



byko-cut

Destructive Film Thickness Gauge

Operating Manual

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1 Overview

byko-cut
Destructive Film Thickness Gauge



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2 System Description

The byko-cut universal is a universal testing instrument to measure the film thickness, adhesion and hardness of paints and coatings on metal and non-metal substrates. The surface is cut according to the related standards or respectively indented and afterwards evaluated under 60 degree illumination.

According to Standards: ASTM D 3002, ASTM D 3359, DIN 50986, DIN 53151, DIN EN ISO 2409, DIN EN ISO 2815

3 Safety Instructions



WARNING

- Do not touch the cutting tools as the sharp edges may cause a laceration.
- Any damage or injury caused by ignoring the safety instructions and general information the manufacturer is not liable.
- If the instrument can not be used safely, discontinue using the instrument and place it in a secure location. Do not use the instrument if it is visually damaged or does not work anymore.
- Do not perform any electrical or mechanical repair, the instrument may only be opened by a trained service technician. Please contact our technical service personnel for assistance.
- If the instrument will not be used over a longer period, please take out the battery to avoid leakage and destruction of the instrument.

4 General Information

- Please only use the original accessories available for the instrument. Inappropriate use of the accessories results in lost of the warranty.
- If used appropriately no hazard is to be expected either mechanically or electrical.
- The instrument consists of sensitive optical, mechanical and electronic precision parts. Do not drop and avoid stress due to vibration and shock.



This symbol means: Do not dispose this product together with your household waste. Please refer to the information of your local community or contact our dealers regarding the proper handling of end-of-life electric and electronic equipment.

Recycling of this product will help to conserve natural resources and prevent potential negative consequences for the environment and human health caused by inappropriate waste handling.



This symbol points out to important additional information.



This symbol warns of danger of injury.

5 Delivery Content

Case

3430, byko-cut universal

or

3431, byko-cut universal

3421 Blade No. 1

3422 Blade No. 2

3423 Blade No. 3

3432, byko-cut universal, without blades

or

3433, byko-cut universal, without blades

804960 Allen key 1.3 mm

802246 Allen key 2.0 mm

802275 Black marker

183019780V Protective cap

802276 Battery 1.5 V

6 Start-up and Power Supply

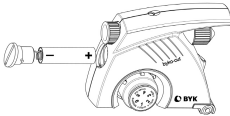
Before starting, read the manual and follow the safety instructions and general information. Unpack the instrument and check the delivery contents for completeness - please refer to chapter "Delivery Contents".

Before starting place the battery in the instrument. The instrument is powered by a 1.5 V Mignon (Alkaline) battery of type AA.

Only use Alkaline batteries!

To assure the instrument is always ready to use, a replacement battery should be available.

6.1 Battery Installation



To insert or replace the battery, open the cover by turning it to the left or right with a coin by 90 degrees. Turn the instrument with the opening up-side down and let the battery slide to your hand. Insert the new battery with the plus pole first into the battery compartment and close it by turning the lid by 30 degrees to the right.



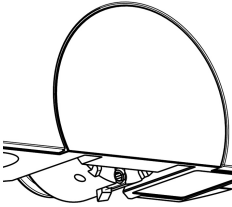
CAUTION!

Batteries and rechargeable batteries are special waste and must not be disposed of with household waste. Make certain to observe the disposal instructions of the battery or rechargeable battery manufacturer.

6.2 Installation of Cutting Tools

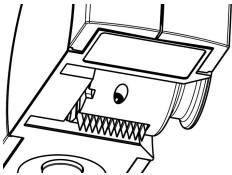
The byko-cut universal comes complete with three cutting tools for film-thickness (tools 1-3). The optional tools for cross-cut can be mounted to the related supports (No. 4-6) of the revolver head as well as the indentation tool for Buchholz hardness to be used in conjunction with the additional weight.

6.2.1 Cutting Tools No. 1-3



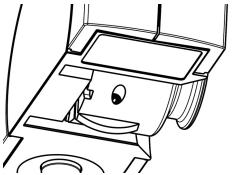
These tools are fixed with hexagon socket screws beside the particular support of the revolver head. To insert or replace the cutting tool, loosen the screw until the tool can easily be moved in the support. Insert the tool and push it against the rear of the support and tighten the screw (see "Accessories and Spare Parts").

6.2.2 Multi-cut Tool for Cross-cut



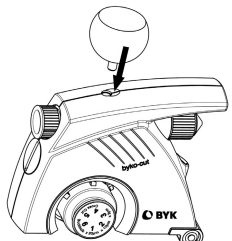
Cross-cut 1 mm, 1.5 mm and 2 mm tools can be used. The screw holding the cutter is beside the holder. To exchange the tool, loosen the screw until the cutter can be pulled out. Insert a new tool and push it against the rear of the mount, fasten the screw (see Accessories and spare parts).

6.2.3 Indentation Tool for Buchholz Hardness



To exchange the tool, loosen the screw until the cutter can be pulled out. Insert a new tool and push it against the rear of the mount, fasten the screw (see Accessories and spare parts).

6.2.4 Weight for Buchholz Indentation

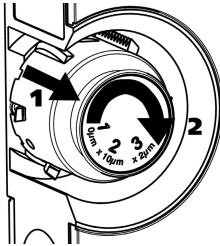


For Buchholz Indentation Test the tool must press with a force of 500 g perpendicular onto the surface. Therefore an additional weight is attached to the byko-cut.

6.3 Usage of the Revolver Head

How to set up the cutting tools in the revolver head:

- For adhesion tools no. 4-5 as well as for Buchholz Indentation no. 6 use the 1.3 mm allen key. For the other cutting tools no. 1-3 use 2 mm allen key.
- **Very important:** Loosen the screw and add the cutting tool inside the support and check that the highest tip of the tool is close to the wheel side.



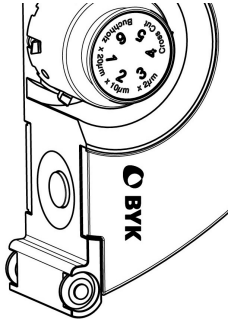
To adjust the revolver head:

1. Pull the holder.
2. Turn it to left or right.

Once in the proper positions the holder locks in place.

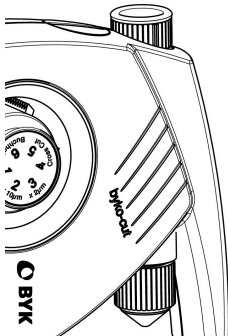
7 Operation

7.1 Microscope



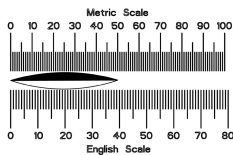
Turn the illumination on by pressing the switch once. To turn it off, press the switch again.

Note(!): The illumination does not switch off automatically. If the light is not switched off, the batteries will empty.



The microscope view can be sharpened by turning the objective lens or the eye-piece adjustment ring.

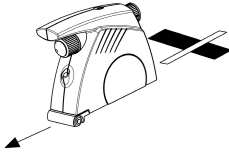
For sharpening the scale view, turn the eye-piece ring to adjust the object view turn the objective lens.



A micrometer/mils scale is built in the microscope to measure the dimensions of paint flaws and intersection.

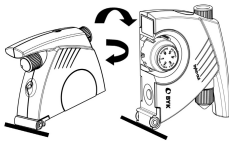
2,000 microns in 100 line markings.

7.2 Film Thickness



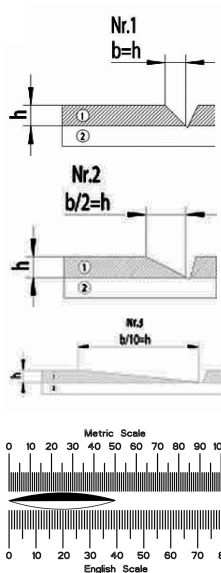
First trace a color-lined using a marking pen. Choose the appropriate cutting tool and create a V-shaped cut through the coating to the substrate. The guiding wheels assure a perpendicular cut and prevent the cutting tool from tilting. For extremely hard or brittle substrates often multiple cuts are necessary to determine the optimal indentation force and drawing speed.

7.2.1 Cut Finder



Before lifting mark the wheeled edge on the coating then turn the byko-cut until the lens is above the cut and the wheeled edge sits exactly at the marking. The cut appears under the microscope.

7.2.2 Determination of Film Thickness



Switch on the illumination. The microscope eyepiece shows a 2 mm long micron/mils scale with 100 line markings, the cut appears under the microscope according to the pictures, depending on the cutting angle. Place the "Zero" mark at the start of the cut and count the units.

Scale of the byko-cut universal

Tool No.	Cutting Angle *	Range in Mils	1 Line Increment in Mils	Range in Microns	1 Line Increment in Microns	Accuracy in Microns (± 1 increment) **
1	45°	0 - 80	1	0 - 2000	20	40
2	26.6°	0 - 40	0.5	0 - 1000	10	20
3	5.7°	0 - 8	0.1	0 - 200	2	4

*) Angle measured from sample plain.

**) For film thickness smaller 15 μm , accuracy plus 1.5 μm . Additional cutting tools are available for very thin or very thick coatings.

7.2.3 Measurement for Film Thickness

Step 1:

Marking Make a perpendicular mark to the scratch direction with a black marker on the panel.

Step 2: Cutting

Select the cutter based on predicted film thickness and make a vertical cut.

Step 3: Adjustment of microscope

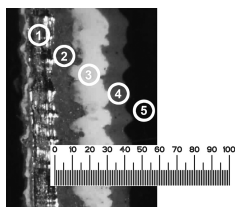
- Place the microscope of the byko-cut Universal over the cut.
- Adjust the top lens for focusing the scale.
- Adjust the lower lens for focusing the surface.

Step 4: Result

Count the line increments and multiply them with the appropriate factor given in the conversion table.

Determination according to ASTM method uses the "mils" scale.

The cut is usually frayed. To increase the precision, measure several parts of the cut and calculate an average. For best results the individual coating layers should have a different color.



The following film thickness calculation example is using cutting tool #3.

- (1) = Substrate
- (2) = E-coat $\sim 12 \times 2 = 24 \mu\text{m}$
- (3) = Primer $\sim 20 \times 2 = 40 \mu\text{m}$
- (4) = Base coat $\sim 10 \times 2 = 20 \mu\text{m}$
- (5) = Black marker

Total Film Build: $\sim 48 \mu\text{m}$

7.3 Cross-Cut Adhesion

In the revolver head optional cutting tools for crosscut can be inserted. The cutters are mounted as described in chapter "Installation of cutting tools".



Important! The sharp tip is facing toward the cutting direction, the tool's sharp tip is used for the cut. Evaluation is performed according to the standard ranges in DIN ISO or ASTM.

Standards: ASTM D 3002, D 3359, DIN EN ISO 2409 The standards prescribe the following spaces between two cuts:

Film Thickness	Cutter Spacing
0 - 60 μm	1 mm
0 - 120 μm	2 mm
> 120 μm	3 mm

The byko-cut is capable of work with 1mm, 1.5 mm and 2 mm cutters. The 3 mm cutting tool is too wide and does not fit into the revolver head.

Use

1. Make a lattice pattern in the film with appropriate tool, cutting to the substrate.
2. For the DIN method brush the cut area in the diagonal direction five times, for the ASTM method place the Permacel tape over the cut and remove the tape.
3. Examine the grid area using the microscope.

7.3.1 Measurement for Adhesion

Tools no. 4 - 5 for adhesion test have to be ordered separately.

How to evaluate the adhesion according to standards?

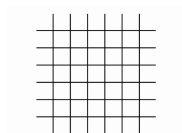
The **ASTM method D-3359** mentions:

- 1 mm cutter for film up to 2 mils (50 μm)
- 2 mm cutter for films between 2 - 5 mils (125 μm)

The **DIN EN ISO 2409** prescribes that the numbers of cuts shall be 6 and the cut in each direction must be same according to the film thickness and the kind of coating used as given as shown below:

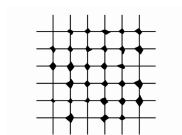
- 0 - 60 μm : 1 mm space for hard coating
- 0 - 60 μm 2 mm space for soft coating
- 61 - 120 μm 2 mm space for hard or soft coating
- 121 - 250 μm 3 mm space for hard or soft coating

7.3.2 Cross-Cut Result



ISO Class: 0 / ASTM Class: 5 B

The edges of the cuts are completely smooth, none of the squares of the lattice is detached.



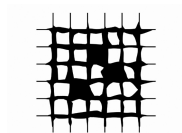
ISO Class: 1 / ASTM Class: 4 B

Detachment of small flakes of the coating at the intersections of the cuts. A cross-cut area not significantly greater than 5 % is affected.



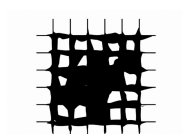
ISO Class: 2 / ASTM Class: 3 B

The coating has flaked along edges and/or at the intersections of cuts. A cross-cut area significantly greater than 5 %, but not significantly greater than 15 % is affected.



ISO Class: 3 / ASTM Class: 2 B

The coating has flaked along the edges of the cuts partly or wholly in large ribbons, and/or it has flaked partly or wholly on different parts of the squares. A cross-cut area significantly greater than 15 %, but not significantly greater than 35 % is affected.



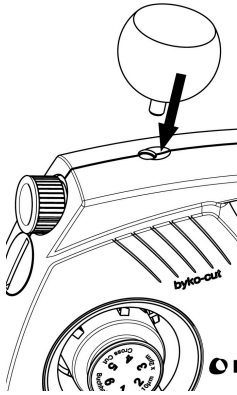
ISO Class: 4 / ASTM Class: 1 B

The coating has flaked along the edges of cuts in large ribbons and/ or some squares have detached partly or wholly. A cross-cut area significantly greater than 35 %, but not significantly greater than 65 % is affected.

ISO Class: 5 / ASTM Class: 0 B

Any degree of flaking that cannot even be classified by classification 4; i.e. an affected area greater than 65 %.

7.4 Buchholz Indentation



With the optional indentation tool and weight for Buchholz hardness the byko-cut can be used for the test according to DIN 53153.

The tool is mounted to the appropriate support and the weight placed on the top of the instrument (see chapter "Weight for Buchholz Indentation").

Place the wheels on the sample and tip the tool onto the surface.

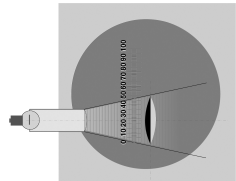
After 30 seconds the tool is lifted from the surface and the cut is measured through the microscope.

Before lifting the byko-cut, mark the wheeled edge on the coating (refer to chapter "Cut Finder"), then turn the byko-cut until the lens is above the cut and the wheeled edge sits exactly at the marking.

The cut appears under the microscope.

The following table shows the values for indentation.

Indentation Resistance



Fullscale is 2 mm length.

Length (mm)	Resis- tance (aB)	Error value max. (ΔaB)	Lower limit (aB) min.	Upper limit (aB) max.	Depth (µm) *	Minium thick- ness (µm)
0,7	142,9	20,4	122,4	163,3	4	12
0,8	125,0	15,6	109,4	140,6	5	15
0,9	111,1	12,3	98,8	123,5	7	20
1,0	100,0	10,0	90,0	110,0	8	20
1,1	90,9	8,3	82,6	99,2	10	20
1,2	83,3	6,9	76,4	90,3	12	25
1,3	76,9	5,9	71,0	82,8	14	25
1,4	71,4	5,1	66,3	76,5	16	30
1,5	66,7	4,4	62,2	71,1	19	30
1,6	62,5	3,9	58,6	66,4	21	35
1,7	58,8	3,5	55,4	62,3	24	35
1,8	55,6	3,1	52,5	58,6	27	40
1,9	52,6	2,8	49,9	55,4	30	40
2,0	50,0	2,5	47,5	52,5	33	45

* Rounded up of whole µm.

The minium coat thickness under the insertion tool should to be 10 µm film thickness.

8 Cleaning and Maintenance

- Do not use solvents to clean the instrument, some parts are not resistant against solvent and solvent-containing detergents.
- Before cleaning switch the illumination of and remove the battery.
- Visually check periodically the condition of the cutting tools.

9 Accessoires and Spare Parts

3425 Cutting Blade 1,0 mm (DIN EN, ISO)

3426 Cutting Blade 2,0 mm (DIN EN, ISO)

3429 Cutting Blade 1,0 mm (ASTM)

3424 Cutting Blade 1,5 mm (ASTM)

5135 Brush

8660 Permacel Adhesive Tape

5137 DIN EN, ISO Adhesive Tape

Optional for Film Thickness

3419 Special Cutter up to 100 μm

3420 Special Cutter up to 3000 μm

Optional for Indentation

3427 Buchholz Indentation Device

3434 Slip-on-Weight

10 Error Correction

Lamp does not light up.

Battery empty, battery inserted in the wrong direction.

All cuts appear rough.

Cutting tool is dull and frayed.

Scale in the microscope is not sharp.

Turn the ocular ring to sharpen image.

11 Declarations

11.1 EU Declaration of Conformity

We,

BYK-Gardner GmbH

Lausitzer Strasse 8

D-82538 Geretsried

declare, that the instrument **byko-cut** complies with the requirements of the following EU directives:

- 2014/30/EU - Electromagnetic Compatibility (EMC)

The following harmonized standards were applied:

- EN IEC 61326-1:2021 - Electrical equipment for measurement, control, and laboratory use - EMC requirements

Geretsried, April 11, 2025



Dr. Jörg Krames

President • BYK-Gardner GmbH

11.2 UK Declaration of Conformity

Hereby,

BYK-Gardner GmbH

Lausitzer Strasse 8

D-82538 Geretsried

declares, that the instrument **byko-cut** complies with the requirements of the following UK directives:

- S.I. 2014/30/EU - Electromagnetic Compatibility (EMC)

The following harmonized standards were applied:

- EN IEC 61326-1:2021 - EMC requirements

Geretsried, April 11, 2025



Dr. Jörg Krames

President • BYK-Gardner GmbH

12 Technical Data

Temperature range	10 °C - 40 °C (operation) 0 °C - 60 °C (store)
Relative humidity	Up to 85% at 35 °C, non condensing
Power supply	Alkaline battery 1 x 1.5 V DC, 0.12 A
Dimensions (WxLxH)	35 x 113 x 98 mm
Weight	410 g

A member of  **ALTANA**

Download your manuals from:
<https://www.byk-instruments.com/p/3430>

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