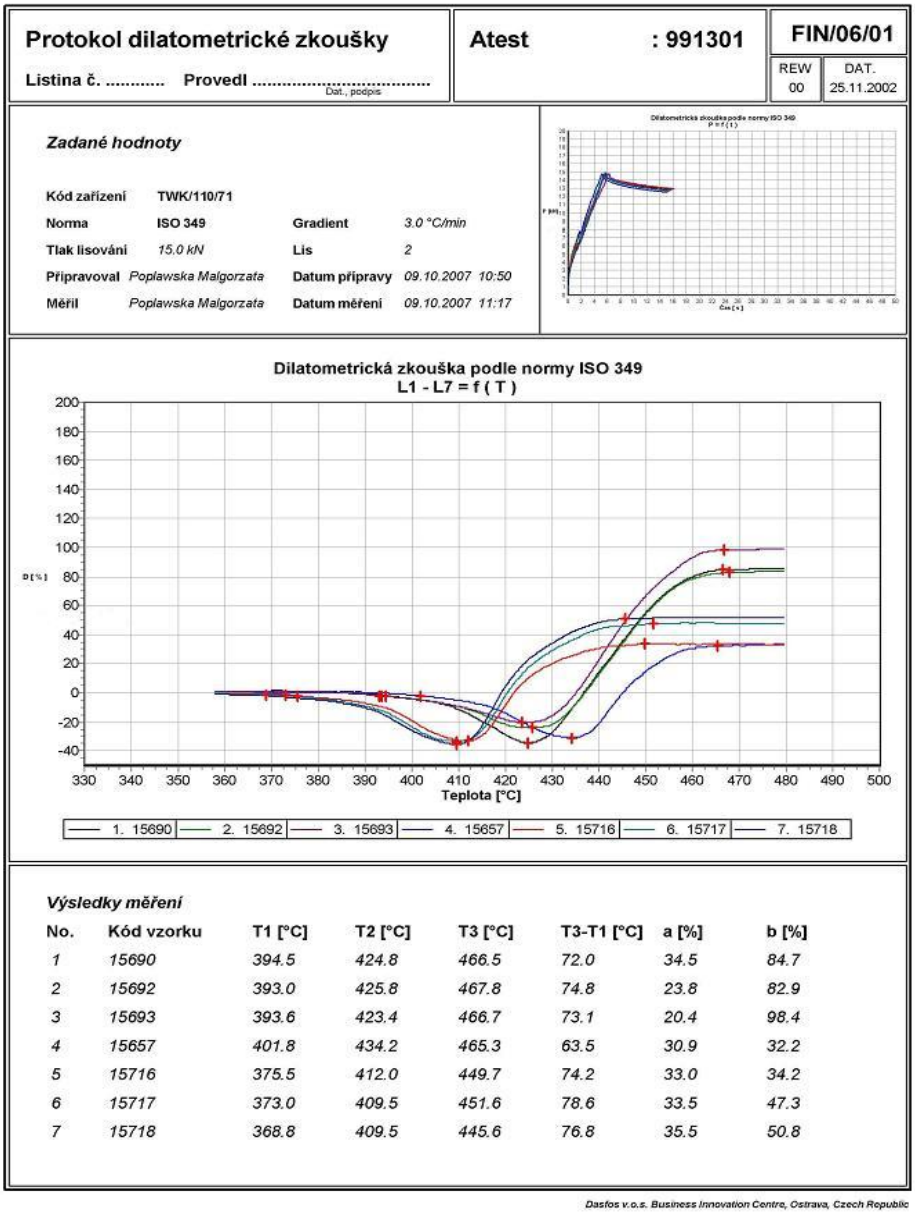
Informative photos



DF-7 Dilatometer, contactless measuring of pistons' movement from above

DF-7 Dilatometer, the control unit

From the left: Control computer – DF-7 Dilatometer – DL-7 Press



Protokol dilatometrické zkoušky

Listina č. ..... Provedl ..... (Dat., podpis)

Atest : 991301

FIN/06/01

REW	DAT.
00	25.11.2002

Zadané hodnoty

Kód zařízení	TWK/110/71		
Norma	ISO 349	Gradient	*3.0 °C/min*
Tlak lisování	*15.0 kN*	Lis	*2*
Připravoval	*Poplawska Malgorzata*	Datum přípravy	*09.10.2007 10:50*
Měřil	*Poplawska Malgorzata*	Datum měření	*09.10.2007 11:17*

Výsledky měření

No.	Kód vzorku	T1 [°C]	T2 [°C]	T3 [°C]	T3-T1 [°C]	a [%]	b [%]
1	*15690*	*394.5*	*424.8*	*466.5*	*72.0*	*34.5*	*84.7*
2	*15692*	*393.0*	*425.8*	*467.8*	*74.8*	*23.8*	*82.9*
3	*15693*	*393.6*	*423.4*	*466.7*	*73.1*	*20.4*	*98.4*
4	*15657*	*401.8*	*434.2*	*465.3*	*63.5*	*30.9*	*32.2*
5	*15716*	*375.5*	*412.0*	*449.7*	*74.2*	*33.0*	*34.2*
6	*15717*	*373.0*	*409.5*	*451.6*	*78.6*	*33.5*	*47.3*
7	*15718*	*368.8*	*409.5*	*445.6*	*76.8*	*35.5*	*50.8*

Dasfos v.o.s. Business Innovation Centre, Ostrava, Czech Republic

Printed final report of a dilatometric test (in Czech language)