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Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Dilatometer RMI AA04/08

ISO 349:1975

ISO 8264: 1989

- 4 dilatometric tubes-retorts
- Very easy operation
- In-built Intel Pentium industry standard PC computer
- Passive Cooling of Electronic
- Robust Construction
- Fast Cooling of Furnace

Hard Coal Testing

RMI
ANALYTICAL & TESTING INSTRUMENTS

Dilatation - Principle

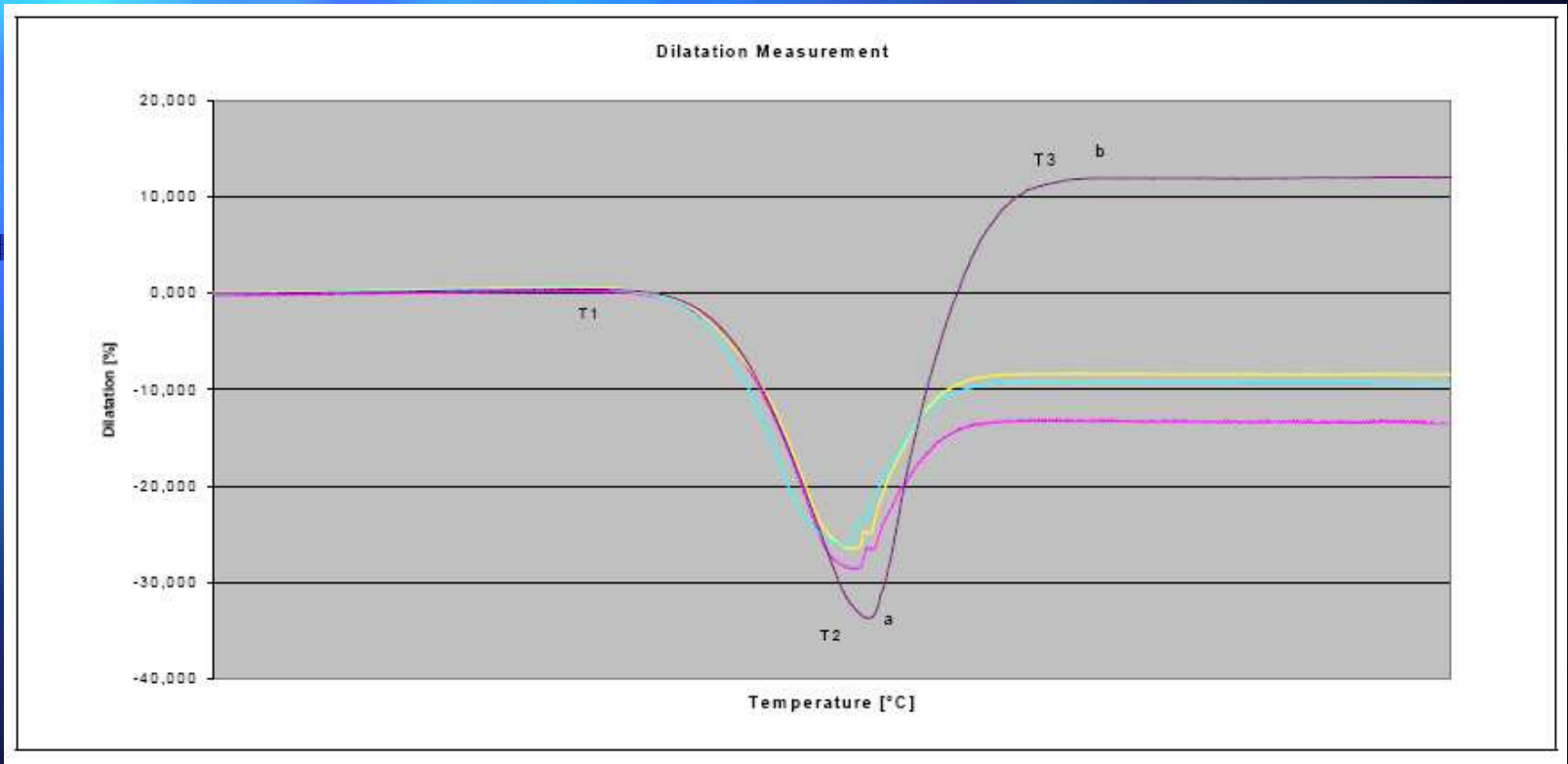
A test piece, in the form of a pencil, prepared from powdered coal is heated at a constant rate 3K/min in a steel retort positioned in a furnace.

The change in level of a piston resting upon the test piece is observed continuously, and a record is produced which is charateristic of the swelling properties of the coal.

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

DILATATION - The measurement of the swelling of hard coal using a dilatometer



Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Dilatation - Definitions

softening temperature; temperature of initial contraction
the temperature at which the downward movement of the dilatometer piston is 0,5 mm

temperature of maximum contraction
the temperature at which the dilatometer piston reaches its lowest point

resolidification temperature; temperature of maximum dilatation
the temperature at which the dilatometer piston reaches its highest point

maximum contraction
the maximum downward movement of the dilatometer piston, measured from the zero point and expressed as a percentage of the initial test piece length

maximum dilatation
the maximum upward movement of the dilatometer piston after contraction, measured from the zero point and expressed as a percentage of the initial test piece length

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Dilatation - Definitions

repeatability

the maximum acceptable difference between two determinations which are carried out in the same laboratory, by the same operator with the same apparatus, on test pieces prepared from the same test sample and tested simultaneously in two different retorts during the same heating cycle or separately in the same retort during different heating cycles

reproducibility

the maximum acceptable difference between the means of two determinations which are carried out in each of

two laboratories, on representative portions taken from the same gross sample, after the last stage of sample preparation

Hard Coal Testing

RMI
ANALYTICAL & TESTING INSTRUMENTS

Dilatation – Preparation of Sample

Sampling – min. weight – see ISO

Size reduction – 0.16 mm

- New ISO - passing 212 µm test sieve 100 %;
passing 125 µm test sieve 70 % to 60 %;
pass 63 µm test sieve 40 % to 30 %.

Storage of sample – oxidation problem

If necessary, store the test sample in an inert atmosphere in a sealed glass phial

Hard Coal Testing

RMI
ANALYTICAL & TESTING INSTRUMENTS

Dilatation – Preparation of Sample

Preparation of test piece

10 g of sample + app. 1 ml water – mixing

-mould, mallet (hammer) and press

- test piece with dimensions

- 60 mm ± 0,25 mm

-60 mm ± 0,5 mm (new ISO)

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Dilatation – Procedure

1. Place a test piece narrow end uppermost in the dilatometer retort and insert the piston into the retort so that it rests on the test piece.

2. Stabilize the furnace temperature at 30 °C below the expected softening temperature or, if this is unknown, at the appropriate temperature given in Table 2 or, if the volatile matter content is unknown, at 265 °C.

3. Insert the retort containing the test piece and piston in the appropriate hole in the furnace block and allow 10 min for the system to regain the stabilized charging temperature. Attach the recording mechanism to the piston during this period and start the test.

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Dilatation – Procedure

Table 2 — Furnace temperature

Volatile matter content of coal (dry, ash-free basis) % (*m*/*m*)	Stabilized charging temperature °C
38,1 and above	265
28,1 to 38,0	295
18,1 to 28,0	325
18,0 and below	355

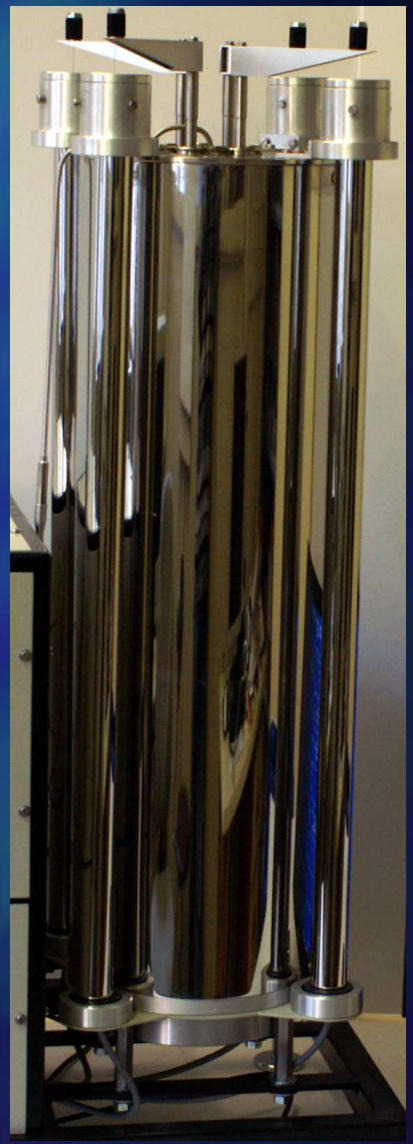
Hard Coal Testing

RMI
ANALYTICAL & TESTING INSTRUMENTS

Dilatometr Furnace

A furnace for heating of four retorts. Starting temperature settable, end temperature 550 °C at a rate of 3 K/min. The furnace comply all specifications of all ISO norms. Low mass special design of furnace with excellent temperature uniformity and fast active cooling.

Temperature controller – PID auto adaptive regulation. Max. difference from linearity 1°C.

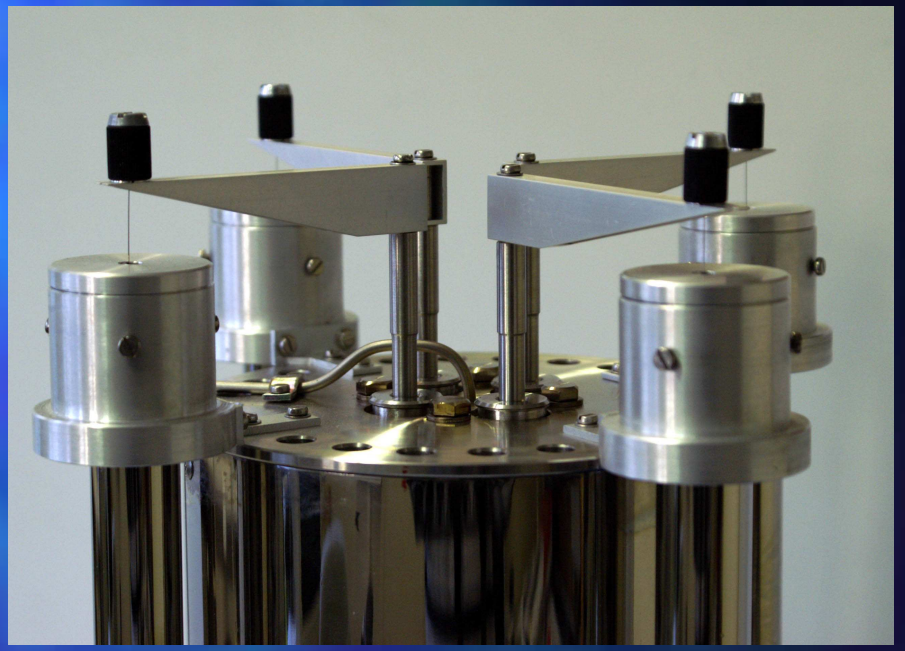


Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Sensors

- unique design of sensors
- LVDT types
- robust construction
- excellent stability
- easy maintenance



Specifications:	
Standardised Sample Height	60 mm - see ISO 349
Measuring Range	200 mm
Sensitivity of the LVDT	< 0,5 mm

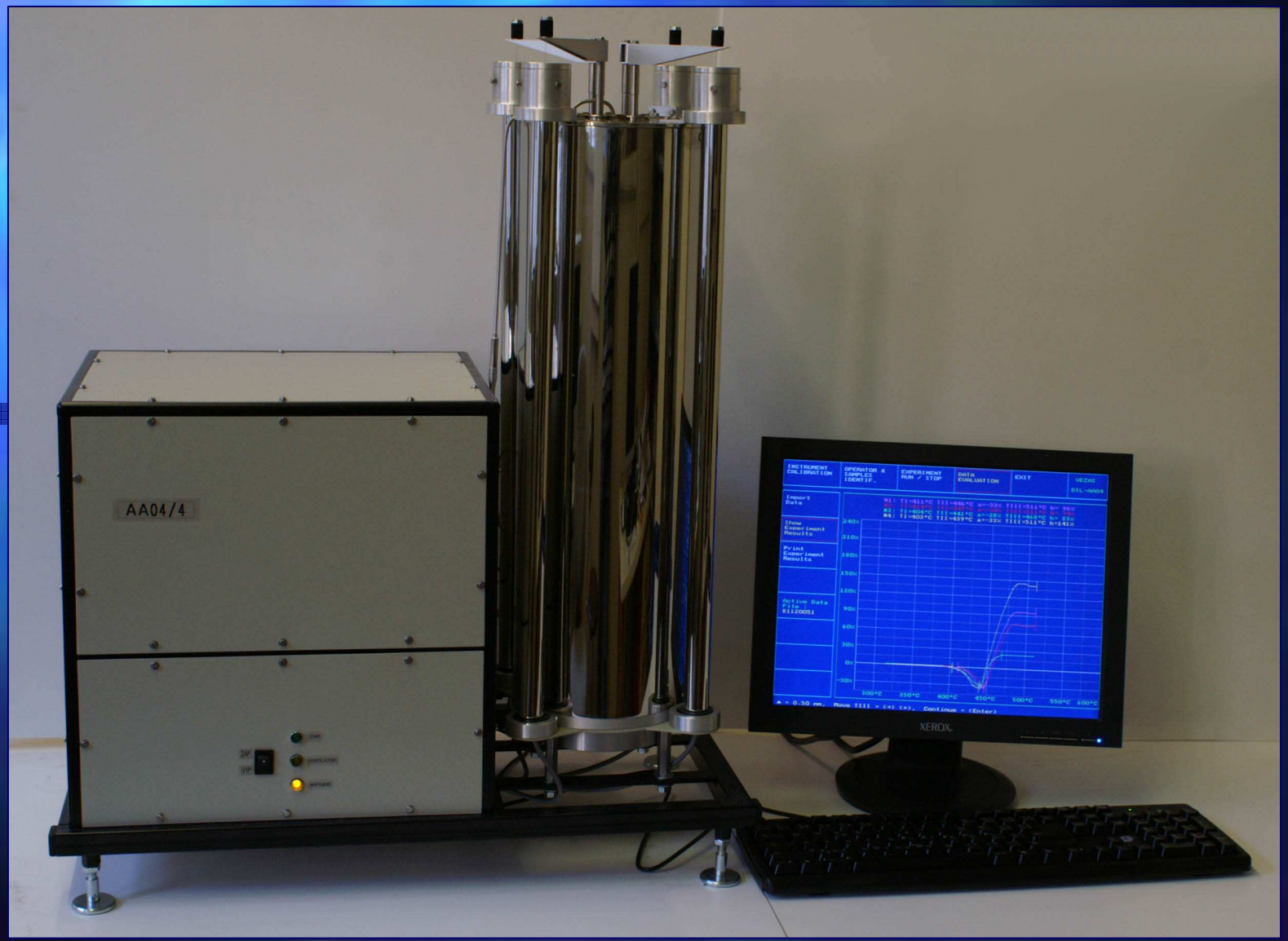
Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Electronics

Hard Coal Testing

RMI
ANALYTICAL & TESTING INSTRUMENTS



Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Software and connections

- DR DOS
- all software is in permanent memory – can be downloaded – upgraded
- excellent stability
- very easy to use
- designed for „routine low level labs“
- data storage – standard Compact Flash Cards
- data export – via CF cards
- data – Excell compatible
- COM printer port
- Ethernet – as option

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

AA 04 – one independet unit

AA 04/08 – two independet units with better price

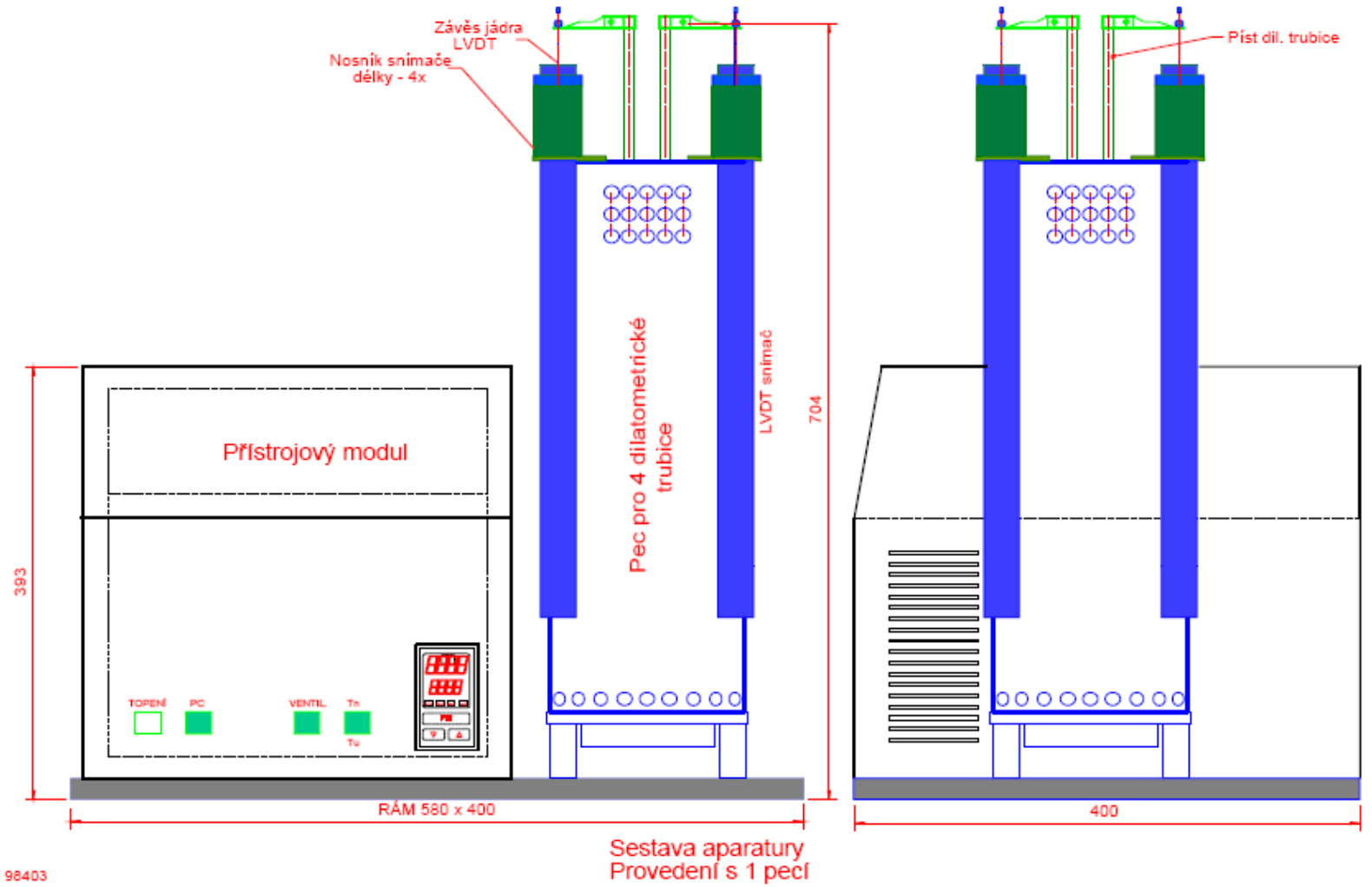
Advantages

– much more better flexibility

- speed of test – large furnaces needs long time for cooling !! (two or more times)

We are FAST and FLEXIBLE

Hard Coal Testing

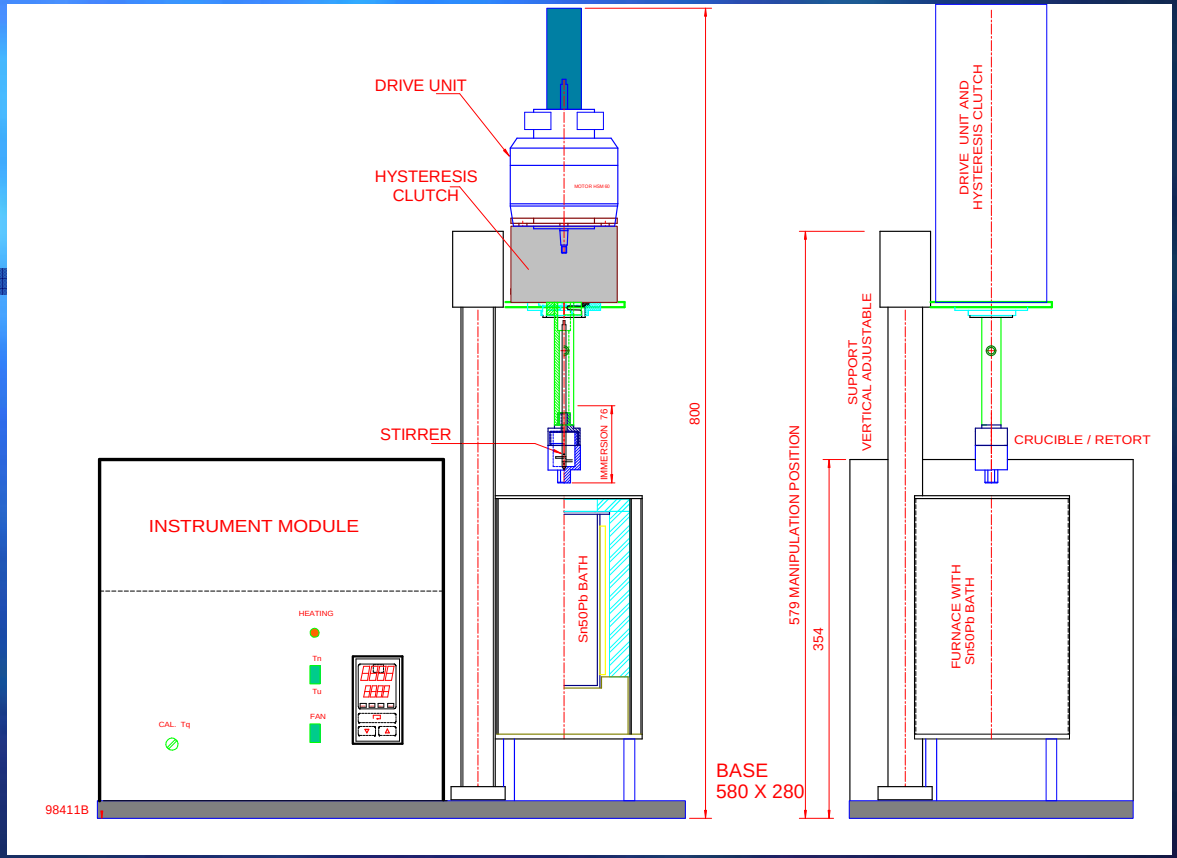


Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Gieseler Plastometer PLAST PM04

ASTM D2639-90



Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Gieseler Plastometer PLAST PM04

ASTM D2639-90

- One retort
- Very easy operation
- In-built Intel Pentium industry standard PC computer
- Passive Cooling of Electronic
- Robust Construction
- Fast Cooling of Furnace

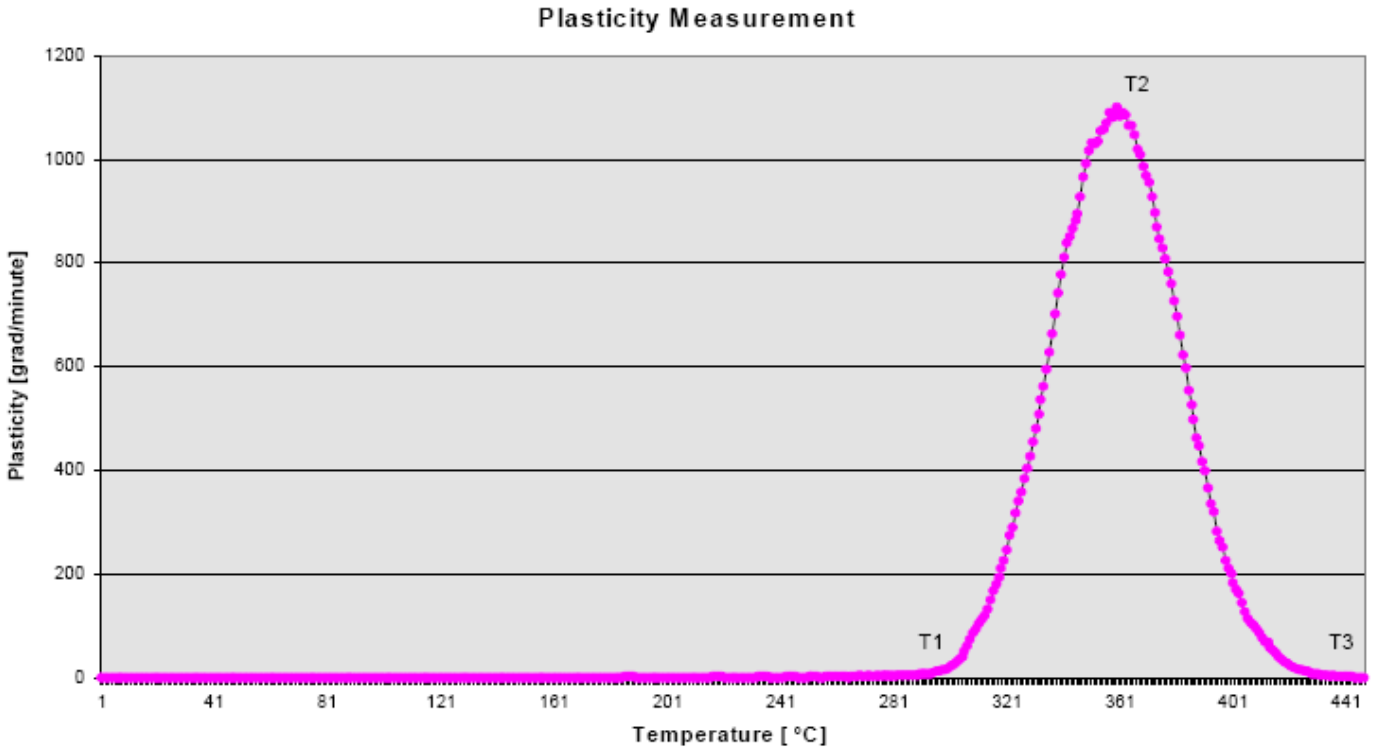
Hard Coal Testing

RMI
ANALYTICAL & TESTING INSTRUMENTS

Plasticity - Principle

Measurements of the plastic properties of coals are made by applying a constant torque to a stirrer placed in a crucible into which the coal is charged. The crucible is immersed in a bath (PbSn soldier) and the temperature increased uniformly (3 K/s). The rotation of the stirrer is recorded in relation to increase in temperature.

Hard Coal Testing



Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Plasticity - Definitions

Initial softening temperature

The temperature at which dial movement or electronic readout indicates a stirring shaft movement of 1.0 dial divisions per minute (dd/min), with continued indication of movement of at least 1.0 dd/min thereafter.

Maximum fluidity temperature

The temperature at which stirring shaft rotation reached the maximum rate.

Plastic range

The difference between the initial softening temperature and the solidification temperature.

Final fluidity temperature (new ISO)

The temperature at which stirrer rotation rate last reached 1 dd/min.

Solidification temperature

The temperature at which the stirring shaft stops.

Maximum fluidity

The maximum rate of rotation for the stirring shaft in dial division per minute.

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Plasticity - Definitions

repeatability

For duplicate tests carried out at different times in the same laboratory, by the same operator with the same apparatus, on representative portions taken from the same sample after the last stage of the reduction process, all characteristic temperature points should agree within 7°C. Likewise, maximum rates of dial drum movement of duplicate tests should agree with the repeatability values given above:

- **three results is less than 24 percent of the average**
- **the four results is less than 26 percent of the average**
- **the five results is less than 28 percent of the range, the average of all five shall be reported.**

reproducibility

Due to the inherent variance of test equipment, the values shown for Reproducibility are indicative only.

Experience with national Gieseler standards indicates that it is very difficult to assign tight limits.

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Plasticity – Sample Preparation

- Gross sample of coal in accordance with ISO 1988 and ISO 13909
- The drying temperature should not exceed 40°C – oxidation problem
- Grinding – size reduction –see ASTM or new ISO

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Plasticity – Sample Preparation

- Gross sample of coal in accordance with ISO 1988 and ISO 13909
- The drying temperature should not exceed 40°C – oxidation problem
- Grinding – size reduction –see ASTM or new ISO

Hard Coal Testing

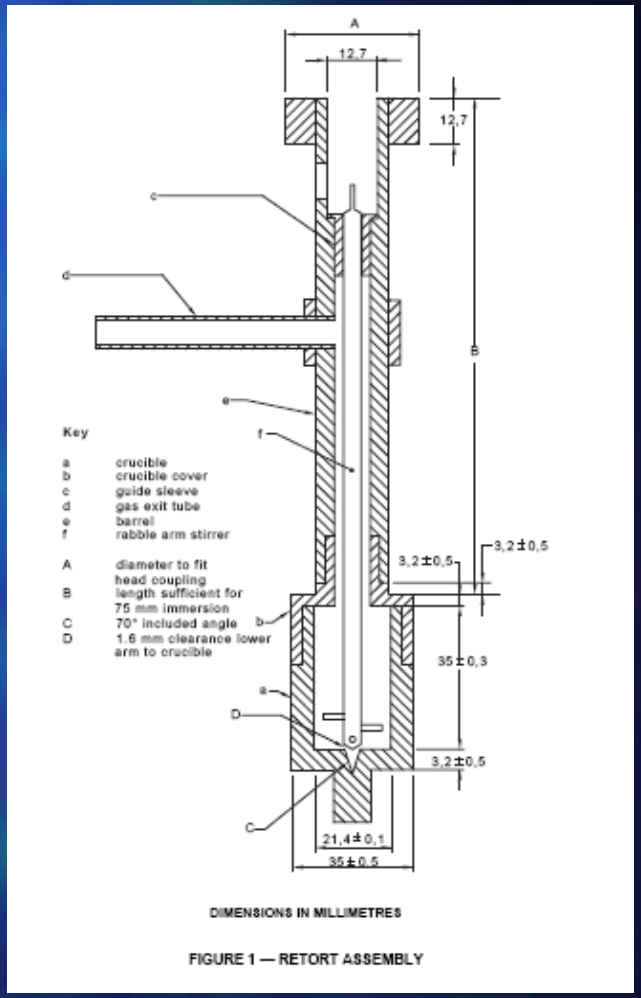
Plasticity – Test Retorte

Retort crucible

Cylindrical 21.4 ±0.1 mm inside diameter and 35 ±0.3 mm in depth with exterior threads for joining the crucible to the barrel. The crucible shall have a 2.38 ±0.02 mm diameter notch with an included angle of 70° in the centre of its inside base to serve as a seat for the stirrer.

Retort crucible cover

With interior threads for joining the crucible cover to the crucible and exterior threads for joining the crucible cover to the barrel. The inside diameter of the hole which accommodates the stirrer is 9.5 ±0.1 mm



DIMENSIONS IN MILLIMETRES

FIGURE 1 — RETORT ASSEMBLY

Hard Coal Testing

Plasticity – Test Retorte

Barrel

121.0 ±2.5 mm long having an inside diameter of 9.5 ±0.1 mm. The top end of the barrel shall be 12.7 mm in inside diameter to a depth sufficient to allow fitting of a guide sleeve through which the axle of the stirrer passes when the apparatus is assembled. A hole, fitted with a tube, shall be provided at the midpoint of the barrel to afford exit for the volatile products during a test.

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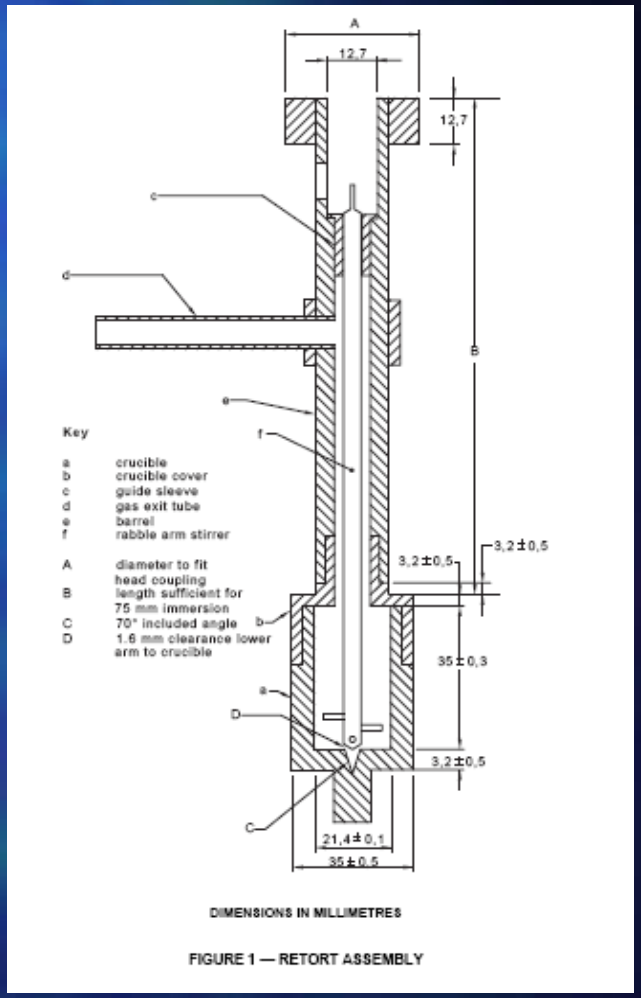
Steel stirrer

Provided with a straight shaft 3.95 ±0.05 mm in diameter and equipped with four rabble arms. The lower end of the stirrer shall be tapered to a point having an included angle of 60°. The rabble arms on the stirrer shall be 1.60 ±0.05 mm in diameter, 6.4 ± 0.05 mm in length, and shall be placed perpendicular to the shaft at 90° intervals around the shaft and 3.2 ±0.05 mm apart center to center along the shaft. The middle two rabble arms shall be set at 180° to each other, and likewise, the remaining two arms 180° to each other. The lowest rabble arm shall be set to give 1.60 ±0.05 mm clearance between it and the bottom of the crucible when the stirrer is in place. The upper end of the stirrer shall be cut to fit into a slot on the lower end of the axle in the plastometer head.



DIMENSIONS IN MILLIMETRES

FIGURE 1 — RETORT ASSEMBLY

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Plasticity – Procedure

- Adjust the hysteresis brake to 101.6 g.cm ±5 g.cm

- Mount the crucible, with the stirrer in place, in the loading device shown in Figure 5 but with the 10 kg weight removed and packing tamper raised. Charge 5.0 g of the prepared sample of coal into the crucible. Rotate the stirrer carefully with fingers in order to fill the voids under the rabble arms. Lower the packing tamper weight, making sure that the total weight is transmitted to the coal charge. Compress the charge by dropping the 1 kg weight twelve times from a height of 115 mm. For coals that are difficult to pack, it is permissible to add 1 to 3 drops of toluene on the shaft of the stirrer near the surface of the coal before the weight is added. Very dry coal may benefit by the addition of several drops of water and thorough mixing prior to packing.

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Plasticity – Procedure

- Remove the crucible from the loading device, screw on the crucible cover taking extreme care not to disturb the position of the stirrer in the coal. Screw the crucible and stirrer into the retort assembly. The stirrer should be centred in the guide sleeve. Screw the retort assembly onto the plastometer head, making sure that the top end of the stirrer fits into the slotted end of the axle.

- Lower the assembled apparatus into the furnace until the bottom of the crucible is immersed to a depth of 75 mm in the molten solder bath maintained at a temperature of 300°C. Place the thermocouple in the bath in accordance with Clause 5.3. The heating control shall be such that the bath will re-attain the initial temperature in 10 ±2 min after immersion of the retort. Thereafter, heat the retort at a rate of 3.0 ± 0.1°C/min on the overall basis. When the movement of the drum or readout from the electronic sensor has reached 1.0 dial division per minute, take readings of temperature and dial movement at 1 minute intervals. Continue readings until the dial shows no further movement.

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Plastometr Furnace

A furnace for heating of one retorts in soldier bath (Pb/Sn solder). Starting temperature settable, end temperature 550 °C at a rate of 3±0.1 K/min. The furnace comply all specifications of ASTM norm. Fast active cooling.

Temperature controller – PID auto adaptive regulation.

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Plastometr Furnace

Two temperature sensors
(heating element ant crucible) type K
Internal diameter of the
furnace 65 mm
Volume bath ~400 cm3
Charge of the alloy Sn50Pb 3 kg
Operating voltage 48 Vac
Input max. 800 W

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Head

- stirrer is loaded by constant torque 101,6 g.cm.
- magnetic clutch
- automatic calibration procedure with excellent reproducibilty
- excellent stability of torgue
- registration – 100 divisions per cycle – optoelectric

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Software and connections

- DR DOS
- all software is in permanent memory – can be downloaded – upgraded
- excellent stability
- very easy to use
- designed for „routine low level labs“
- data storage – standard Compact Flash Cards
- data export – via CF cards
- data – Excell compatible
- COM printer port
- Ethernet – as option

Hard Coal Testing

ANALYTICAL & TESTING INSTRUMENTS

Advantages

– much more better precision of calibration

- better long term stability

- better serviceability