

PNR 12: Consistency of Lotion and Balm

Relevant for: Cosmetics Industry

The penetrometer PNR 12 is suitable for consistency determinations in the cosmetics industry. Various test kits are available for different cosmetic products. The choice of the accessories depends on the consistency and conductivity of the sample.



1 Introduction

This application report gives an example on how to measure lotions or other liquid-like products with a very low consistency with Anton Paar's penetrometer PNR 12.

1.1 High Efficiency Due to Flexibility

The PNR 12 is a gravity penetrometer and measures the resistance a material provides against being pierced by a specifically shaped test body. This allows a rating of the plasticity or consistency of a product.

Due to its easy handling and convertibility the PNR 12 has gained a wide scope of applications. It is suitable for hard products like compact powder or soap as well as for creamy products like toothpaste and hair styling gel.

1.2 Why is measuring the consistency essential?

To achieve constantly high quality it is essential to check the product parameters. The measured penetration values will not only help to assure a constant quality; the consistency of a product will allow conclusions like:

- Is toothpaste soft enough to be squeezed out of a tube?
- How is the spreading behavior of lotion, cream or lipstick? Is it thick enough to stay on the skin surface or does it get absorbed quickly?
- How fast does soap dissolve or get soft?
- Is a lipstick flexible enough or does it break easily?

1.3 Benefit

The consistency is not only important for the product packing but even more for the quality and the product handling.

The PNR 12 has a wide scope of application:

- Consistency tests of creamy or pasty products with test bodies like rods, disks etc.
- The examination of hard and semi-hard products with tipped test bodies like needles etc.

An optimal product consistency is important for a positive evaluation by the customer.

1.4 Definition

The Penetration Unit [PU] is the consistency of a material expressed as distance in tenth of a millimeter.

2 Instrument

To measure the consistency of lotion or other liquid-like products, Anton Paar's PNR 12 was used.



Figure 1: Penetrometer PNR 12

3 Accessories

Various test kits are available for different standards or for the manual and automatic surface detection. The choice of the accessories depends mainly on the consistency of the sample.

The lotion and the balm are examples for very soft samples. Therefore a light plunger and a test body are needed.

In case of electrical conductive samples the PNR 12 offers an automatic surface detection.

Example Accessories:

- Plunger, 10 g, 107 mm length, aluminum
- Perforated disk, Ø 70 mm, 102.5 g, aluminum
- Sample container, Ø 100 mm × 65 mm



Figure 2: Plunger (front), perforated disk (left) and sample container (right)

Optional:

- Temperature sensor for PNR 12
- Circulator bath set CD-B27
- Transfer dish

4 Sample and Instrument Preparation

A correct preparation of a measurement is important for gaining the best result. How to prepare samples and instrument is explained below.

4.1 Sample Preparation and Filling

It is highly recommended to create an own preparation procedure if no standard is available.

It is important that the sample and instrument preparation is always the same.

Here an example:

- Pour the sample bubble-free into three sample containers.
- The depth of the sample should be min. 10 mm higher than the expected penetration unit.
- Create a flat surface.
- The sample should be worked as little as possible during the filling.
- Temper the sample to 25 °C for 2 h.

4.2 Instrument Preparation

- The instrument must be located on a level, vibration-free surface.
- Use the adjustable feet to align the device, check with the leveling bulb.
- The perforated disk and the plunger must be clean and free from water.

- Install the electric surface detector for conductive samples.
- Small sample containers have to be centered against the test body.

4.3 Calibration

Calibration of distance, time and Pt100 is possible.

For detailed information please refer to the manual.

4.4 Settings

- Penetration time: 5 s
- Temperature: 25 °C
- Total weight of test body assembly: 112.5 g

Other settings are possible but it is very important to have the same settings for all comparable samples.

For example the penetration time could be shortened if the penetration value is still too high although the overall weight of the penetration assembly is as low as possible. In this case you can also lower the temperature.

Parameter	Fixed program 3	Fixed program 4
Program name	Cond Sample	Grease
Operator	Operator 01	Operator 01
Penetration time	50	50
Automatic surface detection	Electric sensor	No detection
Force sensitivity	4	4
Automatic temperature control	No sensor, off	No sensor, manual
Min. start temperature	0	0
Max. start temperature	0	0
Unit	1/10 mm	1/10 mm
Limit low	0	0
Limit high	9999	9999
Wait before	1	1
Speed down	12 mm/s	27 mm/s
Distance down	180 mm	180 mm
Wait on surface	2 s	2 s
Speed up	5 mm/s	5 mm/s
Distance up	20 mm	20 mm
Wait after	2 s	2 s
Specials	C-Value (80 g)	NLGI greases

Table 1: Settings for testing lotion

5 Measurement

There are two possibilities for the surface detection when testing the consistency of lotions with the PNR 12. The manual and the automatic surface detection are explained below.

5.1 With Manual Surface Detection

- Select the program “**Grease**”.
- Place the sample container on the penetrometer table.
- Insert the plunger with the perforated disk.
- Press <START>.
- Reset the plunger by gently lifting as far as it goes while pressing the <RELEASE> button.

Attention: Hold the plunger always by hand before pressing the <RELEASE> button.

- Press <START>.
The slide will move to the basic position. After the waiting time the slide starts to move downwards automatically. With the jog wheel, the speed can be increased (turn clockwise) or decreased (turn counterclockwise).
- Press the jog wheel before the sample surface is reached to stop the movement.
- Bring the perforated disk in a position that it is just touching the surface of the sample slightly.
- Press <START>.
This releases the plunger with the perforated disk for 5 s.
- After the penetration time the slide will move upwards 20 mm and remains there for 2 s. During this waiting time the sample can drop back into the sample container.
- After this the slide will move back into basic position.
- The result is shown on the display.
- Repeat this procedure at least three times with different samples.
- Use a clean perforated disk for each determination.

5.2 With Automatic Surface Detection

Please keep in mind that the automatic surface detection by the electronic sensor is only possible with conductive samples.

In this case, the sample container has to be isolated against the PNR 12 table with a suitable material, e.g. a plastic foil.

- Select the program “**Cond Sample**”.
- Place the sample container on the penetrometer table.
- Insert the hook of the electric surface detector in the sample or assemble it outside on the metallic sample container.
- Insert the plunger and the perforated disk.
- Press <START>.
- Reset the plunger by gently lifting as far as it goes while pressing the <RELEASE> button.

Attention: Hold the plunger always by hand before pressing the <RELEASE> button.

- Press <START>. The slide will move to the basic position. After the waiting time the slide starts to move downwards automatically until the surface is reached.
- After penetration time slide will move upwards 10 mm and remains there for 2 s. During this waiting time the sample can drop back into the sample container.
- After this the slide will move back into basic position.
- The result is shown on the display.
- Repeat this at least three times with fresh samples.
- Use a clean perforated disk for each determination.

6 Cleaning

Wipe the perforated disk with a cleaning solvent e.g. ethanol and a tissue between each penetration.

7 Results

The result is the average of three penetration results reported to the nearest whole unit.

Sample	1. Test result in 0.1 mm	2. Test result in 0.1 mm	3. Test result in 0.1 mm	Average in 0.1 mm
1	233	226	232	230
2	232	232	232	232
3	234	228	231	231

Table 2: Example results of a lotion

Sample	1. Test result in 0.1 mm	2. Test result in 0.1 mm	3. Test result in 0.1 mm	Average in 0.1 mm
1	233	229	234	232
2	234	238	234	235

Table 3: Example results of a balm

The automatic detection by electronic sensor is only possible with conductive samples.

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