

easySCRATCH



Manual

Version 1.0



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1 Safety instructions

- Read the manual's instructions carefully before commissioning easySCRATCH
- Keep the manual for future reference
- Follow all safety and warning instructions, displayed on easySCRATCH
- Always place easySCRATCH on a flat surface
- Operate easySCRATCH only in areas, which are not classified as electrical dangerous
- The power supply to the IEC input bushing must be connected to ground, using the supplied IEC power cable
- easySCRATCH has to be equipped with fuses according to the manual's specification and correspond to the supply voltage
- Any replacement power line must have a specification equivalent to the one supplied
- While operating easySCRATCH you should remove loose clothing or jewelry that may get caught. Beware of moving parts
- Avoid inhaling solvent vapors when cleaning or using easySCRATCH
- Do not attempt to lift easySCRATCH at the load unit (in which the shaft for the applying force is guided) or at the sample holder
- easySCRATCH mustn't be used in hazardous areas
- Never put any body parts underneath the indenter
- Make sure that you do not accidentally hit the hand lever

Disposal



easySCRATCH must not be disposed of with household, commercial or industrial waste. Please observe the local disposal methods or contact us regarding the proper disposal of electronic equipment.

2 Scope of delivery

Basic device easySCRATCH

(Universal) Bench vise for samples

Weights: 2 x 10 N; 2 x 20 N; 1 x 50N

IEC-power cable

Manual

Options:

Indenter incl. DAkkS- or ASTM certificate

V-Block for cylindrical samples

Bidirectional multipass scratch

Clamping profiles adapted to the specimen geometry



Please check the completeness of the delivery immediately after receipt of the goods.

3 Specifications

Test load range:	10 – 120 N in steps of 10 N (further steps on request)
Scratch speed:	5 – 20 mm/min
Scratch length:	2 – 40 mm
Max. travelling path:	90 mm
Max. sample height:	40 mm
Clamping range for flat samples:	36 mm
Dimensions without weights:	460 / 295 / 295 mm (H / B / T)
Power supply:	85 – 264 VAC, 47 – 63 Hz Fuses: 5x20, 2 A/250 V
Weight:	Device approx. 13.5 kg Weights approx. 11 kg

4 Introduction

The scratch tester easySCRATCH is the cost-efficient solution to determine the adhesion between the coating and the base material according to DIN EN ISO 20502 and ASTM C1624. A diamond stylus is drawn across the sample surface under a specific, vertically acting test load. The coating damage is assessed under a microscope. Different coating damages, such as cracks, chipping and spalling can occur (see figure 1).

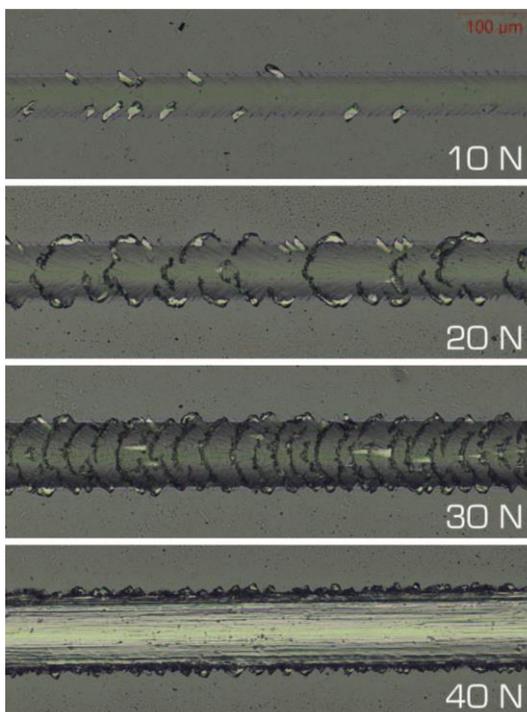


Figure 1: Scratch marks under different loads on a W-DLC sample

For tests during production, it is generally sufficient to test with a constant load, at which no coating damages may occur. Like that the sample can directly be rated, PASS or FAIL. This reduces the effort and the requirements to assess the scratch marks, notably. Depending on the coating system, different test loads can be applied.

The test load is applied by weights, which can be easily exchanged by the operator. Activating the test load application is initiated mechanically with a hand lever. The movement of the sample to generate a scratch mark is motor-driven and its speed can be set. The length of the scratch marks can be adjusted in a wide range.

The diamond stylus is a standardized Rockwell-C-indenter. When necessary, it can easily be installed or removed (for inspection or exchange). The sample holder is mounted in a dovetail guide and can quickly be substituted.

easySCRATCH is mainly used to test ceramic hard-coated materials with coating thicknesses from 1 to 30 μm . The range of application extends from layer development to tests during production.

5 Commissioning

5.1 General information

easySCRATCH must be placed that no shocks or vibrations occur during the scratching process. Power is supplied via a wide-range power supply unit with an input voltage range of 85 - 264 V and a frequency of 47 - 63 Hz.



Due to CE regulations, the nameplate only indicates ranges that are restricted by 10 % each at the top and bottom.

The load application unit is fixed with cable ties to secure it for transport. These must be removed before usage.

5.2 Installation and inspection of the indenter

5.2.1 General information

The indenter is not part of the standard scope of delivery. If an indenter is supplied, it is in a separate package.

A knurled nut, which can be screwed on and off by hand, fixes the indenter of easySCRATCH. No additional tools are needed. Another advantage of the knurled nut is that the indenter is pressed on its entire circumference into the holder which prevents inclination.

5.2.2 Installation of the indenter

To install a suitable indenter, first remove the knurled nut. Afterwards, put the indenter into the holder and fix it with the knurled nut. If an indenter with

marking is used, make sure that it is aligned with the marking on the housing (see figure 2). The adjustment accuracy should be within $\pm 5^\circ$. This ensures that the crystal orientation of the diamond is optimally aligned.

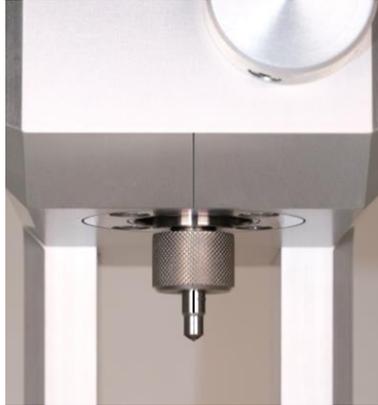


Figure 2: Alignment of the indenter



It is recommended not to touch the diamond tip of the indenter.

5.2.3 Inspection of the indenter

The diamond is exposed to a heavy duty during the scratch test. This can lead to adhesions or even damages to the diamond. For this reason, the diamond must be inspected at short intervals under a suitable microscope (> 100-times magnified). Adhesions must be removed. If the diamond is damaged, the indenter must be replaced.



Inaccuracies, adhesions or damages of the diamond are the main cause of errors in scratch tests.



With BAQ purchased indenters, damaged diamonds can usually be resharpened several times.

6 General operation instructions

6.1 Key functions

ESC

This key is used to exit the current function. You will then reach the higher-level menu option. Modified settings will not be kept.

ENTER

By pressing this key editing in a field is completed or a subordinated menu option is selected.

F1

Function key

F2

Function key

F3

Function key

F4

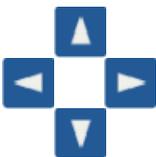
Function key

START

With this key the scratch is started

STOP

If this key is pressed while a scratching process is in progress, it will be stopped.



Cursor keys

With these keys, menu options are selected and the cursor is moved into the input fields. With ◀ and ▶ a manual movement of the sample holder is possible.

In certain situations, the function keys F1 - F4 are used to simplify the operation. In the measurement window, for example, the scratch parameters can be quickly changed using these keys without having to go through the main menu.

The number keys are used to enter numerical values (see section 6.4).

6.2 Menu

A menu consists of a list of available menu options, the active one is highlighted (see figure 3). With the cursor keys ▲ and ▼ the active menu option can be selected. With ENTER the active menu item is chosen and either a window or a submenu is opened. With ESC you will return to the previous menu.



Figure 3: Main menu

When starting easySCRATCH, a reference run is made and the measuring windows will be displayed. Press ESC to enter the main menu, which contains the following submenus:

- Perform scratch (see section 7.6)
- Scratch parameter (see section 8.1)
- Manage starting points (see section 8.2)
- Move sample holder (see section 7.5.2)
- Do reference run (see section 7.1)
- System (see section 10)

6.3 Entering texts

When saving scratching parameters or starting points, entries in plain text are required. Therefore the text input window is opened.

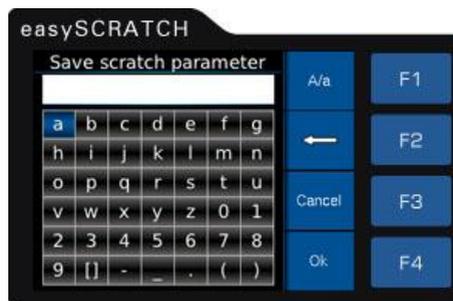


Figure 4: Text entry

In the upper white field (hereinafter referred to as text field) the entered text is displayed. The lines below contain the characters that can be selected. The space character is represented by []. The cursor is moved with the cursor keys through the character field. By pressing ENTER the selected character is chosen and transferred into the text field.

F1 switches between upper- and lower-case letters. F2 deletes the last character in the text field. With F4 (Ok) the text input is done and the entered text is available. ESC respectively F3 (Cancel) ends the text input without saving.

6.4 Entering numbers

To enter numbers, the number input window is opened.



Figure 5: Entering numbers

Use the cursor keys ◀ and ▶ to move the cursor in the text field. By pressing F2 (←) the character to the left of the cursor will be deleted. The digits and decimal separator are entered using the corresponding keys.

With F4 (Ok) respectively ENTER the text input is done and the value is saved. F3 (Cancel) or ESC ends the input without saving.

7 Performing a measurement

7.1 Starting the device – reference move

easySCRATCH is turned on with the switch at the backside of the device. A reference move must then be performed (see figure 6). To avoid collision between the vise and the indenter, an inductive proximity sensor checks whether the indenter is lifted. If the indenter is lifted, the reference move can start.

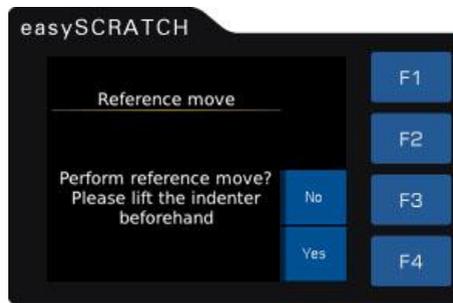


Figure 6: Reference move

The sample holder then moves to a reference point on the left side. A defined starting point is approached and the **Perform Scratch** measurement window is displayed.

If for any reason no reference move could be performed, there are only three menu options accessible: **Scratch parameter**, **Do reference move and System**. All other menu options are only available after a reference move has been performed.

7.2 Setting the test load

The minimum test load (without supplementary weights) is 10 N. If a higher test load is needed, the appropriate additional weights can simply be stacked on the permanently mounted base weight in any combination. With the set of weights, included in the scope of delivery, the test load can be adjusted in steps from 10 N to a maximum of 120 N.

7.3 Criteria for selecting the test load

For each coating system, the user or the coater must determine the critical test load at which no coating damage may occur. For this purpose, several scratch marks are created, whereby the normal force is increased stepwise between the single tests until coating damage occurs. In tests during production, only the highest test load at which no relevant damage may occur is then required.



Especially with high test loads, adhesions to the diamond can occur. Therefore, the diamond should be checked at short intervals under a suitable microscope.



If the diamond should be damaged by an excessive test load, it has to be exchanged or resharpened.



The test load must not exceed 120 N!

7.4 Clamping the sample and positioning in y-direction

Due to the variable profiles, different samples can be clamped into the vice, that is included in the standard scope of delivery. Before each measurement it must be ensured that the sample is correctly fixed so that it cannot be displaced by the occurring tangential force.

Due to the vise's independently adjustable clamping jaws it is possible to move the sample in y-direction (see figure 7). This is especially useful, if several scratches should be made on the same sample.

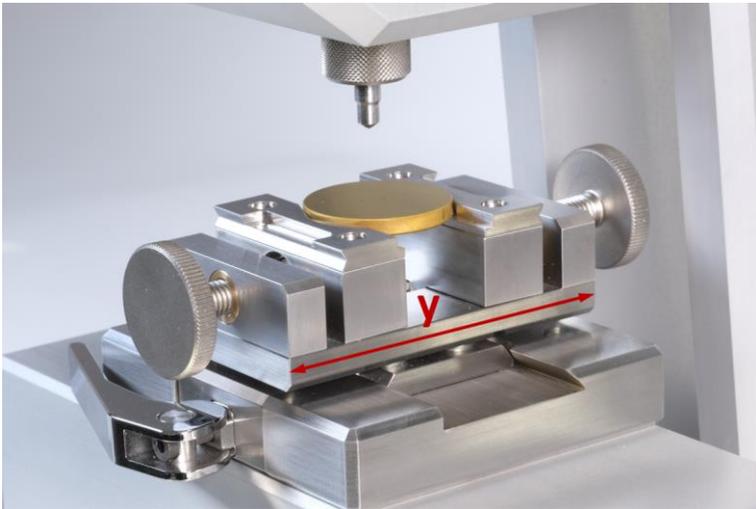


Figure 7: Vise with clamped sample

If the optional prism is used, the cylindrical sample is easily inserted into the prism and pressed against the rear stop (see figure 8). The prism is designed so that the indenter is automatically positioned at the highest point of the sample. This simplifies the measurement of cylindrical samples notably.



Figure 8: Prism to hold cylindrical samples

7.5 Positioning the sample in x-direction

To approach the required starting position easySCRATCH offers different possibilities.

7.5.1 Manual movement via arrow keys

The linear guide in the measuring window can be manually moved via the cursor keys ◀ and ▶. To avoid a collision, the linear guide can only be moved when the indenter is lifted. This limitation can be changed by the operator at his own risk (see 10.1.4).

7.5.2 Move sample holder

Both the main menu and the measuring window (via the F3 function key) take you to the **Move sample holder** rate window. A required distance (0.1 - 90 mm) can here be entered and the linear guide can be moved either to the right (F1) or left (F2).



Movement is only possible when the indenter is lifted.



In the **Move sample holder** window (see 7.5.2) movement is also possible by using the cursor keys ◀ and ▶.

7.5.3 Approaching the saved starting point

By pressing F4 in the measurement window the **Move to starting point** window is opened. The topmost menu item in the list is always the **last starting position**.



Figure 9: Move to starting point

Which is the starting point of the last scratch. This may be e.g. useful, if several scratches should be created next to each other on the same sample.

The positions **Zero** and **Center** are also stored in easySCRATCH by default and can always be approached. Furthermore, the user has the option to define his own starting positions (see 8.2).

All available starting positions can be selected with the cursor keys ▲ and ▼ and approached with ENTER or F4.



Starting points can only be approached if the indenter is lifted.

7.6 Setting the measuring parameters

In the measurement window **Perform Scratch**, speed and scratch length can be set (see figure 10).



Figure 10: Measuring window

The feed rate can be varied in the range of 5 - 20 mm/min by pressing the F1 function key. The measuring length can be adjusted between 2 - 40 mm via the function key F2. Furthermore, parameter combinations can be created and saved (see 8.1).

7.7 Lowering the indenter

Normally, the indenter is located in its rest position, which means that the weights are lifted (see figure 11).



Figure 11: rest position of the indenter

Activating the test load application is initiated mechanically with a hand lever. Lower the indenter carefully by using both hands so that it cannot drop on the sample.



For cylindrical samples, make sure that the indenter is placed on its highest position.

7.8 Starting the scratch process

Before the scratching process can be started, please make sure that the set scratch length does not extend beyond the end of the sample. Then the scratching process can be started with START. The remaining distance and the remaining time are displayed in the measuring window.



If the scratch length exceeds the end of the sample, damages may occur.

The scratching process can be stopped at any time by pressing STOP. Afterwards the indenter can be lifted with the hand lever and brought into its rest position. For analysis under the microscope, the sample can be removed from the dovetail guide together with the vise / prism (see Figure 12).



Figure 12: detachable vise

8 Parameter management

8.1 Scratch parameters

8.1.1 Edit

The scratch parameters **Speed** and **Scratch length** can be adjusted within the following input limits:

speed: 5 – 20 mm/min

scratch length: 2 – 40 mm

The units of the parameters can be set under **System / Configuration**.

8.1.2 Load

In the menu item **Scratch parameters / Load** the saved scratch parameters can be recalled.

With the cursor keys ▲ and ▼ the required data set can be selected and loaded with ENTER or F4. The measuring window is displayed. If a parameter set has been loaded, its designation (here as an example: W-DLC) is displayed in the measurement window at the bottom.



Figure 13: loaded set of parameters

8.1.3 Save

In the menu item **Scratch parameter**, the currently selected scratch parameters are displayed:



Figure 14: Saving scratch parameters

The current parameter combination can be saved under a freely defined name. After selecting the item **Save** a text input field opens, in which the name of the data set can be entered. The maximum length of the designation is 15 characters.

8.1.4 Delete

In the menu item **Scratch parameter / Delete** stored scratch parameters can be deleted when they are no longer needed.

Use the cursor keys ▲ and ▼ to select the entry that is no longer required and press ENTER or F4 to delete it irreversibly.

8.2 Manage starting points

For an easier handling easySCRATCH provides the option to define fixed starting points for the scratches.

In the main menu under **Manage starting points** new starting points can be created or existing starting points can be changed, deleted or approached. The following starting points are available by default:

- Zero: Sample holder moves to the zero position (to the left)
- Center: Sample holder moves to the center

8.2.1 New

New starting points can be created under **Manage starting points / New**. After pressing ENTER you will be asked if the current position of the sample holder should be used. If this is the case, the designation for this starting position can be entered after pressing ENTER or F4. The maximum length is 15 characters. If instead of the current position another position of the sample holder should be saved, **No** has to be selected. Afterwards the requested position can be approached (see 7.5.1 Manual movement via arrow keys or 7.5.2 Moving the sample holder). If the requested position is reached, the positioning is closed via F3 (Exit) and you are asked if the current position should be used. Then this starting point can be named.

8.2.2 Edit

In **Manage starting points / Edit** existing starting points can be modified. The starting point that should be modified can be selected via the cursor keys ▲ and ▼ and chosen by ENTER / F4. After this confirmation you are asked if the current position of the sample holder should be used. By pressing ENTER / F4 the current position will be saved under the existing name.

If another position should be used, **No** has to be selected. Then the requested position can be entered (see 7.5.1 Manual movement via arrow keys or 7.5.2 Move sample holder). After approaching the requested position, the positioning is closed via F3 (Cancel) and you are asked again if the approached position should be used, which is then saved under the existing name.



The factory default starting points Zero and Center cannot be changed.

8.2.3 Delete

Under the menu item **Manage starting points / Delete** no longer required starting points can be deleted.

With ▲ and ▼ the required starting point can be selected and irrevocably deleted with ENTER/F4.



The factory default starting points Zero and Center cannot be deleted.

8.2.4 Move to starting point

In **Manage starting points / Move to starting point** the before saved starting points can be approached. By pressing ▲ and ▼ the requested starting point can be selected out of the list and approached by ENTER / F4.

9 Programming / Software-Update

In order to ensure that easySCRATCH is always up to date, occasional software updates can be carried out usually without having to send easySCRATCH to BAQ GmbH. For a software update, a USB stick with further instructions is provided by BAQ, which is simply plugged into the USB port of the device. easySCRATCH is then automatically updated.

10 Configuration

When selecting **System** in the main menu, a submenu with the following items is opened:

- Configuration: Adjustment of the positioning speed, lowering check, unit of length and time
- Language: Language selection
- Factory defaults: Reset to factory defaults
- Info: Display of system information

10.1 Configuration

In the menu item **System / Configuration** the positioning speed and the units for length and time can be set. Also the lowering check can be enabled or disabled.

10.1.1 Positioning speed

The speed at which the movement of the sample holder occurs can be adjusted in **System / Configuration / Positioning speed** for the following cases:

- Manual movement using the cursor keys ◀ and ▶
- Move sample holder
- Move to starting point

The positioning speed can be varied in the range 0.3 - 600 mm/min.

10.1.2 Unit of length

In the menu item **System / Configuration / Unit of length** can the unit of length be adjusted. This change will affect all spots in easySCRATCH.

The following length units are available:

- Millimeter
- Inch



Changing the unit of length may lead to rounding errors in distances and speeds.

10.1.3 Unit of time

Under **System / Configuration / Unit of time** the unit of time can be adjusted. This change will affect all spots in easySCRATCH. Just the display 'remaining time' will permanently stay in the unit minutes.

The following units of time are available:

- Minutes
- Seconds



Changing the unit of time may lead to rounding errors in speeds.

10.1.4 Lowering check

easySCRATCH is equipped with an inductive proximity sensor, which constantly checks whether the indenter is lifted or lowered. As delivered, the manual movement of the linear guide (see 7.5.1) is only possible when the indenter is

lifted, so that no collision between indenter and vise or sample can occur. In exceptional cases it may be necessary to position the sample manually, while the indenter is lowered slightly. For this purpose, the lowering check can be disabled under **System / Configuration / Lowering check**.



easySCRATCH may be damaged due to the deactivation of the lowering check. Deactivation by the user is at his own risk.

10.2 Language

In the menu item **System / Language** the language can be set. The requested language (German or English) can be selected with ▲ and ▼. It is activated with ENTER or F4 (OK).

10.3 Factory defaults

The following parameters are reset to the displayed standard settings using the menu item **System / Factory defaults**.

- Positioning speed: 200 mm/min
- Unit of length: mm
- Unit of time: min
- Lowering check: active
- Speed: 12 mm/min
- Length of scratch: 10 mm
- Driving route (move sample holder): 5.0 mm

Saved scratch parameter data records as well as specially defined starting points are not deleted by the reset.

10.4 Info

In **System / Info** the system information is displayed. That includes the serial number of the device, software version numbers, the kernel, the data systems' as well as the software and hardware revision.

11 Attachment 1: License information

This product contains Free Software which is licensed under the GNU General Public License (GPL) or under the GNU Lesser General Public License (LGPL). The free software source code can at least for a period of 3 years be requested from BAQ GmbH. However, please be noted that we cannot provide guarantee with the source code, and there is also no technical support for the source code from us.

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