

# PENETRATION

## Test Methods

**Penetration of Bituminous Materials** ASTM D5; IP 49; DIN 52010

**Cone Penetration of Lubricating Grease** ASTM D217; IP 50;  
ISO 2137; DIN 51804; FTM 791-311, FTM 791-313

**Cone Penetration of Petrolatum** ASTM D937; IP 179;  
ISO 2137; DIN 51580

**Needle Penetration of Petroleum Waxes** ASTM D1321;  
IP 376; DIN 51579

**Cone Penetration of Lubricating Grease Using One-Quarter and  
One-Half Scale Cone Equipment** ASTM D1403; IP 310; ISO 2137;  
DIN 51804

**Yield Stress of Heterogeneous Propellants by Cone Penetration  
Method** ASTM D2884

**Roll Stability of Lubricating Grease** ASTM D1831



# Penetration



K19500 Penetrometer with K20800 Penetration Cone

## Ordering Information

<b>Catalog No.</b> K19500	Penetrometer
	<b>Accessories</b>
K19520	Plunger, 15g For use with K20200, K19800 and K20300 Cones
K20910	Plunger, 6.9g For use with K20900 Cone
K19525	Plunger, 47.5g
K19510	Auxiliary Weight Set Includes one each 2.5g, 5g and 10g weights and two 20g weights
K19535	Loading Weight, 50g
K19536	Loading Weight, 100g

## Penetration of Bituminous Materials

Cone Penetration of Lubricating Grease

Cone Penetration of Petrolatum

Needle Penetration of Petroleum Waxes

Cone Penetration of Lubricating Grease Using  
One-Quarter and One-Half Scale Cone Equipment

Yield Stress of Heterogeneous Propellants by  
Cone Penetration Method

## Test Method

Penetration tests are performed on petroleum products to determine consistency and shear stability (lubricating greases) for design, quality control and identification purposes. A standard cone or needle is released from a penetrometer and allowed to drop freely into the sample for 5 seconds (or a different specified interval) at constant temperature. The depth of penetration of the cone or needle into the sample is measured in tenths of a millimeter by the penetrometer.

## Penetrometer

- Conforms to ASTM and related specifications for penetrometers
- Suitable for laboratory or field use

Designed for ASTM penetration tests on petroleum products and for consistency tests on a wide range of food products, cosmetics, pastes and other solid to semi-solid products. Precision machined and assembled to exacting specifications, and ruggedly constructed to insure long service life in both laboratory and field applications. Features a full penetration range of 0-62.0mm with  $\frac{1}{10}$ mm subdivisions (0-620 penetration scale). Accommodates cones and needles to perform all of the ASTM tests on lubricating greases, asphalts, petroleum waxes and petrolatums. Compact design facilitates transport for field use. Head assembly adjusts for accurate placement of the tip of the needle or cone on the surface of the sample. Sturdy cast iron base provides excellent support and has a built-in spirit level and levelling screws to insure proper alignment of the penetrometer during testing. Supplied with 50 and 100 gram weights and standard 47.5g plunger assembly. Order test cones, needles and lightweight plunger (where applicable) separately.

## Specifications

Conforms to the specifications of:

ASTM D5, D217, D937, D1321, D1403, D2884, D4950; IP 49, 50, 179, 310; ISO 2137; DIN 51579, 51580, 51804; FTM 791-311, 791-312, 791-313; AOCs Cc 16-60; AACC 58-14; NFT 60-119, 60-123, 60-132, 66-004

## Included Accessories

Plunger, 47.5g  
Weights, 50 and 100g

## Dimensions l x w x h, in. (cm)

6x6x18 (15x15x46)  
Net Weight: 12 lbs (5.4kg)

## Shipping Information

Shipping Weight: 15 lbs (6.8kg)  
Dimensions: 1.7 Cu. ft.

## Microprocessor Based Digital Penetrometer

- Tests the consistency of lubricating greases, petroleum waxes, bitumens, pastes, creams and other solid to semi-solid products
- Automatically timed operator programmable penetration measurements
- Motorized placement of penetrator on sample surface
- Large LCD to display all functions
- RS232 port for data transfer
- Full measurement range of 0-620 in  $\frac{1}{100}$ mm scale or  $\frac{1}{1000}$ mm scale
- Rechargeable battery or AC operation
- Large, removable base accommodates grease worker cups and other ASTM and non-standard sample containers
- Complete selection of penetrometer cones, needles and accessories for petroleum products testing and for a wide range of other applications
- Conforms to all ASTM, IP, ISO 9001 and related specifications for penetrometers

Microprocessor based penetrometer loaded with advanced features to provide ease of operation and highly reproducible consistency measurements of petroleum products. Microprocessor control provides a full range of measurement and reporting options, and operation is simplified by four user programmable presets that facilitate lowering the penetrator tip to the sample surface.

**Automatically timed penetrations**—The penetrometer defaults to the standard ASTM interval of 5.0 seconds, or the operator may conveniently program a different interval in the range between 0.1 and 9999.9 seconds (in 0.1 second increments). A curing or temperature stabilization period may also be programmed by the operator (to delay the release of the penetrator into the sample) and for added convenience all selected parameters are retained in memory and automatically repeated in subsequent tests until changed by the operator. Separate keypad controls for each parameter simplify operation. Penetration and delay intervals count down on a large, easy to read LCD on the head of the unit.

**Convenient measurement and reporting options**—Penetration measurements in the full range of 0 - 620 in  $\frac{1}{100}$ mm scale are reported in either  $\frac{1}{100}$ mm or  $\frac{1}{1000}$ mm increments at the operator's option. For quality control testing, a penetration range can be entered into memory prior to testing. If a test result falls outside of the programmed range, an audible signal and visual error message alert the operator of a failed sample. Test results are displayed in digital format on a large LCD readout on the head of the penetrometer and can be communicated to a printer or computer via a built-in RS232 interface.

**Simplified penetrator tip placement**—Correct placement of the penetrator tip on the sample surface is essential for accurate penetration test results. The Koehler Digital Penetrometer has four operator programmable presets that lower the penetrator to the sample surface height at the touch of a button, greatly simplifying the process to ensure reproducibility. A fine adjustment button permits slight adjustments as needed. Full manual operation is also available with the use of coarse and fine push button controls and built-in magnifier and illuminator arms. When testing electrically conductive samples, a built-in circuit senses the sample surface for automatic placement. After testing, the penetrometer head returns to a raised position at the touch of a button to facilitate cleaning of the penetrator and changing of the sample.

**More convenience features**—The detachable machined base provides a large platform to accommodate a wide range of sample containers and constant temperature cylinders. It removes easily to permit the head assembly to be reversed (for use with a constant temperature bath) or mounted directly to a bath housing or other location. A built-in rechargeable battery pack permits field operation and provides back-up in the event of power interruption. Battery recharges automatically during operation of the penetrometer on standard AC electrical service.

*For NIST traceable certified thermometers, please refer to the ASTM Thermometer section on pages 184 through 191.*



K95500 Digital Penetrometer

### Specifications

Conforms to the specifications of: ASTM D5, D217, D937, D1321, D1403, D2884, D4950; IP 49, 50, 179, 310; ISO 2137; DIN 51579, 51580, 51804; FTM 791-311, 791-312, 791-313; AOCs Cc 16-60; AACC 58-14; NFT 60-119, 60-123, 60-132, 66-004

Penetration Range: 0-62.0mm (0-620 penetration scale) in  $\frac{1}{100}$ mm or  $\frac{1}{1000}$ mm  
 Penetration Interval: Operator variable from 0.1 to 9999.9 seconds with automatic repeat function and 5.0 second default

### Included Accessories

Standard Plunger, 47.5g  
 Weights, 50 and 100g

### Dimensions l x w x h, in. (cm)

Base: 12 $\frac{1}{2}$ x14 (31.7x35.6)  
 Overall: 12 $\frac{1}{2}$ x14x18 (31.7x35.6x45.7)  
 Net Weight: 21 lbs (9.5kg)

### Shipping Information

Shipping Weight: 27 lbs (12.3kg)  
 Dimensions: 2 Cu. ft.

### Ordering Information

Catalog No.		Order Qty
K95500	Digital Penetrometer, 115V, 50/60Hz	1
K95590	Digital Penetrometer, 220-240V, 50/60Hz	
<b>Accessories</b>		
K19552	Calibration Kit Consists of 0.500, 1.000 and 2.000" gauge blocks with calibration certificate traceable to NIST	
K95573	Plunger, 15g For use with K20200, K19800 and 20300 Cones	
K95519	Plunger, 6.9g For use with K20900 Cone	
K95576	Standard Plunger, 47.5g	
K19587	Loading Weight, 50g	
K19588	Loading Weight, 100g	

# Penetration

## Penetrometer Cones, Needles and Accessories

- Precision machined cones and needles for ASTM and related methods
- Sample containers
- Constant temperature baths
- Grease workers and accessories
- Roll stability testers
- USDA and AOCS penetrometer cones

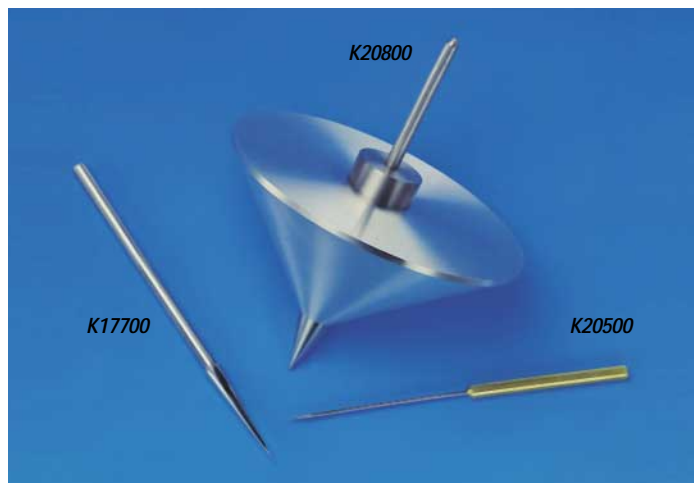
Use together with K19500 and K95500 series penetrometers to determine the consistency of petroleum products. Please call or write for information on non-petroleum test applications.

## Needle Penetration of Petroleum Waxes

### Test Method Standards

ASTM D1321; IP 376; DIN 51579

<b>K17700</b>	Needle, Stainless Steel, 2.5g
<b>K17770</b>	Needle, Stainless Steel, 2.5g, NIST Certified
<b>K17710</b>	Wax Specimen Container Brass cylinder with base plate conforming to ASTM D1321 specifications
<b>K95600</b>	Penetration Bath, 115V, 60Hz
<b>K95695</b>	Penetration Bath, 220-240V, 50Hz
<b>K95696</b>	Penetration Bath, 220-240V, 60Hz



## Penetration of Bituminous Materials

### Test Method Standards

ASTM D5; IP 49; DIN 52010

<b>K20500</b>	Needle. Stainless steel with brass ferrule, 2.5g
<b>K20570</b>	Needle. Similar to K20500, NIST certified, 2.5g
<b>K20600</b>	Needle. Stainless steel with stainless steel ferrule, 2.5g
<b>K20670</b>	Needle. Similar to K20600, NIST certified, 2.5g
<b>388-001-003</b>	Sample Container, 55mm dia. x 35mm depth for penetrations below 200
<b>388-001-006</b>	Sample Container, 70mm dia. x 45mm depth for penetrations between 200 to 350
<b>357-000-001</b>	Transfer Dish Submerges sample container per ASTM specifications
<b>K95600</b>	Penetration Bath, 115V, 60Hz
<b>K95695</b>	Penetration Bath, 220-240V, 50Hz
<b>K95696</b>	Penetration Bath, 220-240V, 60Hz

## Cone Penetration of Lubricating Greases

### Test Method Standards

ASTM D217; IP 50; ISO 2137; DIN 51804; FTM 791-311, FTM 791-313

<b>K20800</b>	Cone, Magnesium With hardened stainless steel tip, 102.5g Standard cone per ASTM D217
<b>K20000</b>	Cone, Brass With hardened stainless steel tip, 102.5g Optional cone per ASTM D217
<b>K18100</b>	Grease Worker series. Refer to page 28 for specifications and ordering information
<b>K19100</b>	Grease Cutter For 'block penetration' tests
<b>K95600</b>	Penetration Bath, 115V, 60Hz
<b>K95695</b>	Penetration Bath, 220-240V, 50Hz
<b>K95696</b>	Penetration Bath, 220-240V, 60Hz

*Please inquire with Koehler Customer Service about accessories for food, cosmetics, paints, soaps, and other consistency measurement applications utilizing the Penetrometer.*

# Penetration



## Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment

### Test Method Standards

ASTM D1403; IP 310; ISO 2137; DIN 51804

- K20900** Quarter-Scale Cone, Aluminum, 2.48g
- K95519** Plunger, 6.9g  
For use with K95500 series Digital Penetrometer
- K20910** Plunger, 6.9g  
For use with K19500 series Digital Penetrometer
- K21000** Quarter-Scale Grease Worker  
Consists of cup and cover assembly with plunger plate, shaft, handle and valve
- K21002** Retaining Base Plate  
Mounts on bench or wall to retain Quarter-Scale Grease Worker when working heavy greases.
- K21001** Blank Lid  
With seal, for Quarter-Scale Grease Worker.  
Use when heating samples prior to test.
- K20200** Half-Scale Cone, Stainless Steel, 22.5g
- K95573** Plunger, 15g  
For use with K95500 series Digital Penetrometer
- K19520** Plunger, 15g  
For use with K19500 Penetrometer
- K20210** Half-Scale Grease Worker
- K95600** Penetration Bath, 115V, 60Hz
- K95695** Penetration Bath, 220-240V, 50Hz
- K95696** Penetration Bath, 220-240V, 60Hz

## Cone Penetration of Petrolatum

### Test Method Standards

ASTM D937; IP 179; ISO 2137; DIN 51580

- K20800** Cone, Magnesium  
With hardened stainless steel tip, 102.5g
- K20700** Sample Container  
With cover, conforms to ASTM D937 specifications
- K95600** Penetration Bath, 115V, 60Hz
- K95695** Penetration Bath, 220-240V, 50Hz
- K95696** Penetration Bath, 220-240V, 60Hz

## Roll Stability of Lubricating Grease

### Test Method Standard

ASTM D1831

- K18300** Roll Stability Tester series (page 156)
- K20900** Cone Penetration Test Equipment, One-Quarter or One-Half Scale series

## Additional Penetration Cones

- K19800** Magnesium Cone, 15g  
For ASTM D2884 testing of Heterogeneous Propellants
- K19900** Aluminum Cone, 45g  
For AOCS CC 16-60 testing of fats, butter, margarine
- K20090** Aluminum Cone, 35g  
For USDA testing of pastes
- K20300** Aluminum Micro-Cone, 5g  
For lubricating greases, cosmetic creams. Use together with K20310 Sample Cup and Collar



*K20300 Aluminum Micro Cone*



*K19900 Aluminum Cone*

# Penetration



K18190 Mechanical Grease Worker

## Grease Workers

- Conform to ASTM D217 and related specifications
- Mechanical and manually operated types
- Single and double-unit models

**Mechanical Grease Workers**—For “worked penetration” and “prolonged worked penetration” tests to determine consistency of lubricating greases. Consists of single or dual steel ASTM grease workers mounted on a sturdy base and driven by a powerful gear reduction motor. Meets ASTM specifications for stroke length and rate. Equipped with a presetting electronic counter that automatically shuts off the drive motor after any desired number of strokes up to 99,999. Steel grease workers have threaded cup and cover, and steel plunger plate with shaft and handle that connects to eccentric cam on drive unit. Accessory dial thermometer inserts in plated vent cock. Spring loaded tightening clamps hold grease workers securely on base, and steel pins in base facilitate disassembly of grease workers after testing.

**Manually Operated Grease Worker**—Hand lever operated grease working machine designed for short duration “worked penetration” tests on lubricating greases. Consists of one steel ASTM grease worker with hand lever mechanism mounted on a sturdy steel base. Spring loaded tightening clamps hold grease worker securely on base, and steel pins in hand lever upright support facilitate disassembly of grease worker. Base plate is drilled at corners to allow for bolting to table top.

## Ordering Information

### Catalog No.

#### Mechanical Grease Workers

K18100	Single-Unit Model, 115V 60Hz
K18110	Single-Unit Model, 220-240V 50Hz
K18119	Single-Unit Model, 220-240V 60Hz
K18190	Double-Unit Model, 115V 60Hz
K18191	Double-Unit Model, 220-240V 50Hz
K18192	Double-Unit Model, 220-240V 60Hz

#### Manually Operated Model

K18000	Grease Working Machine
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For Quarter-Scale and Half-Scale Grease Workers, refer to page 27.

### Accessories

K18022	Dial Thermometer Inserts in petcock of steel grease worker. Supplied with adapter.
K18021	Overflow Ring Collects displaced grease during penetration measurements.
K18020	Steel Grease Worker Complete per ASTM specifications. Consists of cup, cover, plunger and vent cock.
K18030	Steel Grease Worker Similar to K18020 above, but with 270-hole plunger plate per FTM 791-313 (AN-G-15) specifications.
K18028	Cover Assembly Replacement cover assembly for steel grease worker. Includes vent cock, plunger plate, shaft and handle.
K18029	Grease Cup
K18023	Blank Lid, with seal For ASTM Steel Grease Worker. Use when heating samples prior to test.

## Specifications

Conforms to the specifications of:

ASTM D217, D4950; IP 50; ISO 2137; DIN 51804; FTM 791-311, 791-313\*

\*Requires substitution of 270-hole grease worker (K18030)

Drive Motor: fan cooled gear reduction type, 1/8hp (single-unit model)  
or 1/2 hp (dual-unit model)

Electrical Requirements:

Mechanical Grease Workers:

115V 60Hz, Single Phase, 3A

220-240V 50/60Hz, Single Phase, 1.5A

## Included Accessories

Mechanical ASTM Steel Grease Worker (1 or 2)

## Dimensions lwxhxh,in.(cm)

Mechanical Grease Workers:

Single-Unit: 10x13½x14¼(25x34x37)

Double-Unit: 14x13½x14¼(36x34x37)

Manually Operated Grease Worker: 30x10x15½(76x25x39)

Net Weight:

Mechanical Single-Unit: 106 lbs (48.1kg)

Mechanical Double-Unit: 139½ lbs (63.3kg)

Manual: 21 lbs (9.6kg)

## Shipping Information

Shipping Weight: Single-Unit: 141 lbs (64.0kg)

Mechanical Double-Unit: 171 lbs (77.6kg)

Manual: 28 lbs (12.7kg)

Dimensions: Mechanical: 4.2 Cu. ft.; Manual: 2.7 Cu. ft.



K95600 Penetrometer Bath

## Penetrometer Bath

- Conforms to ASTM and related specifications
- Conditions petroleum samples and others requiring close temperature control prior to or during testing
- For use with manual and microprocessor penetrometer models
- Digital temperature control with low-liquid and overtemperature safety cut off

Constant temperature water bath for conditioning samples prior to a penetration test. Full visibility bath has a large shelf to accommodate a wide range of sample containers, including all containers used in ASTM tests. Sample containers can be left in the bath during the penetration test if required. The base of the Koehler manual penetrometer can be placed directly on the shelf of the bath, or the head assembly of the digital automatic model can be reversed to overhang the bath. Microprocessor digital temperature control maintains bath liquid temperature with  $\pm 0.05^{\circ}\text{C}$  stability throughout the operating range. A large LED provides bath temperature readout in switchable  $^{\circ}\text{C}/^{\circ}\text{F}$  format and a dual-speed circulating pump assures temperature uniformity. The bath is protected by a separate adjustable overtemperature thermostat and a low liquid cut-off. A built-in cooling coil is provided for circulating a refrigerated coolant or tap water if needed.

## Specifications

Conforms to the specifications of:

ASTM D5, D217, D937, D1321, D1403, D2884

Temperature Range: Ambient to  $70^{\circ}\text{C}$

Temperature Stability:  $0.05^{\circ}\text{C}$  ( $0.1^{\circ}\text{F}$ )

Electrical Requirements:

115V 60Hz, Single Phase, 9A

220-240V 50/60Hz, Single Phase, 4.5A

## Dimensions l x w x h, in. (cm)

18x13 $\frac{1}{8}$ x8 $\frac{1}{2}$  (45.7x33x21.6)

Net Weight: 6 lbs (2.7kg)

## Shipping Information

Shipping Weight: 10 lbs (4.5kg)

Dimensions: 1.2 Cu. ft.

## Ordering Information

### Catalog No.

K95600	Penetrometer Bath, 115V 60Hz
K95695	Penetrometer Bath, 220-240V 50Hz
K95696	Penetrometer Bath, 220-240V 60Hz

### Accessories

250-000-17F	ASTM 17F Thermometer Range: 66 to $80^{\circ}\text{F}$
250-000-17C	ASTM 17C Thermometer Range: 19 to $27^{\circ}\text{C}$
250-000-63F	ASTM 63F Thermometer Range: 18 to $89^{\circ}\text{F}$
250-000-63C	ASTM 63C Thermometer Range: $-8$ to $+32^{\circ}\text{C}$
250-000-64F	ASTM 64F Thermometer Range: 77 to $131^{\circ}\text{F}$
250-000-64C	ASTM 64C Thermometer Range: 25 to $55^{\circ}\text{C}$

For NIST traceable certified thermometers, please refer to the ASTM Thermometer section on pages 184 through 191.

## Additional Accessories

Additional equipment, materials and/or reagents are required to perform some of the test procedures in the preceding pages. Please refer to the applicable test method for further information, or contact Koehler for assistance.

### **Cone Penetration of Lubricating Grease** ..... Page 26

ASTM D217; IP 50; ISO 2137; DIN 51804; FTM 791-311, FTM 791-313

Spatula

Paper

Light Petroleum Naphtha

### **Needle Penetration of Petroleum Waxes** ..... Page 26

ASTM D1321; IP 376; DIN 51579

Glycerin

### **Cone Penetration of Petrolatum** ..... Page 27

ASTM D937; IP 179; ISO 2137; DIN 51580

Laboratory Oven

### **Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment** ..... Page 27

ASTM D1403; IP 310; ISO 2137; DIN 51804

Spatula