petrotest®

Penetration & Texture Tester PNR

Manufacturer since 1873

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Petrotest® Company ..... on the rear

Special accessories and designs are not listed in the brochure but available on request.

Penetrometer PNR 12 & PNR 21 - Rheotex, similar but different

The two rheological instruments are looking similar but are different in function. Both instruments privide the information about the texture or the consistency of your goods.

With a little effort only you will get data about the quality of pasty or creamy products, their processing characteristics or their plasticity. Gain information about the elastic properties, the solidification and the setting of your product. Or you learn about the swelling up of a dough, the maturing of sausages or cheese.

„Which of the two is the better instrument?“ - This is not the question, because these two types of instruments do not compete with each other - they complement one another with their test results. But they work in a different manner, and therefore, the measurement results are different too. Each of them gives its own kind of test results.

Texture examinations must be easy and comfortable!

There is no reason to make difficult tasks even more complicated.

The one ...

the **PNR 12**, belongs to the group of conventional gravity-penetrometers, well proved for many decades and used for the determination of consistency of highly viscous and plastically workable stuff.

A needle shaped or a conical test body is precisely lowered to the surface of the material under test, and then sinks into the matter by its own weight during a defined test duration. This penetration, which is indicated in Penetration Units of 0.1 mm per unit or directly in millimeters, and allows a rating of the plasticity or consistency.

The origin of these penetrometers is in petroleum industry for testing the constitution of lubricating greases and waxes, or to measure the hardness of bitumens.

Due to its ease of manipulation the gravity-penetrometer has gained a wide scope of application: consistency tests of butter, margarine and other edible fats, in cosmetic and pharmaceutical industry to test jointments and creams, in dairy industry for the examination of yoghurts, cheeses etc, or to examine the condition of freshness or ageing of food and fruits.

Petrotest® presents a new generation of measuring instruments, based on:

- decades of experience in measuring low forces
- know-how of penetration tests on various materials
- CNC supported precise mechanical work
- micro processor technology
- software development

The other one ...

the **PNR 21** is a material testing machine for the lower force range, which allows to measure load forces as well as tensile stresses.

Although it very much looks like the penetrometer - and indeed the same test bodies are used occasionally - this instrument must not be considered as the more comfortable or more accurate one.

This apparatus works in a different manner, and therefore, shows other results: A suitably shaped (a needle, a cone, a cylinder or a plate) is pushed with a preprogrammed speed into the tested material or pulled out. The forces affecting the test body are measured and indicated in the form of a “displacement/force curve“ or as a“force/time function“.

As the PNR 21-Rheotex also determines tensile forces, the scope of application extends to examinations of adhesivity of sealants, cements etc.

Expressed as a formula:

The PNR 12 penetrometer measures the penetration depth in millimeters.
The texture analyzer PNR 21-Rheotex measures load and tensile forces.

PNR 12 gives one solitary displacement value at the end of a test.
PNR 21 provides a series of values, which can be shown as a force/displacement curve or as a diagram „force versus time“.


Needle-Penetration


Cone-Penetration


Rod-Penetration


Disk-Penetration


Plunger without Force Sensor

PNR 12

Microprocessor controlled penetrometer with digital read-out to examine plastic & elastic deformable substances

Needle-Penetration

Cone-Penetration

Rod-Penetration

and further methods

- suitable for research and routine tasks
- easy to operate
- solid but still precise
- standard test period 5 seconds

Advantages

The key advantages are:

Easy **Jog-Wheel** operation, manual or electronic positioning, **digital display** of parameters and values.

Test duration: can be preset between 0.1 and 18 000 seconds (5 hours). The automatic default value is set on 5 sec. when the unit is switched on.

Start delay: can be set on up to 600 seconds. The plunger and penetrator will not be released before the preset delay time has expired. This delay may be useful for tests that involve a temperature stabilization, as well as exactly reproducible reaction times which must pass.

Limit indicator: very helpfull for routine testing. An audible signal will appear if a reading lays outside upper and lower limits.

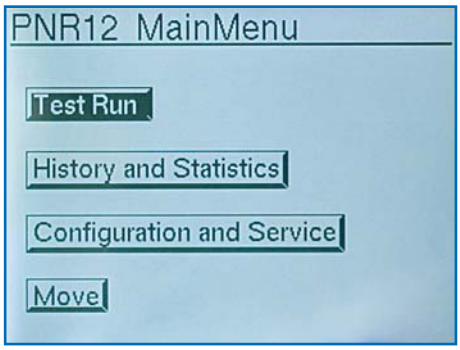
Conversions on demand into: NLGI-class, EN-bitumen value, c-value, 1/4-cone to solid-cone, 1/2-cone to solid-cone.

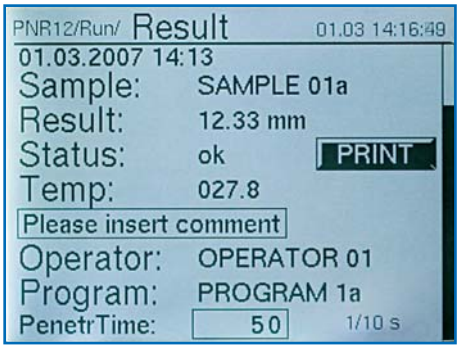
Setting of start-point: made easier on electrically conductive samples by an **electronic surface detector**, an ultra bright **LED lamp** and an **observation lens** both, on flexible arms.

USB-interface: to connect a printer or for data recording on an USB-stick.

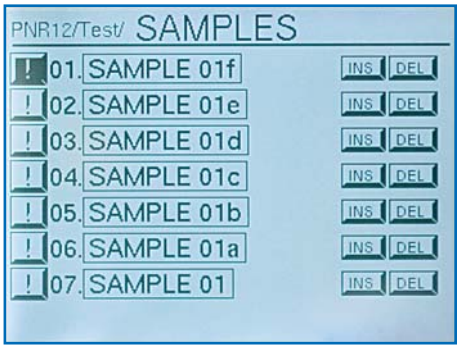
Precise adjustment: easy set up due to **leveling screws** on the Penetrometer base plate.

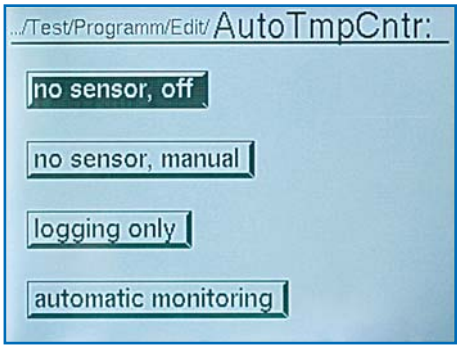
Jog-Wheel Control Pannel

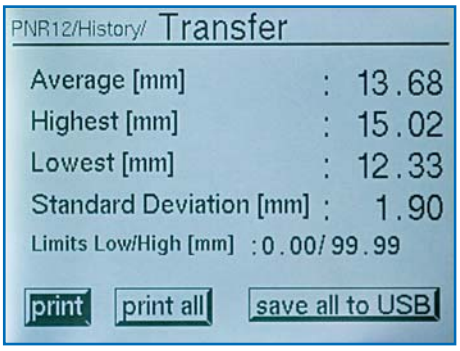




Connection Bar







Technical Data

Measurement Range:
0 to 55 mm

Resolution: 0.01 mm

Test Load: 2 kg max.

Test Duration:
0.1 to 18 000 seconds
preset standard duration:
5 seconds

Start Delay:
adjustable up to 600 sec.
(10 minutes)

Limit Indicator:
audible alarm when test value falls outside preset values.

Value Display:
digital indication of penetration depth in millimeters

Value Conversion:
on demand into NLGI-class, EN-bitumen value, c-value, 1/4-cone to solid-cone, 1/2-cone to solid-cone

Value Output:
USB interface for data recording on a memory-stick or the connection of a printer

Electronic Detector
for determining the precise contact of the penetrator on the surface of electrically conductive samples.

Weight: 10 kg (net)

Dimensions:
(L x W x H) 31 x 30 x 58 cm

Bitumen Test with Auto-Detection

Automatic Surface-Detection

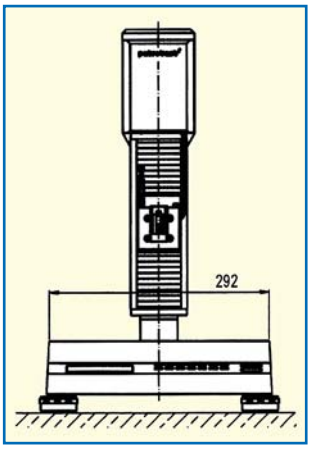
An optional **Extension Module** with **Force Sensor** detects the surface of bitumen-samples **underneath a layer** of water automatically.
The standardized test sequence can be started automatically as well.
This feature allows precise adjustment even by **unexperienced personal**.
For the bath-temperature control an additional **Temperature Sensor** is available.

Plunger with Force Sensor

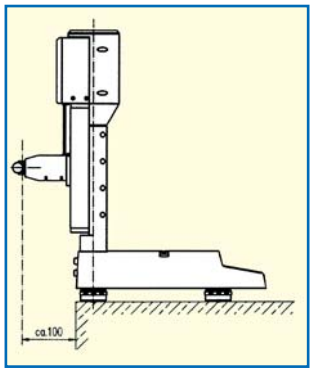
Temperature Sensor (18-1149)

PNR 21 - Rheotex

Microprocessor controlled texture analyzer with digital read-out to examine plastic & elastic deformable substances



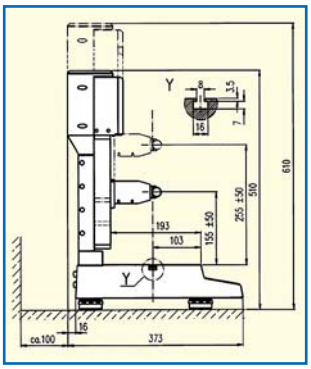
- suitable for research and routine tasks
- easy to operate
- solid but still precise
- individually set motion sequences with criteria of condition



Details

The PNR 21 is a compact but highly flexible texture analyzer, that demonstrates the forces, which occur when the properly choosen test body is pushed into the tested material or withdrawn.

Especially due to its easy and convenient handling the apparatus allows a quick and economical examination of the plastic & elastic properties of food, jointments and other pasty materials as adhesives, cements, plasters etc.



The user gains beneficial information about the ageing, the maturity or the curing, as well as the estimated subsequent processing.

PNR 21 Rheotex uses different test bodies. It depends on the measurement problem, whether a needle, a cone, a cylindrical or platelike ram is applied. These test bodies are mounted to a support-arm with force sensor which is attached to a vertically movable carriage.

The load or tensile forces, which affect the force sensor, when the carriage moves upwards or downwards are indicated on a computer screen as a force/time curve, a force/displacement diagram or as a displacement/time function.

In particular cases like the pull tests of adhesive foils, a fixing clip is fastend on the support-arm instead of a test body.

The position of the measuring carriage or the test body is programmable as to direction, velocity, stroke length or time. Further a force-threshold can be set, which causes a jump to the next program step or the test termination.

Up to 10 program steps can be preset and combined in optional order to create a test procedure.

Offering the possibility to generate tests

- with automatic contact of the sample surface
- alternating load tests or oscillating programs
- program loops with constant load
- pauses and no motion stages

For the PNR 21 as: Observation of deformation processes of doughs, pastes and similar viscous material.

Examination of the elastic properties of those materials using alternating load tests or monitoring the time/force characteristics.

Further applications are found in the bakery industry, where the soaking of doughs is to be examined, or in other branches of the food industry, when the maturing of sausages, cheese or other dairy products shall be examined.

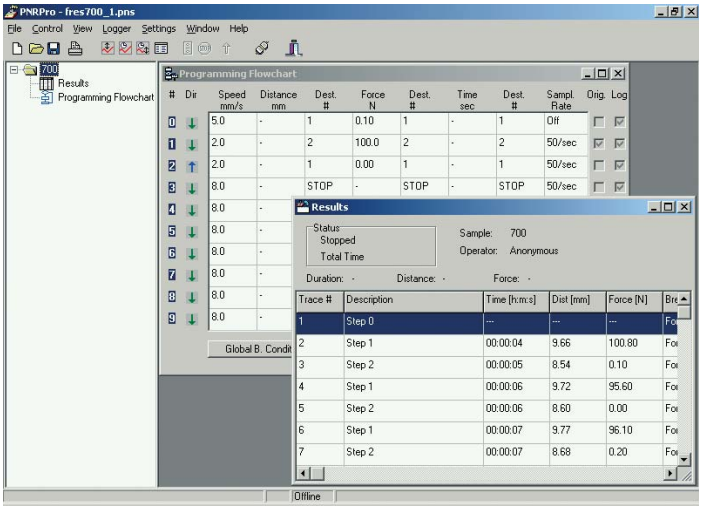
In order to infer the storing and shipping capability of fruit by the state of ripening or to gain information about further processing, a platelike ram is used to generate a certain compression force.

A special case is the determination of the hardness of butter and other edible fats. The german standard DIN 10 331 measures the force which is needed to cut a sample cube with a cutting wire strained in a fork.

The instrument permits to monitor curing and congealing reactions of adhesives, mortars etc. or to observe the behaviour of sealing matter and cements.

The creation of test programs is very easy.
Either made directly on the instrument or by using PNRCon software and a PC with Windows.

The **PNRPro Software** (as shown) is optional and offers additional possibilities.



The use of a computer does not only enable a much easier and more extensive creation of test procedures, but also allows their storage and reloading.
The test results can be stored and shown as a force/displacement diagram, or as a force/time or displacement/time function.

Technical Data

Operating Span:
Force: ±100 Newtons

Displacement:
100 mm (start position of measuring carriage can be varied by the user)

Speed: 0.1 - 8 mm/s (480 mm/min) ±0.1 %

Resolution:
Force measurement:
up to 9 Newtons: 0.01 N
more than 9 Newtons: 0.1 N
Displacement: 0.01 mm

Data Output:
a) Digital Display on the instrument shows actual test parameters and measured values directly.

b) Measured Value Printer to print-out of test parameters and end value of the last program step.

c) PC to indicate, print-out and store (as a data file and/or ASCII file to export to other programs) all test parameters, measured values and their graphic displays.

RS232-Interfaces:
9-pin PC interface (bidirectional) and
25-pin printer interface (transmits the final value only)

Dimensions: (L x W x H)
approx. 320 × 375 × 500 mm
weight: 11 kg approx.

Accessories:
a) included in delivery:
- PNRCon software (for Windows)

b) not included in delivery:
- Pentium PC (min. 233 MHz with a free bidirectional RS232 interface and a parallel printer)
- PNRPro software
- Measured Value Printer to connect at serial 25-pin socket

Power supply:
115 - 230 V, 50/60 Hz
(with EU or US-plug)

18-1120 (without Kit)

Sensor-Plungers
(18-1135/18-1136/18-1137)

Temperature Sensor (18-1149)

18-1145

Leveling Bulb (18-1146)

Penetrometer

18-1120 **PNR 12 - Automatic Penetrometer**

Accessories have to be selected according to the standard.
(Suitable for: Needle-, Cone-, Rod-Penetration and further methods)

Features:
- manual positioning by Jog-Wheel operation
- electronic positioning to a preset depth with Memory-function
- surface detection by conductivity sensor
- 16 user programs possible
- data transfer to USB-Stick possible
- extra bright LED-sample illumination

Consisting of:
Microcomputer, electronic distance measuring device, stepper motor for exact positioning, 24 V safety voltage supply, stable base plate and housing.

Microcomputer:
Large graphical monochrome display, intuitive graphical menu, status feedback to operator, Jog-Wheel driven menu (turn & push), storage of last 200 measurements.

The **Surface-Detection Software** of the PNR 12 will be activated by sensor-plungers. This option will detect the surface of bitumen-samples underneath a layer of water, it starts the standardized test sequence and reports the results automatically.

Electronic Elements:
Distance measuring device (1/100 mm), stepper motor, ultra bright LED-sample illumination on flexible arm, electronic detector for conductive samples, USB-interface for printer & memorystick.

Mechanical Elements:
Penetrometer base plate with leveling feet and removable aluminum test table, instrument housing two colored powder coated, splash water protected membrane keyboard, plunger holder with solenoid release mechanism and observation lens with flexible arm

To be ordered separately: Test Accessories (test kit, needle, cone etc.) are required!

Technical Data:

Measuring range	: 0 to 55 mm
Max. test load	: 2 kg
Resolution	: 0.01 mm
Test duration	: 0.1 to 18000 seconds (preset standard duration: 5 seconds)
Start delay	: adjustable up to to max. of 600 sec. (10 minutes)
Data output	: USB interface to connect printer or USB-stick
Surface detector	: for electrically conductive samples
Dimensions	: 30 x 31 x 58 cm (WxHxD), weight 10 kg
Power supply	: 100/240 V, 50/60 Hz, EU-plug

Note: Test Accessories, Tempering Units etc. are listed on the following pages!

Options & Accessories

Sensor-Plunger "Force"

Features:
plunger with an extremely sensitive force sensor for the automatic surface detection underneath a layer of water. It activates the related the PNR 12 software automatically. Suitable for Bitumen-samples (<160 PU) and **for PNR 12 only!**

18-1135 ... **47.5 g** (for max. 1 additional weight)
18-1136 ... **97.5 g** (for max. 1 additional weight)
18-1137 ... **97.5 g extra long** (for up to 4 additional weights of 50g (18-1200) or 100 g (18-1201))

18-1149 **Temperature Sensor** with PT-100 to monitor the sample-bath temperature

18-1145 **Calibration Kit "PNR 12"** for calibration of distance, time and temperature.

Supplied with:

for distance calibration	: 1 test ram & 4 gauge blocks (5 / 9 /15 & 25 mm)
for time calibration	: 1 contact-rod & 1 stop watch (electric input)
for temperature calibration	: 2 reference-plug (+20°C & +90°C)
to be ordered optional	*: 21-0662 thermometer ASTM D 63C, officially certified*

21-0697 Electronic Digital **Stop Watch**
21-0698 Electronic Digital **Stop Watch**, calibrated

Serial Impact Printer for single sheet & continuous paper, with USB-interface to record data like test results, duration of test, etc. (instead of a PC)

Supplied with: 1 data transmission cable, 1 ink ribbon (black)

25-0282 Power supply: 220/240 V, 50/60 Hz
25-0283 Power supply: 100/130 V, 50/60 Hz

Spare Parts

18-0705 **Electronic Surface-Detector for conductive samples**
complete with contact hook and wire

18-1146 **Leveling Bulb "PNR"**,
with pole for horizontal adjustment

25-0284 **Ink Tape** for serial printer

Texture Tester

PNR 21 - Rheotex Texture Tester
Consisting of:
testing machine for texture and consistency examinations, covering load and tensile forces up to 100 Newtons, max. displacement 100 mm, traveling speed 0.1 to 8 mm/s, RS232-interface for printer or PC connection, control and programming software PNRCon used to record measured values, their graphic display, as well as to save test results and test programs.

Supplied with:

a) delivery does include:
- PNRCon software (for Windows)

b) delivery does not include:
- ordinary Pentium PC: (min. 233 MHz recommended) with at least 1 free RS 232-interface and extended software PNRPro
- printer: customary printer with parallel data input socket (probably already installed with PC).

18-1700 Power supply: 115-230 V, 50/60 Hz, EU-plug
18-1701 Power supply: 115-230 V, 50/60 Hz, US-plug

18-1700 + Kit

Note: Test Accessories, Tempering Units etc. are listed on the following pages!

Options & Accessories

18-1721 **PNRPro Software**
offering additional possibilities like simultaneous display of stored master curves and comparison of actual test curve, statistical analysis, storage of test series in a data base for comfortable comparison and their statistical evaluation, programmable zero setting for a defined program step (labeling), menu in English.


Included in 18-1700

Circulator-Baths & Accessories
Details see page 24.

Testbodies

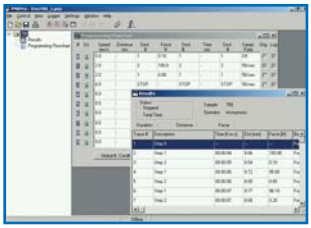
18-0279 **Needle "VICAT"**, 2 g, flattened, Ø 1 mm, effective length 35 mm, stainless steel

18-0255 **Penetration Ball**, 6.3 g, Ø 6.3 mm, overall length with shaft 100 mm, brass

18-0045 **Plunger**, 10 g, length 107 mm, aluminum
for test needle 18-0279, test ball 18-0255 and other penetrators

Test Ram
18-0251 15.0 g, Ø 8 mm, 40 mm effective length, with plane end face, aluminum
18-1726 21.8 g, Ø10 mm, 100 mm overall length, with plane end face, aluminum

Platelike Test Ram „Adhesion“
18-0247 10 cm² (Ø 35.7 mm)
18-0248 20 cm² (Ø 50.5 mm)

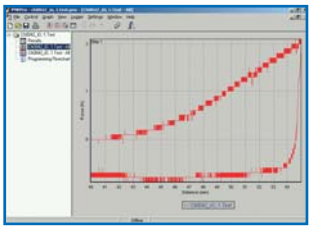

18-1721
PNR Pro

18-1560 **Test Kit “Butter”** DIN 10 331 (more details see page 12)

18-1728 **Test Kit “Adhesive Strength”** (more details see page 12)

To heat-up ram, sample and jar to the requested temperature without getting in contact with the tempering fluid.

Note! Requires a circulation thermostat (not included).



18-2221

18-2222

18-2223

18-2224

18-2225

Test Sets

This section lists complete sets of sample jars, plungers and penetrators which have proven practical on the based on experience or which are required by standards or relevant measuring regulations for specific applications.

All elements of these penetrator combinations are, also available individually.

In dimensions and weight the test accessories are according the stated standards.

Petrotest® Instruments will take no responsibility for the correct procedure process, since the measurement procedures are set up by the standard councils. (Especially "Ball-Penetration" according ASTM D 5329/EN 13 880-3)

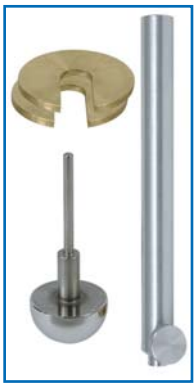
Material	Penetrator / Specification	Order No.	Complete Set
Bituminous materials, Chocolate, Confectionery, Lipstick, Compact powder, Soap, Yeast	**Standard needle 2.5 g** ASTM D 5, AASHTO T 49, JIS K2207	**18-2220**	3 standard needles, 2.5 g (18-1160) 1 plunger, 47.5 g (18-0042) 1 load weight, 50 g (18-0051) 5 sample jars I, Ø 55 x 35 mm (18-0066) 1 Petri dish I, Ø 43 x 11 mm (13-0514) 1 tempering bath (18-0065)
	Standard needle 2.5 g EN 1426, (IP 49 with accessories)	**18-2221**	3 standard needles, 2.5 g (18-1160) 1 plunger, 47.5 g (18-0042) 1 load weight, 50 g (18-0051) 5 sample jars I, Ø 55 x 35 mm (18-0066) 1 sample jar III, Ø 70 x 45 mm (18-0068) 1 sample jar V, Ø 70 x 60 mm (18-0069) 1 reduction ring Ø 53/36 x 20 mm (18-0076) 1 reduction ring Ø 53/36 x 30 mm (18-0077) 1 tempering bath, Ø 160 x 80 mm. with serpentine heat exchanger tube (18-0070) 1 intermediate bottom(18-0091) 1 thermometer holder (18-0094) 1 thermometer ASTM 63C -8 to +32 : 0.1 °C (90-0106) 1 thermometer ASTM 64C +25 to +55 : 0.1 °C (90-0107)
Bitumen <350 PU*	**Standard needle 2.5 g** ASTM D 5 (<350 PU), EN 1426 (<330 PU) manual surface detection	**18-2222**	3 standard needles, 2.5 g (18-1160) 1 plunger, 97.5 g (18-0050) 3 sample jars I, Ø 55 x 35 mm (18-0066) 1 sample jar III, Ø 70 x 45 mm (18-0068) 1 tempering bath, Ø 160 x 80 mm. with serpentine heat exchanger tube (18-0070) 1 intermediate bottom(18-0091) 1 thermometer holder (18-0094) 1 thermometer ASTM 63C -8 to +32 : 0.1 °C (90-0106)
Bitumen <160 PU*	**Standard needle 2.5 g** ASTM D 5 (<160 PU), EN 1426 (<160 PU) (100 g, 5 seconds) **automatic** surface detection (for PNR 12 only)	**18-2223**	3 standard needles, 2.5 g (18-1160) 1 sensor-plunger, 97.5 g (18-1136) 3 sample jars I, Ø 55 x 35 mm (18-0066) 1 tempering bath, Ø 160 x 80 mm. with serpentine heat exchanger tube (18-0070) 1 intermediate bottom(18-0091) 1 thermometer holder (18-0094) 1 temperature sensor PT-100 (18-1149)
Bitumen >330 PU*	**Long Standard needle 2.5 g** ASTM D 5 (>350 PU), EN 1426 (>330 PU) manual surface detection	**18-2224**	3 long standard needles, 2.5 g (18-9994) 1 plunger, 97.5 g (18-0050) 3 sample jars, Ø 55 x 70 mm (18-0075) 1 tempering bath, Ø 160 x 80 mm. with serpentine heat exchanger tube (18-0070) 1 intermediate bottom(18-0091) 1 thermometer holder (18-0094) 1 thermometer ASTM 63C -8 to +32 : 0.1 °C (90-0106)
Modified Bitumen <160 PU*	**Standard needle 2.5 g** ASTM D 5 (<160 PU) (200 g, 60 seconds) **automatic** surface detection (for PNR 12 only)	**18-2225**	3 standard needles, 2.5 g (18-1160) 1 sensor-plunger, 97.5 g (18-1136) 1 load weight, 100 g (18-1201) 3 sample jars I, Ø 55 x 35 mm (18-0066) 1 tempering bath, Ø 160 x 80 mm (18-0065) 1 intermediate bottom(18-0091) 1 thermometer holder (18-0094) 1 temperature sensor PT-100 (18-1149)

* PU = Penetration Unit = 0.1 mm

Test Sets (continued)

Material	Penetrator / Specification	Order No.	Complete Set
Bitumen	**Test ram** Van der Baan Bitumen Index EN 13 179-2	**18-2370**	1 aluminum ram 0.5 cm², Ø 8 mm, 15 g (18-0251) 1 sample jar Ø 30 x 30 mm (18-0252)
Soap (softening time)	**Test cutter**	**18-0270**	1 test cutter, 140 g, stainless steel (18-0270)
Silicone rubber	**Test ram**	**18-2390**	1 test ram Ø 6.3 mm, 6.4 g (18-0272) 1 plunger, 47.5 g (18-0042)
Bread (Softness, crumb strenght)	**AIB Test ram** American Institute of Baking, Chicago	**18-2350**	1 test ram (18-0241) 1 plunger, 98 g (18-0043) 1 load weight (18-0051) for 215 g overall load
	Test cap Deuroback (Hannover) testing proposal	**18-2351**	1 calotte-tipped test cap, 50 g (18-0243) 1 plunger (18-0045) 2 load weights, 25 g (18-0056)
Cement etc. (Curing time, setting time)	**Test ram**	**18-2271**	1 test ram, Ø 3 mm, 4.3 g (18-0271) 1 plunger, 47.5 g (18-0042)
Plaster / Gypsum	**VICAT needle and special cone** ISO 6873	**18-2273**	2 VICAT needles, 2 g (18-0279) 1 plunger, 98 g (18-0043) 2 load weights, 100 g (18-0052) 1 special cone, 85 g (18-0280) 1 plunger, 15 g (18-0044) 2 plaster / gypsum molds (18-0281) 2 base plates (10-0057)
Sealant, fillers	**Ball-Penetration** ASTM D 5329, EN 13 880-3, BS 2499-3	**18-2213** **18-2214**	(for PNR 10 only) or (for manual Penetrometer only)
	Optional hollow cone ASTM D 5329, EN 13 880-2	**18-2215**	1 optional hollow cone, 102.5 g (18-0101) 1 plunger, 47.5 g (18-0042) 1 sample jars Ø 55 x 35 mm (18-0066) 1 tempering bath (18-0065) 1 spacer plate for tempering bath (18-0091)
Putty and fruit, viscous pastes, cheese	**Pin needle**	**18-2321**	1 plunger, 15 g (18-0044) 1 load weight, 2 g (18-0053) 3 pin needles, 3 g, brass (18-0221)
		18-2322	3 pin needles, 3 g stainless steel (18-0222) 1 plunger, 15 g (18-0044) 1 load weight, 2 g (18-0053)
Petroleum waxes, parrafins yeast, sausages and meat products, marzipan, chocolate	**Tapered needle** ASTM D 1321, DIN 51 579, IP 376	**18-2230**	2 tapered needles, 2.5 g (18-0081) 1 plunger, 47.5 g (18-0042) 1 load weight, 50 g (18-0051) 3 wax test cylinders, Ø 25 x 32 mm (18-0078) 3 base plates (18-0085) 1 tempering bath (18-0170) 1 thermometer ASTM 64C (21-0653)
Vaselines, paraffines (penetration >150) edible fats, pudding, jelly, face & skin cream, pastes, emulsions, paints, putty filters, yogurt, curds, substances similar to lubricants, mayonnaise	**Optional hollow cone** ASTM D 937, IP 179, ISO 2137	**18-2251**	1 optional hollow cone, 102.5 g (18-0101) 1 plunger, 47.5 g (18-0042) 1 vaseline jar Ø 100 x 65 mm (18-0104)
	Optional hollow cone DIN 51 580	**18-2252**	1 optional hollow cone, 102.5 g (18-0101) 1 plunger, 47.5 g (18-0042) 3 wax test cylinders with base plate, Ø 50 x 40 mm (18-0089) 1 tempering bath (18-0065)
	Optional hollow cone ASTM D 217, IP 50, ASTM D 7342, DAB 10-V.5.8.1	**18-2260**	1 optional hollow cone, 102.5 g (18-0101) 1 plunger, 47.5 g (18-0042) 1 grease jar, Ø 76.5 x 63.5 mm (18-0103)

18-2390



18-2351

18-2215

18-2230

18-2260

18-2380

18-2380

18-2175

18-1728

Test Sets (continued)

Material	Penetrator / Specification	Order No.	Complete Set
Small quantities of fats, greases or lubricating grease, ball bearing greases	**Quarter-scale cone** ASTM D 1403, IP 310	**18-2270**	1 plexiglas quarter-scale cone with metal tip, 1.08 g (18-0131) 1 plunger, 8.3 g (18-0132) 1 grease jar with cover Ø 19 x 11 mm (18-0133)
	SHELL half-scale cone ASTM D 1403, IP 310, SMS 658	**18-2280**	1 SHELL half-scale cone, 22.5 g (18-0141) 1 plunger, 15 g (18-0044) 5 sample jar (18-0142)
Substances similar to lubricating grease solid or semi-liquid cosmetic cream	**Micro-cone ASTM D**	**18-2290**	1 micro-cone, 5 g (18-0151) 1 plunger, 15 g (18-0044) 1 three-section grease collection jar (18-0153)
	Micro-cone KLEIN DAB 10-V.5.8.1 European Pharma-copoeia	**18-2300**	1 micro-cone KLEIN, 7.0 g (18-0161) 1 plunger, 16.8 g (18-0162) 1 grease collection jar (18-0153) 1 centering disk (18-0155)
Semi-liquid lubricating graeses, jam and marmelade, ketchup, mustard, paints and varnishes, printing inks, fruit preparations	**Perforated disk ASTM**	**18-2310**	1 perforated disk, 102.5 g (18-0201) 1 plunger, 47.5 g (18-0042) 1 grease jar Ø 76.5 x 63.5 mm (18-0103)
	Solid cone ASTM D 217, IP 50	**18-2311**	1 solid cone, 102.5 g (18-0112) 1 plunger, 47.5 g (18-0042) 1 grease jar Ø 76.5 x 63.5 mm (18-0103)
Mayonaise, mustard, semi-liquid fats and greases, rubber solutions	**Conical perforated disk**	**18-2380**	1 conical perforated disk Ø 35 mm, 19.5 g (18-0254) 1 plunger, 15 g (18-0044) 3 load weights, 5, 10 and 20 g (18-0054, 18-0055, 18-0056)
Semi-liqiud fats, greases & pastes, emulsions, honey, paints & varnishes, potting compounds, ceramic pastes	**Hollow rod**	**18-0260**	1 hollow rod, 7 g, 10 mm 3 load weights, 3, 13 and 23 g
	Plexiglas rod	**18-0261**	1 plexiglas test rod, 10 g, Ø 10 mm (18-0261)
Curd-based foodstuff, yogurt, cream, paints & varnishes	**Hollow plexiglas cone**	**18-2361**	1 hollow plexiglas cone, 15 g (18-0122) 1 plunger, 10 g (18-0045)
Soft pastes, toothpaste, printing inks	**Test cylinder with tip**	**18-2330**	1 set of test cylinders with tip (18-0231 and 0232) 1 plunger, 15 g (18-0044)
Viscous substances, paints & varnishes, glue, jam, puddings, gelatine, mustard	**Perforated disk** with cylindrical holes	**18-2341**	1 perforated disk, 11 g (18-0211) 1 plunger, 10 g (18-0045) 5 sample jars III (18-0068)
		18-2342	1 perforated disk, 28 g (18-0212) 1 plunger, 10 g (18-0045) 5 sample jars III (18-0068)
Edible fats, butter, margarine, solid emulsions, confectionery and candy	**Aluminum cone** AOSC Cc 16-60	**18-2360**	1 AOSC-aluminum cone 20°, 45 g (18-0171) 1 plunger, 47.5 g (18-0042)
	Aluminum cone Unilever method	**18-2175**	1 aluminum cone 40°, 31.5 g (18-0176) 1 plunger, 48.5 g (18-0177) 1 load weight, 80 g (18-0178)
	Butter cutting wire (for PNR 21 only) DIN 10 331	**18-1560**	1 fork with adjustable cutting wire (18-1561) 5 frames, 25 x 25 mm (18-1562)
Paint, Glue	**Adhesion ram** (for PNR 21 only)	**18-1728**	1 adhesion ram set, incl. a Ø 3 + 10 mm ram (18-1729) 1 tempering plate (18-1730) 3 sample jars, Ø 15 x 0.4 mm (18-1731)

Needles

Very many aspects apply to selection of the best-suited penetrators and no hard and fast selection rules can be given.
In general and as an initial approximation, we can state the following:

The harder and more solid the material to be measured, the more pointed and needle-like the penetrator should be.
The specified test needles have proven practical for measurements on fruit, cheese, yeast and chocolate, etc.

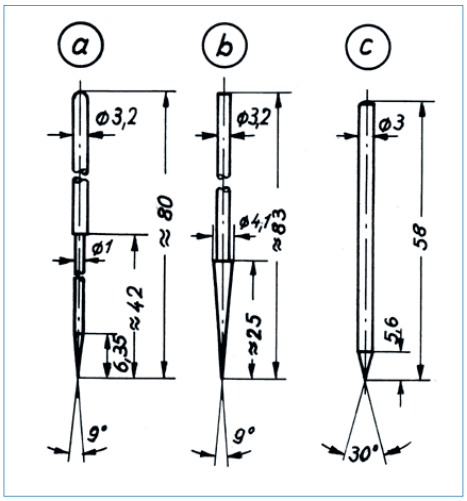


Fig. 1

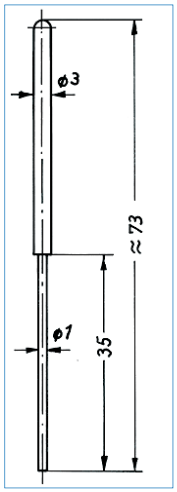


Fig. 2

Order No.	Description	Weight	Material	Remarks
18-1160	**Standard needle** ASTM D 5 - IP 49 - EN 1426	2.5 g	brass / stainless steel	suitable sample jars: 18-0066, 18-0067, 18-0068, 18-0069, 18-0090 reduction rings: 18-0076, 18-0077 Fig. 1a
18-1161	...with PETROTEST **works certificate** ASTM D 5 - IP 49 - EN 1426			
18-1163	…**officially certified**, with UKAS certificate **acc. IP 49 - EN 1426**			
18-1164	…**officially certified**, with UKAS certificate **acc. ASTM D 5** (IP 49 - EN 1426)			
18-9994	**Standard needle**, extended version for measurements up to 500 PE (50 mm)	2.5 g	brass / stainless steel	
18-0081	**Tapered needle** DIN 51 579 - ASTM D 1321 - IP 376	2.5 g	brass / stainless steel with ID-number	suitable sample jars: see 18-0083 Fig. 1b
18-1180	...with PETROTEST **works certificate**			
18-1182	…**officially certified**, with NAMAS certificate			
18-0221	**Pin needle**	3.0 g	brass	Fig. 1c
18-0222			stainless steel	
18-0279	**VICAT needle** ISO 6873 - EN 26 873 for consistency measurements on dental plaster: cylindrical pin Ø 1.0 x 50 mm long	2 g	stainless steel	matching equipment: plunger (18-0043) with 2 additional weights (18-0052), and plaster mold (18-0281) with base plate (10-0057) Fig. 2

18-0101

Cones

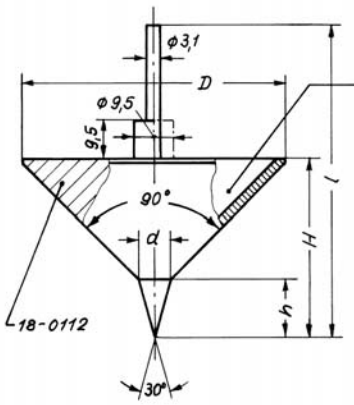
The specified **cones** have proven practical for measurements on fats and greases, jellies, creams and similar materials.

Due to their larger penetration cross-sectional area, tapered penetrators compensate highly for inhomogeneities in the material to be measured so that the measurement results generally show less dispersion than it is the case if test needles are used.

18-0102

18-0112

Fig. 3



Nr.	φD	H	φd [mm]	h	l
18-0101	65	44	8,4	15	77
18-0102					
18-0112	69,35	47			82
18-0121	65	44			77
18-0122					
18-0123					
18-0131	16,3	11,6	2,1	3,8	39,5
18-0141	32,5	22	4,2	7,5	37,5

18-0121

18-0122

18-0123

18-0141

18-0131

ASTM & DIN Standard Cones

Order No.	Description	Weight	Material	Remarks
18-0101	**Optional hollow cone** ASTM D 217 - IP 50 - ASTM D 937 - IP 179 DIN 51 580 - ISO 2137	102.5 g	brass / stainless steel	suitable sample jars: (18-0066) (18-0089) (18-0103) (18-0104)
18-1101			calibrated	
18-0102	**Optional hollow cone** DAB 10 - V.5.8.1 European Pharmacopoeia similar to: ASTM D 217 - IP 50 ASTM D 937 - IP 179 ISO 2137	102.5 g	stainless steel (corrosion resistant)	
18-0112	**Standard solid cone** ASTM D 217 - IP 50 ASTM D 937 - IP 179 ISO 2137	102.5 g	aluminum / stainless steel	Fig. 3
18-0121	**Standard hollow cone**	35.0 g	aluminum / stainless steel	
18-0122		15.0 g	plexiglas / aluminum	
18-0123	**Hollow magnesium cone** ASTM D 2884	15.0 g	aluminum-magnesium-alloy	suitable sample jar: (18-0103) Fig. 3
18-0141	**SHELL half-scale cone** ASTM D 1403 (IP 310 limited)	22.5 g	brass / stainless steel	suitable equipment: plunger (18-0044) sample jar (18-0142) grease worker (18-0145) Fig. 3
18-0131	**Quarter-scale cone** ASTM D 1403 - IP 310, ISO 2137	1.08 g	plexiglas / stainless steel	suitable equipment: plunger (18-0132) sample jar (18-0133) Fig. 3

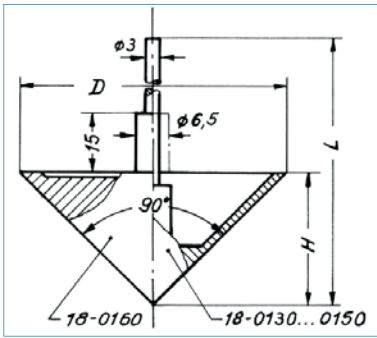
Half-, Quarter-, Micro-Cones

Unless standards or other measuring regulations require the use of special penetrators, the non-standardized **SUR cones** should be used to optimize testing.
Due to their more simple shape, they not only are more favorably priced, but also afford the advantage that their shape remains unchanged over the entire penetration depth, producing comparable measured results on materials with low or high penetration values. This is not always the case with the standardized cones with an offset tip.

"**Half-scale cones**" and "**Quarter-scale cones**" in addition to various types of "**Micro-cones**", are available for measurements on small sample quantities. In certain cases, special sample jars are recommended.

Note: If using conversion formulas which permit measured values to be converted to the penetration depth which one would have obtained if using the corresponding standard cone, the measuring inaccuracy is also increased proportionately.

Fig. 4



Nr.	D	H [mm]	L
18 - 0130	15	7,5	21
18 - 0140	32	16	32
18 - 0150	65	32,5	68
18 - 0160			86


18-0160


18-0150


18-0140


18-0130

SUR Cones

Order No.	Description	Weight	Material	Remarks
18-0160	SUR **solid cone**	102.0 g	aluminum	Fig. 4
18-0150	SUR **hollow cone**	30.0 g		
18-0140	SUR **half-scale cone**	5.0 g		
18-0130	SUR **quarter-scale cone**	1.7 g		


18-0151 18-0152 18-0161

Fig. 5

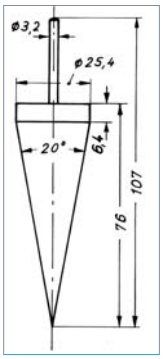


Fig. 6

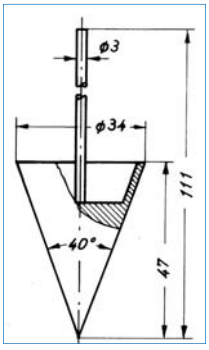
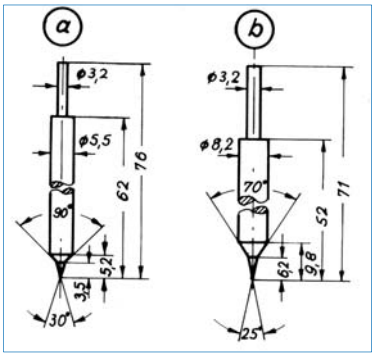


Fig. 7




18-0171 18-0176

Special Cones

Order No.	Description	Weight	Material		Remarks
18-0151	**ASTM micro-cone**	5.0 g	aluminum	Fig. 7a	suitable equipment: 3-section grease collecting jar (18-0153) centering disk (18-0155) grease worker (18-0164)
18-0152	(ASTM proposal 1949)	10.0 g	stainless steel	Fig. 7a	
18-0161	**KLEIN micro-cone** (DAB 10 - V.5.8.1)	7.0 g	aluminum	Fig. 7b	
18-0171	**AOSC duralumin cone 20°** (AOSC Cc 16-60)	45.0 g	aluminum	Fig. 5	suitable equipment: plunger (18-0042)
18-0176	**Unilever duralumin cone 40°**	31.5 g	aluminum	Fig. 6	suitable equipment: plunger (18-0177) additional weight (18-0178)
18-0280	**Special cone** (ISO 6873) for consistancy measurements on dental plaster (Ø 45 mm, height 45 mm)	85.0 g	aluminum		suitable equipment: plunger (18-0044) plaster mold (18-0281) with base plate (10-0057)


18-0280

Rods & Rams

18-0260 18-0261

Fig. 8

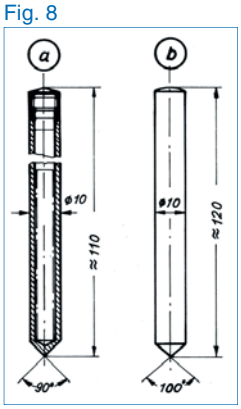
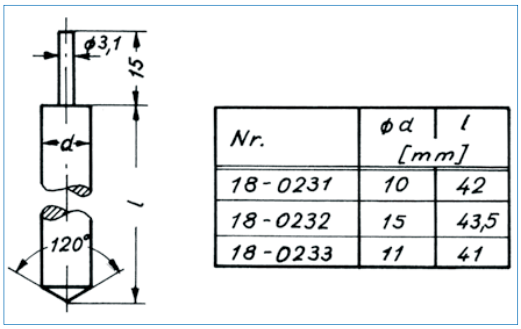
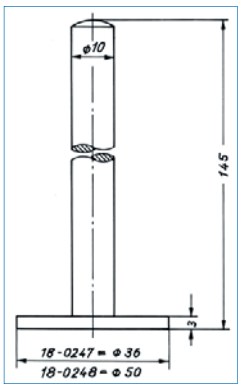


Fig. 9



Nr.	ø d	l [mm]
18-0231	10	42
18-0232	15	43,5
18-0233	11	41

Fig. 13



18-0231 18-0232 18-0233

Fig. 10

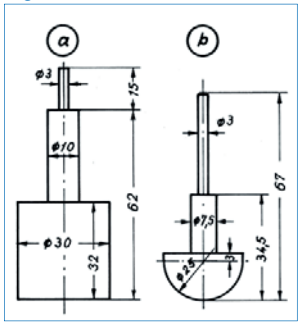


Fig. 11

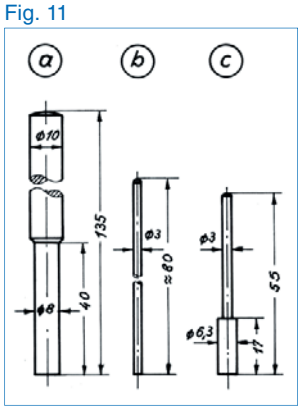
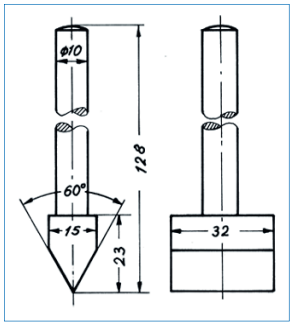


Fig. 12



18-0241 18-0243 18-2355

18-0251 18-0271
18-0270 18-0272

Order No.	Description		Weight	Material	Remarks
18-0260	**Hollow aluminum rod** with 3 weights (3/13/23 g)		7, 10, 20 or 30 g	aluminum Fig. 8a	plunger not required
18-0261	**Plexiglas test rod**		10.0 g	plexiglas Fig. 8b	
18-0231	**Test cylinder**	Ø 10 mm	15.0 g	stainless steel	Fig. 9
18-0232		Ø 15 mm	35.0 g	stainless steel	
18-0233		Ø 11 mm	10.0 g	aluminum	
18-0241	**AIB test ram** for measurements on bread		67.0 g	aluminum Fig. 10a	acc. the American Institute of Baking
18-0243	**Test cap** for measurements on bread and confectionery		50.0 g	stainless steel Fig. 10b	acc. test proposal of Deuroback, Hannover
18-2355	**Test ball** Ø 17 mm		27.5 g	stainless steel	for EN 13 880-3, ASTM D 5329 plunger (18-0042), sample jar (18-0068) required
18-0255	**Test ball** Ø 6.3 mm		6.3 g	brass	
18-0251	**Test ram**	Ø 8 mm	15.0 g	aluminum Fig. 11a	bitumen index acc. van der Baan plunger not required
18-1726		Ø 10 mm	21.8 g		
18-0270	**Test cutter**		130.0 g	stainless steel Fig. 12	softening time of soap plunger not required
18-0271	**Test ram** Ø 3 mm		4.3 g	stainless steel Fig. 11b	curing time of cement plunger 47.5 g (18-0042)
18-0272	**Test ram** Ø 6.3 mm		6.4 g	stainless steel Fig. 11c	silicone rubber with plunger 47.5 g (18-0042)
18-0247	**Platelike test ram**	Ø 35.7 mm		Fig. 13	10 cm²
18-0248		Ø 50.5 mm			20 cm²

Perforated Disks

Perforated disks are primarily used for measuring fluid and viscous materials.

Since it is difficult to position the disks on the sample surface the **"immersion-start"** method is frequently used, i.e. the starting position of the perforated disk is selected beneath the sample surface and the measurement is conducted from this point.

The method of measurement with perforated disks is similar to the measuring principle of the falling-ball viscometer.

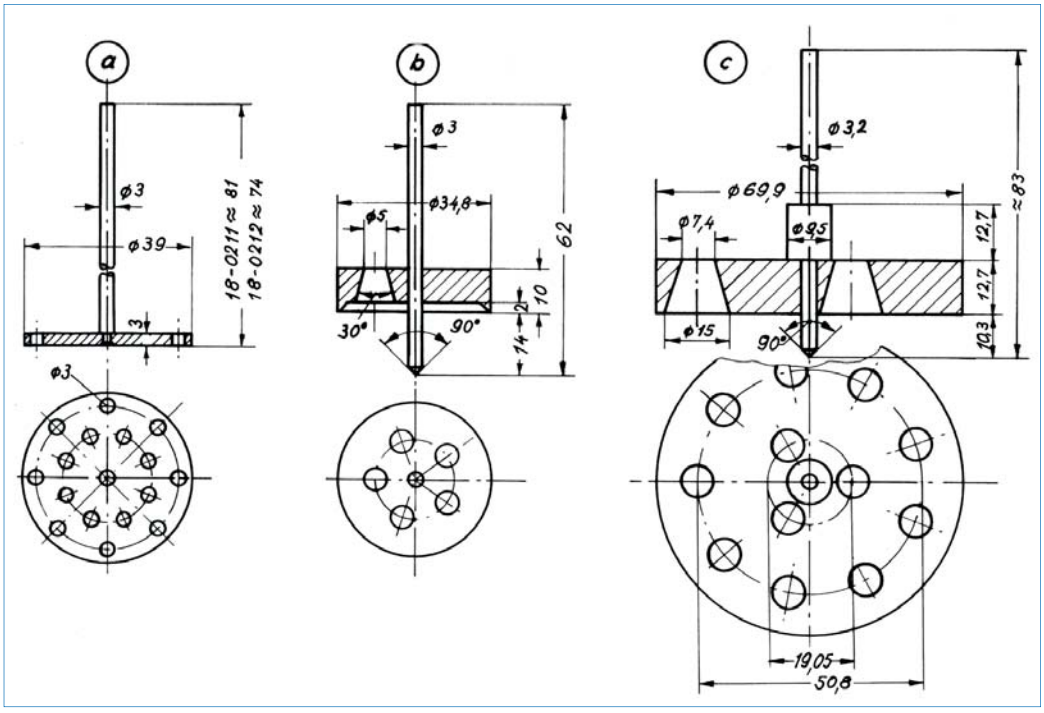
In cases of specific substances to be measured (in laboratory tests), it is possible to obtain analogies to the dynamic viscosity values.

The use of centering devices (e.g. centering disk 18-0119 for sample jar 18-0103) is recommended for **precise centering** of the measurement disk.

When using perforated disks, it is important that the sample jars are sufficiently large in order to prevent **wall effects** influencing the measurement. Alternately the shape or size of the sample jar for the measurement is selected precisely so that possible wall effects remain a constant factor in measurement.

18-0201

Fig. 14



18-0254

Order No.	Description	Weight	Material	Remarks
18-0201	**Perforated disk** Ø 70 mm acc. ASTM proposal	102.5 g	aluminum	suitable equipment: sample jar (18-0103) centering disk (18-0119) Fig. 14c
18-0254	**Perforated disk** Ø 35 mm	19.5 g	aluminum	Fig. 14b
18-0211	**Flat perforated disk** Ø 39 mm	10.0 g	aluminum	Fig. 14a
18-0212		28.0 g	stainless steel	

18-0211

18-0132 18-0044
18-0045 18-0162

18-0042 18-0050
18-0177 18-0043

18-1135 18-1136 18-1137

18-0046 18-0047

18-0048 18-0049

Plungers (Clamping Rods)

Plungers serve as clamping and guide shanks for various penetrators.
Unless specifically listed conditions impose restrictions, it is always possible to combine any penetrator with any plunger. This does not necessarily mean that every penetrator / plunger combination is practical.

In general, the accessories are combined with the objective of a round total weight, if possible.
Combining the heavy-weight plungers (18-0046 to 18-0049) with very slim penetrators such as the tapered needle (18-0081) or the bitumen needles requires very careful work and should be avoided whenever possible due to the risk of deformation.

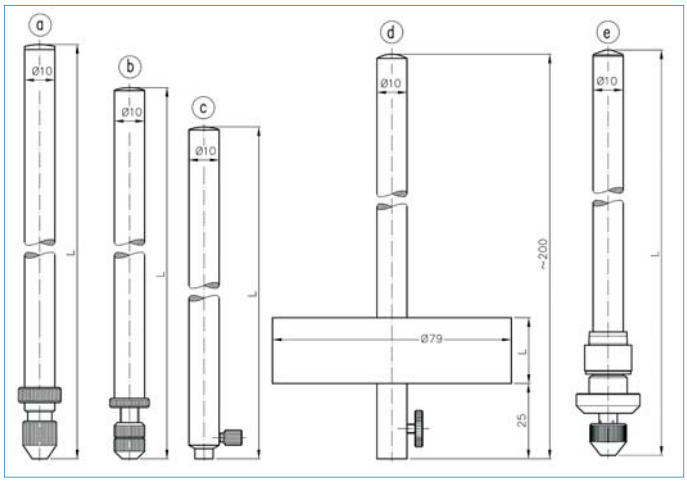


Fig. 15

Order No.	Weight	Length	Material		Primarily used with
18-0132	8.3 g	99 mm	Electron (Magnesium)	Fig. 15c	quarter-scale cone (18-0131)
18-0045	10.0 g	107 mm	aluminum	Fig. 15c	15 g plexiglass cone (18-0122)
18-0044	15.0 g	118 mm	aluminum	Fig. 15b	ASTM micro-cone (18-0151 and 18-0152) SHELL half-scale-cone (18-0141)
18-0162	16.8 g	116 mm	aluminum / brass	Fig. 15b	KLEIN micro-cone (18-0161)
18-0042	47.5 g	162 mm	brass, nickel-plated acc. ASTM D 2884	Fig. 15a	general-purposes, in particular with: tapered and standard needles, standard cones (in accordance with DIN-ISO-ASTM-IP)
18-0100	47.5 g	160 mm	aluminum	Fig. 15a	Contact-plunger with surface sensor for zero-point adjustment
18-1135	47.5 g	158 mm	stainless steel	Fig. 15e	automatic Bitumen measurements with standard needle & ...
18-1136	97.5 g	158 mm			max. 1 additional weight
18-1137	97.5 g	183 mm			up to 4 additional weights 50 g (18-1200) or 100 g (18-1201)
18-0177	48.5 g	135 mm	brass, nickel-plated	Fig. 15c	UNILEVER margarine cone (18-0176)
18-0050	97.5 g	154 mm	brass, nickel-plated	Fig. 15a	general-purpose, in particular: tapered needles, standard cones (in accordance with DIN-ISO-ASTM-IP)
18-0043	98.0 g	152 mm	brass, nickel-plated	Fig. 15a	general purpose
18-0046	497.5 g	9 mm	brass, nickel-plated	Fig. 15d	very hard materials or very large samples such as whole loaves of bread
18-0047	997.5 g	21.5 mm			
18-0048	1497.5 g	34 mm			
18-0049	1997.5 g	46 mm			

Additional Weights

18-0053 2 g Additional weight with slot
18-0054 5 g Additional weight with slot
18-0055 10 g Additional weight with slot
18-0056 20 g Additional weight with slot
18-0051 50 g Additional weight with center hole
18-0052 100 g Additional weight with center hole

18-0178 80 g Special additional weight for UNILEVER cone (18-0176)

18-0053 18-0055
18-0054 18-0056

18-0051 18-0052 18-0178

Sample Jars, Cylinder and Accessories

No special conditions apply to the shape or size of the sample jars unless stipulated by the relevant test regulations or specifications.

It is important that the **bottom of the jar is very flat,** The sample jars must be stable, i.e. they must not wobble on the measuring bench of the penetrometer.
Otherwise, this would increase the risk of measurement errors. Due to lateral drift of the penetrator and the plunger. It is advisable to throw away sample jars which have been deformed when dropped, etc.

The diameter of the sample jars must be adequately large in order to avoid the measurement result being influenced by wall effects, in particular, when working with test cones, to prevent the cones contacting the rim of the jar.
As a general guideline, the diameter of the sample jar should be approximately three times the penetration diameter of the penetrator.

The dimensions of our sample jars have been selected in accordance with requirements of international mineral oil standards and are characterized by uniform dimensional accuracy and excellent stability.

Sample Jars / Ring

Sample Jars

18-0066 **Sample Jar - Size I, Ø 55 x 35 mm**, flanged rim, brass, nickel-plated (ASTM D 5 - IP 49, test needles)
18-0067 **Sample Jar - Size II, Ø 55 x 55 mm**, flanged rim, brass, nickel-plated
18-0068 **Sample Jar - Size III, Ø 70 x 45 mm**, flanged rim, brass, nickel-plated. (ASTM D 5 - IP 49)
Sample Jar - Size IV, Ø 55 x 45 mm,
18-0090 ... flanged rim, brass, nickel-plated (ASTM D 5 (former DIN 52 010))
18-0137 ... tin cup, **single-serving**
18-0069 **Sample Jar - Size V, Ø 70 × 60 mm**, flanged rim, brass nickel plated. (ASTM D 5 - IP 49)

18-0075 **Sample Jar, Ø 55 x 70 mm,** flanged rim, brass, nickel-plated (ASTM D 5)

Ring Shaped Insert to reduce the sample volume for use with jars size I, II, or IV (acc. to EN 1426)
18-0076 ... Ø 53 (Ø 36 inside) × 20 mm heigh
18-0077 ... Ø 53 (Ø 36 inside) × 30 mm heigh

18-0256 **Sample Jar, Ø 36 x 31 mm,** for small sample volume (EN 1426)
18-0257 **Cooling-Ring** (external) for sample jar 18-0256 (EN 1426)

18-0066 & 18-0076

18-0137

18-0256 & 18-0257

18-00142 (SHELL)

18-0281 (VICAT)
+ 10-0057

18-0103

18-0153

18-0104

18-0107

18-0113

Sample Jars

Fig. 16

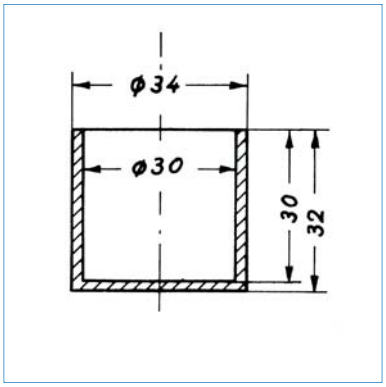


Fig. 17

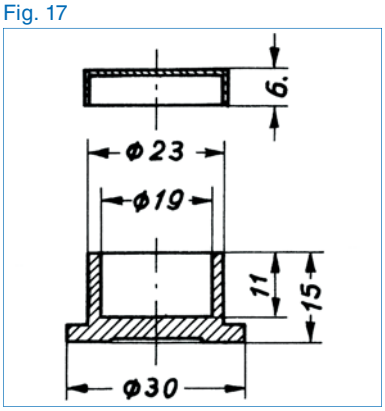
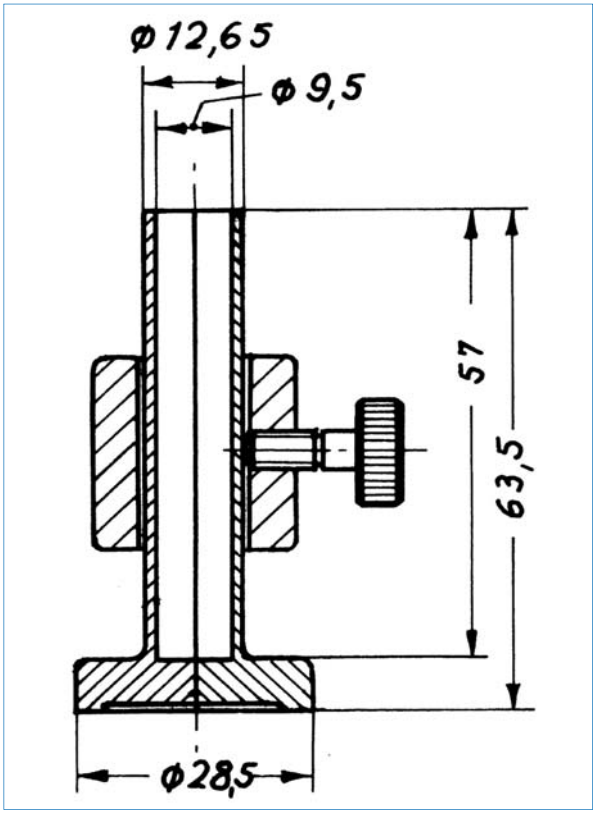


Fig. 18



18-0142 **Sample Collecting Jar, Ø 38 x 31.8 mm**
ASTM D 1403
preferably for measurements with the SHELL half-scale-cone (18-0141)

18-0252 **Sample Jar, Ø 30 x 30 mm,** for test ram 18-0251
EN 13 179-2 (acc. to van der Baan) determining the bitumen index. (Fig. 16)

18-0281 **Plaster Mold (VICAT), Ø 65 / 70 mm x 40 mm**, conical, plastic
ISO 6873 (EN 26 873)

10-0057 **Glass-Plate, 120 x 120 x 6 mm** (for plaster mold 18-0281)

18-0103 **Fat / Grease Sample Jar, Ø 76.5 x 63.5 mm**, flanged rim, brass, nickel-plated.
(for ASTM / DIN standard cones 18-0101 to 18-0123 and perforated disk 18-0201)
Use the **centering disk 18-0119** to avoid the contact between cone and jar rim.

18-0133 **Grease Collecting Jar, Ø 19 x 11 mm,** with cover
for measurements with one-quarter cone (18-0131)(Fig. 17)

18-0153 **Grease Collecting Jar**, 3-sections, with insert cylinder
The insert allows to reduce the sample volume by regulating the cylinder height,
for measurements with micro-cone (18-0151, ASTM-5g and 18-0152, ASTM-10g)
or with the micro-cone (18-0161) acc. to Klein (Fig. 18)

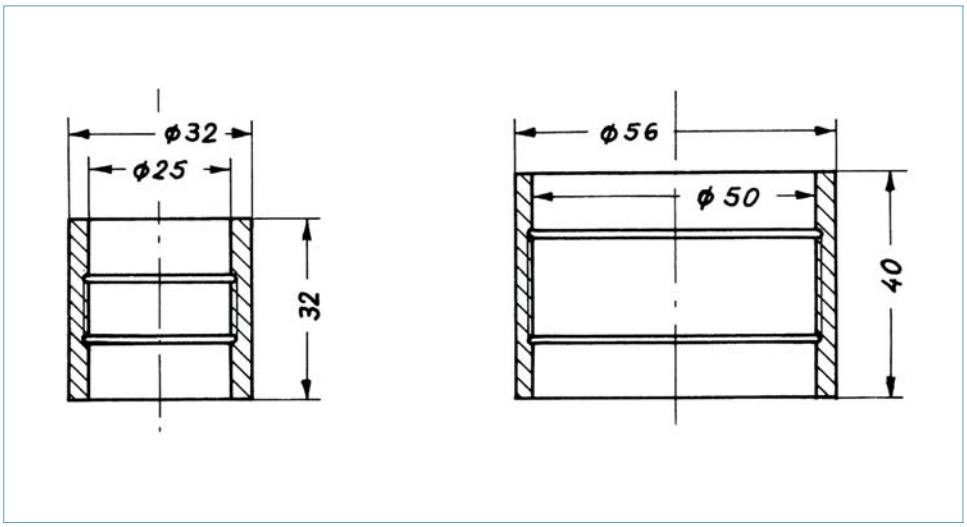
18-0104 **Vaseline Sample Jar, Ø 100 x 65 mm** with smooth rim and overlapping cover,
for measurements with standard cone (18-0101) in acc. with ASTM D 937.

18-0107 **Grease Worker Base Section,** stainless steel, Ø 100 x 75 mm (ASTM D 2884)

18-0113 **Overflow Ring** with seal for semi-liquid lubricating greases (fits grease worker base section)

Cylinder

Fig. 19



18-0083 (18-0078 & 18-0085)

18-0079

18-0083 **Wax Test Cylinder, Ø 25 x 32 mm,** with base plate
for melting waxes and for measurements with tapered needles (18-0081 / 82) or measurements in acc. with DIN 51 579 - ASTM D 6380 (ASTM D 371)

18-0089 **Wax Test Cylinder, Ø 50 x 40 mm**
with base plate (for optional cone 18-0101; DIN 51 580)

18-0078 **Wax Test Cylinder, Ø 25 x 32 mm** (Fig. 19)

18-0079 **Wax Test Cylinder, Ø 50 x 40 mm** (Fig. 19)

18-0085 **Base Plate, 70 x 70 mm**, made of glass (for wax test cylinder)

18-0111

Accessories

18-0109 **Grease Cutter,** for clean cutting of fat or grease blocks

18-0105 **Spatula**, 30 x 200 mm, stainless steel (ASTM D 2884)

18-1727

18-0111 **Centering Gauge**, for sample jars or 2-inch grease blocks
(for PNR without T-slot in the table)

18-0114 **Centering Gauge**, for sample jars or 2-inch grease blocks
(for PNR with T-slot in the table; complete with clamping support)

18-1727 **Clamping Support** (2 groove stones with bolds fitting the PNR-table T-slot)

18-0119 **Centering Disk, Ø 100 mm**, made of plexiglass
with center hole for standard cone tips
suitable for fat / grease jar (18-0103) and grease worker base plate (18-0107)

18-0155 **Centering Disk, Ø 11-12.75 mm**, (for grease collecting jar 18-0153)

18-0155 18-0119

18-0712 **Halogen Lamp,** extra bright, to be placed beside the penetrometer
Power supply: 230 V, 50 Hz

Tempering Units

To keep a constant sample temperature during the testing procedure on the PNR 10 & 21 table, we suggest to use the tempering-bath with the serpentine heat exchanger tube (18-0070) in connection with a circulator-bath, where samples can be pre-tempered at the same time, too.

18-0065 & 18-0094 & 18-0093

18-1730 & 18-1731
in 18-1728

18-0070

18-0070 &
18-0094 & 18-0093

For adhensions tests with the PNR-21 you may use a “dry-bath” the tempering plate (18-1730), which will be connected to a thermostatic bath, also.
The tempering block will be tightend with 2 groove stones in the PNR-table T-slot (see penetration combinations 18-1728).

18-0170

Tempering-Bath (Transfer Dish), nickel-plated brass, Ø 160 x 80 mm,
to keep a constant sample-temperature for the PNR-table

18-0065 ... **without** heat exchanger
18-0070 ... **with serpentine heat exchanger tube** and hose sockets to connect a circulator.
(effective inside: Ø 135 x 70 mm) (ASTM D 2884)

18-0091 **Spacer Plate** for tempering-baths (18-0065, 18-0070, 18-0169)

18-0094 **Thermometer Holder**
for tempering-baths (18-0065, 18-0070, 18-0169)
to hold thermometer (18-0093 / 16-0376 / 90-0106 / 90-0166 and 90-0107 / 90-0167)

18-0091

18-0170 **Tempering-Bath**, borosilicate glass
ASTM D 1321
with heat-exchanger coil (effective inside Ø 185 x 90 mm) to connect a circulator and an intermediate bottom as well as a thermometer holder

18-0168 **Heat-Exchanger Coil and Intermediate Bottom**
for tempering-bath (18-0170)

18-0169 **Glass-Bath** with spout, borosilicate glass, 2 liter
for tempering-bath (18-0170)

18-0094

Thermometer DIN 12 785
21-0091 ... range 0 to +55 °C : 0.2 °C
21-0092 ... range 0 to +55 °C : 0.2 °C (officially certified)

Thermometer ASTM 63 C
90-0106 ... range -8 to +32 °C : 0.1 °C
21-0662 ... range -8 to +32 °C : 0.1 °C (officially certified)

Thermometer ASTM 64 C
90-0107 ... range +25 to +55 °C : 0.1 °C
21-0663 ... range +25 to +55 °C : 0.1 °C (officially certified)

Temperature Sensor (18-1149)

18-1149 **Temperature Sensor** with PT-100 to monitor the sample-bath temperature
(for PNR 12 only)

Tempering Units

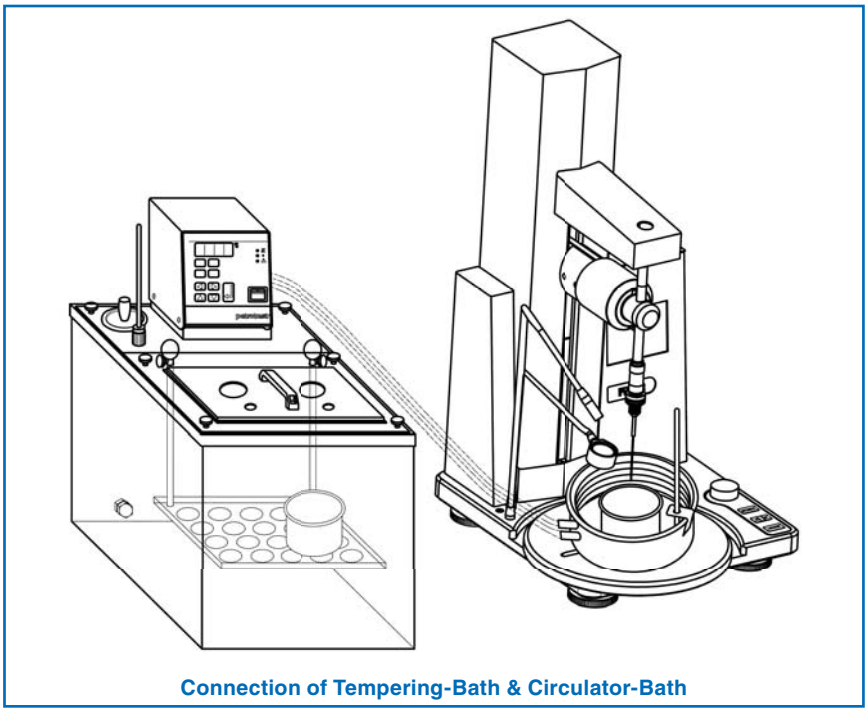
18-1730 **Tempering Plate** for adhensions measurements
Consisting of:
an external tempered aluminum plate with a slot for a sample jar,
sockets to connect a circulator, fixed on PNR-table by clamping stones.

18-1731 **Sample Jar** for tempering plate, brass, Ø 15 x 0.4 mm

18-1730 & 18-1731

11-0181 **Hose**, silicon (Ø 8 mm, 8 m)

25-0228 **Hose-Set**, insulated (Ø 8 mm, 2x 2 m with fittings)



Connection of Tempering-Bath & Circulator-Bath

Circulator-Baths

For tempering applications directly in the bath (e.g. sample pre-tempering) and / or for heating & cooling of instruments with heat-exchanger tube but without circulation pump (e.g. PNR-tempering dish).

The following circulator-baths are designed for an ambient temperature range of +5 to +40°C and will serve multi-function purposes, therefore choose the required hose (above) accordingly.

Circulator-Bath ED-5 (internal & external heating)
Consisting of:
Stainless steel bath with **cooling-coil**. Thermostat with digital display, splash-proof keypad, **integrated heater**, **pump** and over-temperature protection.
Supplied with: 1 bath cover, 1 hose-set (2x 1 m Ø 8 & 10 mm)
Note: Requires counter-cooling for applications near ambient temperature.
Insulated hose-set (25-0228) is recommended.

Technical Data:

Working range	: +20 to +100°C	Pump capacity	: 15 l/min, 340 mbar
Display / Resolution	: LED / 0.1°C	Bath opening	: 15 x 15 x 15 cm (WxDxH)
Control	: PID	Volume	: 4.5 l
Heater capacity (115 V)	: 2000 W (1000 W)	Dimensions	: 17 x 33 x 36 cm (WxDxH)
		Weight	: 7 kg

18-0304, 18-0305

18-0304 Power supply: 230 V, 50 Hz, EU-plug
18-0305 Power supply: 115 V, 60 Hz, US-plug

Circulator-Baths

18-0403, 18-0402

Circulator-Bath DP (internal & external heating)

Consisting of:
Stainless steel bath with adjustable **intermediate bottom** and **cooling-coil**.
Thermostat with digital display, splash-proof keypad, **heater**, **pump**, RS232-**interface**, over-temperature- & low-level-protection.

Supplied with:
1 bath cover Ø 5 cm, 1 bath cover 20 x 20 cm, 1 thermometer (-2 to +105:0.5°C)

Note: Requires counter-cooling for applications near ambient temperature.
Hose not included. Insulated hose-set (25-0228) is recommended.

Technical Data:

Working range	: +20 to +150°C	Pump capacity	: 15 l/min, 320 mbar
Display / Resolution	: LED / 0.01°C	Bath opening	: 20 x 20 x 25 cm (WxDxH)
Control	: PID	Volume	: 20 l
Interface (capability)	: RS232 (LIMS)	Dimensions	: 37.5 x 45 x 47.5 cm (WxDxH)
Heater capacity (115 V)	: 2000 W (1000 W)	Weight	: 3.4 kg

18-0403 Power supply: 230 V, 50 Hz, EU-plug
18-0402 Power supply: 115 V, 60 Hz

25-0386, 25-0387

Circulator-Bath C10-V26/BP (internal & external heating & cooling)

Consisting of:
Stainless steel bath with **intermediate bottom**. Thermostat with analog display, **heater**, **cooler**, pressure-**pump**, over-temperature protection, pump-pressure control.

Supplied with:
2 bath covers, 1 pump-set for external tasks, 1 thermometer (0 to +100:0.5°C)

Note: Insulated hose-set (25-0228) is recommended.

Technical Data:

Working range	: -10 to +100°C	Pump capacity	: 17 l/min, 300 mbar
Display / Resolution	: analog / 1°C	Bath opening	: 30 x 35 x 20 cm (WxDxH)
Control	: analog	Volume	: 19 - 26 l
Heater capacity	: 1500 W (1000 W)	Dimensions	: 36 x 75 x 40 cm (WxDxH)
Cooling capacity	: 250 W at +20°C	Weight	: 31 kg

25-0386 Power supply: 230 V, 50/60 Hz, 2000 W, EU-plug
25-0387 Power supply: 115 V, 60 Hz, 1500 W

25-0388, 25-0389

Circulator-Bath DC10-V26/BP (internal & external heating & cooling)

Consisting of:
Stainless steel bath with **intermediate bottom**. Thermostat with digital display, splash-proof keypad, **heater**, **cooler**, pressure-**pump**, over-temperature protection, pump-pressure control.

Supplied with: 2 bath covers, 1 pump-set for external tasks

Note: Insulated hose-set (25-0228) is recommended.

Technical Data:

Working range	: -10 to +100°C	Pump capacity	: 17 l/min, 300 mbar
Display / Resolution	: LED / 0.1 & 0.01°C	Bath opening	: 30 x 35 x 20 cm (WxDxH)
Control	: PID	Volume	: 19 - 26 l
Heater capacity (115 V)	: 2000 W (1200 W)	Dimensions	: 36 x 75 x 40 cm (WxDxH)
Cooling capacity	: 250 W at +20°C	Weight	: 31 kg

25-0388 Power supply: 230 V, 50/60 Hz, 2500 W, EU-plug
25-0389 Power supply: 115 V, 60 Hz, 1700 W

Grease Workers

There are a number of special-type grease workers available as specified for the worked penetration tests.

However, even normal grease working in the ASTM grease worker will often prove difficult and tiresome so that the use of auxiliary equipment that decreases the labor of working greases is recommended.

17-1506

Electrically-Operated Grease Worker

The grease working machine is available for either single or double-worker operation at a speed of 60 strokes per minute, the number of strokes being continuously indicated by an automatic index counter. The counter can be preset for any number of strokes, the counting gear automatically disengages the indexing contact to stop the machine.

Since the handles of workers for use in grease working machines have to be designed to form a bearing, only specifically-constructed grease workers can be used.

Grease Working Machine, 2-place, complete with workers
ASTM D 217 - IP 50 - ISO 2137 - JIS K 2220 - NF T60-132 - ASTM D 7342
with further accessories acc. FTM 791-313

Consisting of:
heavy base plate, gear motor with crank flanges (preset to make 60 strokes per minute), grease worker quick-chucking, counting mechanism (six-digit), automatic-stroke count and shut-off device.

Supplied with:
2 **Gease Workers** with screw-coupling (incl. bi-metal thermometer and 51-hole worker plate),
1 **Pin Wrench** (80-100 mm with 8 mm pin)

Note! 270-hole worker plates are not included.

Technical Data:

Test places	: 1 - 2
Dimensions (WxHxD)	: 360 x 330 x 680 mm
Weight	: approx. 40 kg

17-1506 Power supply: 230 V, 50/60 Hz
17-1505 Power supply: 230 V, 60 Hz

17-0509 & 17-0510
17-0511 & 17-0512

Accessories

Grease Worker to fit grease working machine
Consisting of:
bi-metal thermometer, stainless steel pot & cover, aluminum handle as a guide bearing.

17-0509 51-hole plate **ASTM D 217 - IP 50 - ISO 2137 - NF T60-132 - ASTM D 7342** (bayonet-coupling)
17-0510 270-hole plate **FTM 791-313** (bayonet-coupling)

17-0511 51-hole plate **ASTM D 217 - IP 50 - ISO 2137 - NF T60-132 - ASTM D 7342** (screw-coupling)
17-0512 270-hole plate **FTM 791-313** (screw-coupling)

17-0514

17-0515

17-0514 **Worker Plate with 51 holes** (ASTM D 217 - IP 50 - ISO 2137 - NF T60-132 - ASTM D 7342)

17-0515 **Worker Plate with 270 holes** (FTM 791-313.2)

17-0504 **Disassembling Set** for grease worker,
8 mm pin wrench and table mounted cylinder holder

18-0107

Spare Parts

18-0107 **Grease Worker Base Section,** stainless steel, Ø 100 x 75 mm, screw-coupling (ASTM D 2884)

18-0108 **Bi-metal Thermometer**, measuring range: 0 to +30 °C

17-0513 **Pin Wrench** for opening and closeing of grease workers with 8 mm pin

17-0516 **Seals** for the lifting rod of the grease worker, pack of 5

18-0108

17-0516

Hand-Operated Grease Worker

At the hand-operated grease working machine is the grease worker chucked on a base and the worker handle is guided by lever arm operation in such a manner that the perforated plate inside the worker jar can be moved up and down even through high consistency samples with minimal effort.

17-0500

17-0500 **Grease Worker Slave**
ASTM D 217 - IP 50 - ISO 2137 - JIS K2220 - NF T60-132
Consisting of:
base plate and chuck, lever arm and lever support post and grease worker with 51-hole worker plate and bi-metal thermometer

17-0502

17-0502 **Grease Worker**
ASTM D 217 - IP 50 - ISO 2137 - JIS K2220 - NF T60-132
Consisting of:
51-hole worker plate and bi-metal thermometer
The handle of grease-worker for use in the grease worker slave is designed to form a guide bearing for the lever arm.

17-0513

Accessories (for machine & manual workers)

17-0514 **Worker Plate with 51 holes** (ASTM D 217 - IP 50 - ISO 2137 - NF T60-132)

17-0515 **Worker Plate with 270 holes** (FTM 791-313.2)

18-0107 **Grease Worker Base Section,** stainless steel, Ø 100 x 75 mm (ASTM D 2884)

17-0504 **Disassembling Set** for grease worker,
8 mm pin wrench and table mounted cylinder holder

17-0513 **Pin Wrench** for opening and closing of grease workers with 8 mm pin

Spare Parts

18-0108 **Bi-metal Thermometer**, measuring range: 0 to +30 °C

17-0516 **Seals** for the lifting rod of the grease worker, pack of 5

18-0134

18-0135

Manually Operated Micro Grease Worker

18-0134 **Micro-Grease Worker**
ASTM D 1403 - IP 310 - ISO 2137 - JIS K2220 - NF T60-132
Consisting of: with retaining plate and special key,
for walk penetration with the 1.08 g quarter-scale cone (18-0131)

18-0135 **Grease Collecting Jar** for micro-grease worker (18-0134)

18-0153

18-0145

18-0145 **Micro-Grease Worker**
ASTM D 1403 - IP 310 - ISO 2137 - JIS K2220 - NF T60-132
for walk penetration with the 22.5 g SHELL half-scale-cone (18-0141)

18-0153 **Grease Collecting Jar**, 3-sections, with insert cylinder
The insert allows to reduce the sample volume by regulating the cylinder height, for measurements with micro-cone (18-0151, ASTM-5g and 18-0152, ASTM-10g) or with the micro-cone (18-0161) acc. to Klein (Fig. 18, page 20)

18-0164

18-0164 **Micro-Grease Worker to KLEIN**
Consisting of: 3 inserts for grease quantities of approx. 5, 9 and 13 ml

Roll Stability Tester

ASTM D 1831 - ASTM D 7342 - MIL-G-10924

The Roll Stability Tester is a four place test unit widely used for the shear stability tests on lubricating greases. The testing apparatus not only conforms to ASTM D 1831 but exceeds the listed specifications regarding test time and temperature.

Tests with this Roll Tester can be conducted at temperatures up to +200 °C and for periods up to 50 hours and more.

During the test period the exterior of the test apparatus is safe to touch at all times even at highest temperature setting.

This is due to the use of high-quality thermal insulation and cooling design. With its extraordinary temperature range and excellent features the apparatus represents a unique alternative for tests of high temperature lubricating greases.

Features:

Designed for long test runs at temperatures up to +200 °C

Digital timer with bright and easy-to-read two color display

High-accuracy digital temperature controller with Pt-100 probe

Low noise operation <63 dB(A)

Excellent uniform heat distribution provided by aluminum fan and shielded heaters

Various options available to meet different user requirements

Roll Stability Tester, 4-place
ASTM D 1831 - MIL-G-10924 - ASTM D 7342

Supplied with:
4 test cylinders with rollers and gaskets and tool for closing and opening cylinders.

Technical Data:

Rotation Speed	: 165 rev/min
Temperature range	: ambient to +200°C
Dimensions (WxHxD)	: 700 x 730 x 690 mm
Weight	: approx. 70 kg (without test equipment)

Options:
Extended version with RS485-interface and PC-software, test duration, test temperature, rotation speed and test intervals remote and data logging, adjustable rotation speed of test cylinders.

17-1600 Power supply: 230 V, 50 Hz, 1800 W
17-1601 Power supply: 230 V, 60 Hz, 1800 W
17-1605 Power supply: 115 V, 60 Hz

17-1610

Options & Accessories

17-1700 **Adjustable Rotation Speed**
at the Rotation Stability Tester, speed from 100-200 rpm in steps of 1 rpm through a potentiometer with a scale and a digital display of the rotation speed.

17-1710 **Extended Version** with RS485-interface and PC-software

Spare Parts

17-1610 **Test Cylinder** with steel rollers

17-1615 **Gasket** for test cylinder

17-1620 **Wrench** for opening and closing of test cylinder

SAMPLE	RECOMMENDED ACCESSORIES	DESCRIPTION
Accumulator material	PNR 21 + 18-0250	PNR 21 + Tube-Test Rod (Ø10/ø9.6 x 150 mm)
Agar-Agar	18-0152 + 18-0042 + 18-0051	ASTM-Micro-Cone + 47.5 g Plunger + 50 g Weight
Asbestos	18-0063 + 18-0042 + 18-0051	Bitumen-Needle + 47.5 g Plunger + 50 g Weight
Asphalt	18-2220 18-2370	Test Set “Bitumen” van-der-Baan-Rod
Battery paste	PNR 21 + 18-0250	PNR 21 + Tube-Test Rod (Ø10/ø9.6 x 150 mm)
Bitumen	18-2270 18-2370	Test Set “Quarter-Cone” van-der-Baan-Rod
Bituminous adhesives	18-2220	Test Set “Bitumen” ASTM D 5/IP 49
Bituminous materials	18-2211	Test Set “Bitumen” DIN 52 010
Bonbon	18-0063 + 18-0045 + 18-0051 + 18-0052	Bitumen-Needle + 10 g Plunger + 150 g Weight
Bouillon cube	18-0081 + 18-0042 + 18-0051	Taper-Needle + 47.5 g Plunger + 50 g Weight
Bread	18-2350 18-2351	Test Set with American Test-Ram Test Set with German Test-Cap
Butter	18-2360 18-2175	Test Set “20°-Cone” Test Set “UNILEVER”
Chocolate	18-0081 + 18-0042 + 18-0051 18-0063 + 18-0042 + 18-0051	Taper-Needle + 47.5 g Plunger + 50 g Weight Bitumen-Needle + 47.5 g Plunger + 50 g Weight
Coloring paste	18-2330	Test Set ”Cylinder & Plunger“
Compact powder	18-0063 + 18-0042 + 18-0051	Bitumen-Needle + 47.5 g Plunger + 50 g Weight
Corned beef	18-2175 18-0232 + 18-0042 18-0260	Test Set “UNILEVER” Test-Cylinder + 47.5 g Plunger Al-Hollow-Rod with 3 Weights
Cosmetic cream	18-2300	Test Set “Micro-Cone”
Cream (pasty consistency)	18-0201 + 18-0042 + 18-0103 + 18-0119	Perforated Disk + 47.5 g Plunger + Grease-Jar + Centering Disk
Cream (petrolatum consistency)	18-0101 + 18-0042 + 18-0103	Optional Hollow-Cone + 47,5 g Plunger + Grease-Jar
Cream (small sample)	18-2300	Test Set “Micro-Cone”
Cream (solid)	18-0231 + 18-0045 + 18-0054 + 18-0056 18-0081 + 18-0042	Test-Cylinder + 10 g Plunger + 25 g Weight Taper-Needle + 47.5 g Plunger
Curds	18-0122 + 18-0045	Standard Hollow-Cone + 10 g Plunger
Damping mastic	18-0081 + 18-0042	Taper-Needle + 47.5 g Plunger
Dental plastic paste	18-0222 + 18-0043 + 18-0052	Pin-Needle + 98 g Plunger + 100 g Weight
Dispersion	18-0260 + 18-0212 + 18-0044	Al-Hollow-Rod + Perforated Disk + 15 g Plunger
Dough (firm)	18-0044 + 18-0221 18-0044 + 18-0151	15 g Plunger + Pin-Needle 15 g Plunger + ASTM-Micro-Cone
Dough (soft)	18-0201 + 18-0042 + 18-0103 + 18-0119	ASTM Perforated Disk + 47.5 g Plunger + Grease-Jar + Centering Disk
Edible fat	18-2360 18-2175 18-0260 18-0261	Test Set “20°-Cone” Test Set “UNILEVER” Al-Hollow-Rod Plexiglas-Rod
Emulsion (firm)	18-2175 + 18-2360	Test Set “UNILEVER” + Test Set “20°-Cone”
Emulsion (medium)	18-0260 18-0261	Al-Hollow-Rod Plexiglas-Rod
Emulsion (soft)	18-0122 + 18-0045	Standard Hollow-Cone + 10 g Plunger
Floor polish	18-2230	Test Set “Wax-Needle”
Frankforters (Deformation)	18-0243 + 18-0042 + 3x 18-0052	Test-Cap + 47.5 g Plunger + 300 g Weight
Frankforters (large sample)	18-0171 + 18-0043 + 2x 18-0052	20°-AOCS-Cone + 98 g Plunger + 200 g Weight
Frankforters (small sample)	18-0161 + 18-0043	Micro-Cone + 98 g Plunger
Fruit (fresh)	18-0042 + 18-0051 + 18-0063 or 18-0081	47.5 g Plunger + 50 g Weight + Bitumen- or Taper-Needle
Fruit jelly	18-0122 + 18-0044 + 18-0056 18-0211 + 18-0044	Standard Hollow-Cone + 15 g Plunger + 20 g Weight Perforated Disk + 15 g Plunger
Fruit preparation	18-0260 18-0122 + 18-0044 + 18-0052 + 18-0056	Al-Hollow-Rod Standard Hollow-Cone + 15 g Plunger 120 g Weight
Fruit pulp	18-0122 + 18-0044 + 18-0052 + 18-0056 18-0260	Standard Hollow-Cone + 15 g Plunger + 120 g Weight Al-Hollow-Rod
Gel firmness	18-0140 + 18-0044	SUR-Half-scale-Cone + 15 g Plunger
Gelatin	18-0232 + 18-0042 18-0260 + 27 g Weight	Test-Cylinder + 47.5 g Plunger Al-Hollow-Rod + 27 g Weight
Honey	18-2175 + 18-0232 + 18-0260 18-2175 + 18-0232 + 18-0261	Test Set “UNILEVER” + Test-Cylinder + Al-Hollow-Rod Test Set “UNILEVER” + Test-Cylinder + Plexiglas-Rod

SAMPLE	RECOMMENDED ACCESSORIES	DESCRIPTION
Ice cream	18-2330	Test Set “Cylinder & Plunger“
Jelly (jam)	18-0150 + 18-0044	SUR-Hollow-Cone + 15 g Plunger
Joint filling mortar	18-0232 + 18-0043	Test-Cylinder + 98 g Plunger
Lipstick	18-2211	Test Set “Bitumen” DIN 52 010
Liver sausage	18-2360 18-2175	Test Set “20°-Cone” Test Set “UNILEVER”
Lubricating (small sample)	18-2270 18-2280 18-2290 18-2300	Test Set “Quarter-Cone” Test Set “Half-scale-Cone” Test Set “ASTM-Micro-Cone” Test Set “Micro-Cone”
Lubricating grease (large samples, firm)	18-2253 or 18-2260	Test Set with Hollow-Cone & Grease-Jar
Lubricating grease (large samples, semi fluid)	18-2310 18-2311 18-2380	Test Set “ASTM-Micro-Cone” Test Set “Solid-Cone” Test Set with Taper Perforated Disk
Margarine	18-2360 18-2175	Test Set “20°-Cone” Test Set “UNILEVER”
Marzipan (almond paste)	18-2230	Test Set “Wax-Needle”
Meat (cooked)	18-0081 + 18-0042 + 18-0051 + 18-0052	Taper-Needle + 47.5 g Plunger + 150 g Weight
Meat (raw)	Perforated Disk 250 g + 18-0063 + 18-0042	Perforated Disk 250 g + Bitumen-Needle + 47.5 g Plunger
Ointment	18-0152 + 18-0162 + 18-0153 18-0101 + 18-0042 + 18-0103 18-0101 + 18-0042 + 18-0104	ASTM-Micro-Cone + 16.8 g Plunger + 3-part Grease-Jar Standard Hollow-Cone + 47.5 g Plunger + Jar Standard Hollow-Cone + 47.5 g Plunger + Vaseline-Jar
Paraffin	18-2230	Wax-Needle
Pastes (firm)	18-2230	Wax-Needle
Pastes (soft)	18-0233 + 18-0044	Test-Cylinder + 15 g Plunger
Potato mash	18-2175	Test Set “UNILEVER” (after 1 day of settling UNILEVER-Combination / 5 s => 30...35 mm)
Printing colors (firm)	18-2330	Test Set “Test-Cylinder & Plunger“
Printing colors (soft)	18-0201 + 18-0042 + 18-0103 + 18-0119	ASTM-Perforated Disk + 47.5 g Plunger + Jar + Centering Disk
Pulp	18-0102 + 18-0042 + 18-0051 + 18-0103	Standard Solid-Cone + 47.5 g Plunger + 50 g Weight + Jar
Puree flakes	18-2330 18-2380	Test Set “Test-Cylinder & Plunger“ Test Set with Taper Perforated Disk
Putty, cement	18-0231 + 18-0044	Test-Cylinder + 15 g Plunger
Roe (fish)	18-0232 + 18-0043 + 18-0052	Test-Cylinder + 98 g Plunger + 100 g Weight
Salami	18-0081 + 18-0042 + 18-0051 + 18-0052	Taper-Needle + 47.5 g Plunger + 150 g Weight
Sausage	18-0081 + 18-0042 + 18-0051	Taper-Needle + 47.5 g Plunger + 50 g Weight
Sausage dough	18-2360 18-2175	Test Set “20°-Cone” Test Set “UNILEVER”
Sealing cement	18-0222 + 18-0044	Taper-Needle + 15 g Plunger
Sealing mastic	18-2220 18-0222 + 18-0044	Test Set “Bitumen” ASTM D 5/IP 49 Taper-Needle + 15 g Plunger
Shortening (hard)	18-0101 + 18-0043 + 18-0103	Standard Hollow-Cone + 98 g Plunger + Jar
Shortening (soft)	18-0121 + 18-0045 + 18-0103	Standard Hollow-Cone + 10 g Plunger + Jar
Silicon mass	18-0260	Al-Hollow-Rod
Soap	18-0063 + 18-0042 + 18-0051	Bitumen-Needle + 47.5 g Plunger + 50 g Weight
Soap (maceration)	18-0270	Test-Cutter
Tablets	18-0063 + 18-0046	Bitumen-Needle + 500 g Plunger
Tooth paste	18-0044 + 18-0233 18-2175	15 g Plunger + Test-Cylinder Test Set “UNILEVER”
Vaseline acc. to DAB 10	18-0101 + 18-0042 + 18-0103 18-0101 + 18-0042 + 18-0104 18-0152 + 18-0162 + 18-0153	Standard Hollow-Cone + 47.5 g Plunger + Jar Standard Hollow-Cone + 47.5 g Plunger + Vaseline-Jar ASTM-Micro-Cone + 16.8 g Plunger + 3-part Grease-Jar
Waxes	18-2230	Test Set “Wax-Needle”
Yeast	(18-2211 former) 18-2220 18-2230 18-0081 + 18-0042 + 3x 18-0051 18-0140 + 18-0177 + 18-0052	(Test Set “Bitumen” DIN 52 010 or 9) Test Set “Bitumen” ASTM D 5 / IP 4 Test Set “Wax-Needle” Wax-Needle + 47.5 g Plunger + 150 g Weight SUR-Half-scale-Cone + 48.5 g Plunger + 100 g Weight
Yogurt (firm)	18-0140 + 18-0044	SUR-Half-scale-Cone + 15 g Plunger
Yogurt (liquid)	18-0260	Al-Hollow-Rod

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