

**Programmable  
Logic Control (PLC)**



**SCRATCH  
HARDNESS  
TESTER  
430 P**

**Automatic  
Test Sequence**



**9 preset  
Standard  
Cross Cuts**

testing equipment for quality management

**ERICHSEN**

### Technical Description

**DIN EN ISO 2409  
ASTM D 3359  
JIS K 5600-5-6  
SNV 37 111**

**VDA 621-411  
ECCA T6  
GME 60 280**

- Scratch Hardness
- Cross Hatch Cut
- Scratch Resistance
- Writing Effect

# SCRATCH HARDNESS TESTER 430 P

## Purpose and Application

The motor-driven **SCRATCH HARDNESS TESTER 430 P** is a universal testing instrument designed for carrying out a wide range of tests on varnished and plastic surfaces to determine their resistance to scratches and cuts. Single cuts, parallel cuts and - by turning the specimen by 90° - cross-cuts can be applied to test panels of various thicknesses.

The **SCRATCH HARDNESS TESTER 430 P** is particularly provided for adhesion tests using the cross hatch cut method (in accordance with all mostly required standards) and for specific plastics tests according with Opel (scratch resistance and writing effect). For these as well as for further tests numerous setting possibilities on the basic instrument and a large variety of test tools are available.

Using the **SCRATCH HARDNESS TESTER 430 P**, series testing can be conducted with much greater ease. The results of testing are reproducible and well-defined.

## Design and Function

The **SCRATCH HARDNESS TESTER 430 P** is a benchtop instrument of sound mechanical construction which provides reliable, well-defined cuts, even under extreme test conditions. The test procedure is carried out automatically and all parameters (cutting speed, cutting stroke, cross-cut pattern) can be set using the keyboard. Each motion sequence (transport of test panel, cut positioning and any required pressure adjustment) is driven by a separate step motor.

During the test the specimen is conveyed linearly and at a constant speed under the test tip which has been set at the required pressure load (max. 40 N). A transmission guide ensures that the test tip is lowered onto the test panel as defined. The scope of supply includes two control plates for different cross-cut patterns which can be easily interchanged.

With Model 430 P parallel cross hatch cuts with graduated test forces are possible. After carrying out the first cross hatch cut the instrument can be stopped and the test force (up to 50 N) can be adjusted individually before starting the next test track. Theoretically, 80 test tracks with a distance of 0.5 mm of different test forces are possible within the pre-selected cross hatch cut programme.

The **SCRATCH HARDNESS TESTER 430 P** is power-driven and obtainable in two versions - with manual or with motor-driven force regulation. On the manual version it is a simple matter to adjust the test force to the exact pressure. The instrument with motor-driven force regulation provides the additional benefit of conducting a trial run with gradually increasing force. In this way, the force required to achieve a through cut can be automatically ascertained in the course of a "trial cut".

A 6-piece weight set is available as an optional accessory for conducting special tests in the lower pressure range and enables cuts with test forces in the range (1 - 15) N - graduated in 1-N steps.

## Special Features

- 2 cutting speeds and 2 cutting lengths which can be combined as required
- 9 preset cross-cuts in compliance with the most commonly used standards
- 1 freely programmable cross-cut pattern for special applications
- Setting for cut distance with step motor precision
- "Stop"-option within the cross hatch cutting mode, for individually changing the test force for the next scratch track of the concerning current cross-cut pattern
- Visual display upon cutting through insulating layers to metal substrate
- Rapid clamping device for test panels, with wide clamping range.

## Cross Hatch Testing

The **SCRATCH HARDNESS TESTER 430 P** enables cross hatch tests to be conducted in accordance with all the usual standards, summarized in the following table, and carried out immediately without additional programming. The following cross-cuts can be selected by pressing a key (number of cuts x distance in mm between cuts) 2 x 5, 6 x 1, 6 x 2, 6 x 3, 8 x 1, 8 x 2, 11 x 1.

The cuts are carried out automatically in succession using the test tip for cross hatch at a cutting speed of 40 mm/s. After turning the test panel manually by 90°, the procedure is repeated to complete the cross-cut pattern. The load required to ensure that the layer of varnish will be cut through to the substrate must be ascertained in trial runs. With **Model 430 P-II** (motor-driven force adjustment) this can be carried out very simply by performing a "trial cut".

For the examination of cross hatch cuts a magnifying glass with 2.5 magnification is included in the scope of supply. To evaluate the cross hatch pattern achieved, it is visually related to a comparison pattern within a scheme indicated in the relevant standard (cross cut classification). In ECCA T6 it is mentioned that the cross hatch cut test may be intensified by a subsequent cupping test according to DIN EN ISO 1520. For this purpose we recommend the ERICHSEN Lacquer and Paint Testing Machines, models 200 and 202 C.

Although the results of adhesion tests in accordance with the cross hatch method are comparable with each other, they are - due to their respective procedures - not transferable to results of alternative test methods (e.g. perpendicular pull-off test according to DIN EN ISO 4624).

# SCRATCH HARDNESS TESTER 430 P

The ERICHSEN production programme offers the following model for adhesion testing to the pull-off method:

- Adhesion Test Apparatus, Model 525 (manual / inexpensive)

Standard	Layer thickness	No. of cuts x distance (mm)
DIN EN ISO 2409	up to 60 µm	6 x 1 (for soft substrates) 6 x 2 (for hard substrates)
JIS K 5600-5-6	over 60 µm to 120 µm over 120 µm to 250 µm	6 x 2 6 x 3
ASTM D 3359	up to 50 µm over 50 µm to 125 µm	11 x 1 6 x 2
SNV 37111	up to 60 µm over 60 µm	8 x 1 8 x 2
VDA 621-411	up to 60 µm over 60 µm to 120 µm over 120 µm	6 x 1 6 x 2 6 x 3
ECCA T6	up to 50 µm over 50 µm	6 x 1 2 x 5

## Cross Hatch Standards

### Scratch Resistance Testing

For testing scratch resistance in accordance with Opel (GME 60280 / GMW14688) the test tip with a 1 mm Ø is selected together with the preset grid "20 cuts at a distance of 2 mm" (20 x 2). The stress pattern in this case is applied with a test load of 5 N (set of weights) by the same procedure as for the cross hatch test (cutting speed 1m/min).

To analyse the scratch resistance test the brightness variance ( $\Delta L$ ) is determined in comparison with the plastic surface which is not subjected to strain. The colour measuring device to be used for this purpose must fulfil the following requirements: illuminant D65, measuring geometry d/8 with gloss exclusion, measuring aperture Ø 27 mm.

### Writing Effect Testing

For testing the writing effect in accordance with Opel the test inset offered as optional accessory, is required. This inset has to be mounted on the load arm instead of the tool holder. The stress pattern is applied with the preset grid "80 cuts at a distance of 0.5 mm" (80 x 0.5) and a test load of 7 N (set of weights) analogue to the cross hatch test (cutting speed 1 m/min).

To evaluate the result of the writing effect test the gloss difference is determined in comparison with the plastic surface not subjected to strain. The gloss meter used should be provided with a 60° geometry; the measuring area must be small enough to allow carrying out reproducible gloss measurements on the surface subjected to strain. For this test purpose all the ERICHSEN glossmeters of the PICOGLOSS family are highly recommended.

### Special Tests

Deviating from the determinations of the above mentioned tests (cross hatch test, scratch resistance, writing effect) further scratch tests can be carried out varying the following parameters:

- Test tip
  - ball test tool Ø 0.5 / 0.75 / 1 / 3 mm
  - asymmetric test tools: cross cut / Clemen
- Test load
  - rough range 50 N with 2 N graduation (standard)
  - fine range 15 N in 1 N steps (optional)
- Cutting grid
  - preset, selectable by depression of key: 2 x 5, 6 x 1, 6 x 2, 6 x 3, 8 x 1, 8 x 2, 11 x 1, 20 x 2, 80 x 0.5 (number of cuts x distance in mm)
  - freely programmable: all grids max. width 40 mm and a multiple of 0.5 mm as cutting distance.
- Cutting pattern
  - parallel cuts or cross cuts
- Cutting path
  - 25 mm or 40 mm (exchangeable guide plates)
- Cutting speed
  - 16.7 mm/s (1 m/min) or 40 mm/s

In order to minimize testing time, the smallest possible length of cut is always selected, together with the relevant connecting member.

# SCRATCH HARDNESS TESTER 430 P

## Technical Data

Dimensions (W x H x D)	330 x 460 x 750 mm
Net weight	approx. 40 kg
Power supply <sup>1)</sup>	230 VAC / 50 Hz
Consumption	400 W
Test panel format, min.	80 x 50 mm
Test panel format, max.	165 mm wide, any length
Thickness of specimen	0.5 - 20 mm
Standard load range	2 - 50 N (2-N grading)
Special load range <sup>2)</sup>	1 - 15 N (1-N grading)
Cutting path	25 or 40 mm
Cutting speed	1 m/min or 40 mm/s

<sup>1)</sup> alternatively 115 VAC / 60 Hz  
(please specify mains supply when ordering)

<sup>2)</sup> Optional set of weights for bottom load range

### Reference Class:

Both versions of the SCRATCH HARDNESS TESTER 430 P are supplied with a Manufacturer's Certificate M in accordance with DIN 55 350-18 that includes among others the following information:

Actual and setting values of loading force, scratching speed and cutting distance, test equipments used with calibration status, product identification, date, name of inspector.

Comparisons of the setting/actual values for the following parameters are made:

- Loading force (5 setting values evenly distributed over the load range)
- Cutting speed (both desired values in combination with both cutting paths)
- Cutting distance (exemplary for setting value 0.5 mm).

Order Information	
Order No..	Product Description
0190.01.31	<b>SCRATCH HARDNESS TESTER 430 P-I</b> motor-driven turntable and cutting position and with <b>manual</b> adjustment of loading force, manual turning of test panels and control plate for cutting path of 40 mm Load pressure max. 50 N
0190.02.31	<b>SCRATCH HARDNESS TESTER 430 P-II</b> as for Order No. 0190.01.31, but with <b>motor-driven</b> adjustment of loading force
Included in scope of supply:	
<ul style="list-style-type: none"> <li>.. Transport case with <ul style="list-style-type: none"> <li>- 3 Allen keys (SW 2 / 2.5 / 3)</li> <li>- Connecting member for cutting path of 25 mm</li> <li>- Folding magnifier (2.5 fold magnification)</li> <li>- Recesses for set of weights, test inset (writing effect) and for max. 8 test tips</li> </ul> </li> <li>.. Mains connection cable</li> <li>.. Operating instructions</li> </ul>	

### Caution:

- Test tips are not included in the scope of supply
- Please specify mains supply when ordering

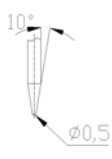
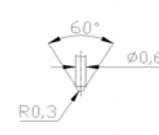
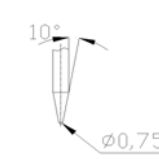

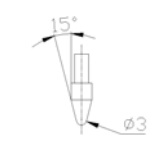
Accessories / Spares	
Order No.	Description of Product
0564.01.32	Test tip for cross hatch <sup>1)</sup>
0539.01.32	Test tip acc. to van Laar (Ø 0.5 mm) <sup>2)</sup>
0539.02.32	Test tip acc. to Bosch (Ø 0.75 mm) <sup>2)</sup>
0539.03.32	Test tip acc. to ISO 1518 (Ø 1.0 mm) <sup>2)</sup>
0539.04.32	Test tip (Ø 3.0 mm) <sup>1)</sup>
0218.02.32	Test tip acc. to Clemen <sup>2)</sup>
0539.05.32	Test inset for writing effect
0430.03.32	Test disc for writing effect
0567.01.32	Set of weights for bottom load range (6 pcs.)

<sup>1)</sup> hardened steel

<sup>2)</sup> equipped with hard metal

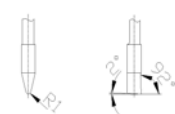
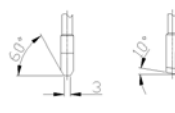
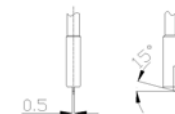
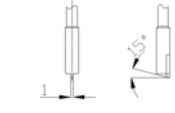
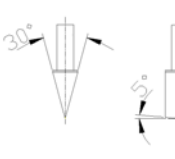
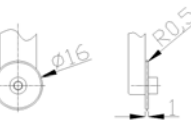
Subject to technical modification.  
Gr. 12 - TBE 430 P – XI/2009

## Spherical Inserts

Description	Test geometry	Material
test tip acc. to van Laar <sup>1) 2)</sup>		carbide insert
test tip acc. to IHD <sup>1)</sup>		
test tip acc. to Bosch <sup>2)</sup>		
test tip acc. to ISO <sup>1) 2)</sup>		
test tip acc. to BMW <sup>2)</sup>		hardened steel

- <sup>\*)</sup> additionally covered with an extremely hard layer  
<sup>1)</sup> long shaft, directly assembled  
<sup>2)</sup> short shaft, only for using with the adapter set  
<sup>3)</sup> only for using with the disc adapter of the universal adapter set

## Asymmetric Inserts

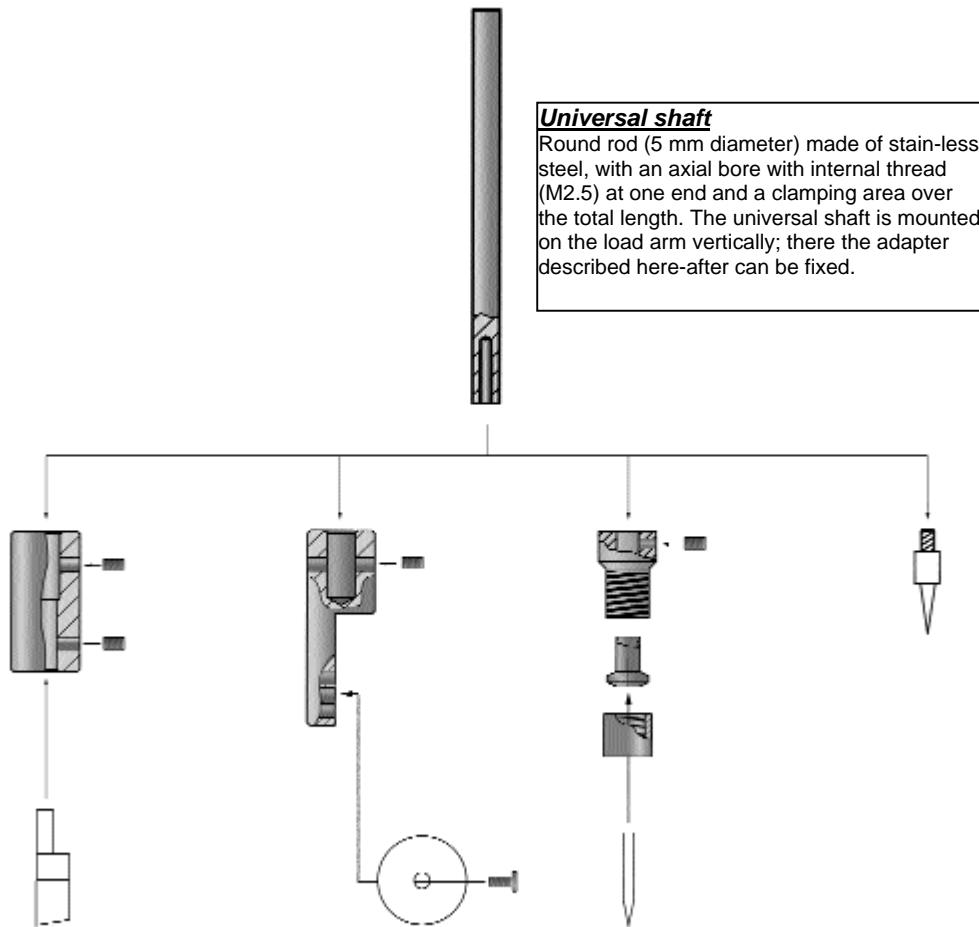
Description	Test geometry	Material
test tip acc. to Clemen <sup>1) 2)</sup>		carbide insert
test tip acc. to VW <sup>1)</sup>		
test tip acc. to Sikkens <sup>1)</sup>		
test tip acc. to Sikkens <sup>1)</sup>		
test tip for cross hatch cutting <sup>2)</sup>		hardened steel <sup>*)</sup>
test disc acc. to Oesterle <sup>3)</sup>		duroplast copper stainless steel stainless steel <sup>*)</sup>

## Technical Data

Dimensions (L x W x H)	580 mm x 280 mm x 210 mm
Specimen dimensions	max. 150 mm x 210 mm (DIN A 5)
Power supply	(100 - 240) VAC, (47 - 63) Hz
Net weight	approx. 13 kg
Scratching force	(0.5 – 20) N
Medium test speed	22/35/200 mm/s (fixed) (20 – 200) mm/s programmable
Length of cycle	60/110 mm (with/without guide plate)

## Universal Adapter Set

In addition to the standard range of test tools the Universal Adapter Set allows the use of a variety of additions tool inserts. In this way individual test problems with specific tool geometries deviating from established determinations can be solved in an easy manner. The adapter set consists of the following components:



### **Universal shaft**

Round rod (5 mm diameter) made of stain-less steel, with an axial bore with internal thread (M2.5) at one end and a clamping area over the total length. The universal shaft is mounted on the load arm vertically; there the adapter described here-after can be fixed.

### **Clamping adapter**

Cylindrical part made of stain-less steel, with one axial bore each of 4 mm and 5 mm diameter as well as radial threaded bores with clamping screws. The clamping adapter is intended for tool inserts using a cylindrical shaft (4 mm dia.).

### **Disc adapter**

Cylindrical part made of stainless steel with axial bore (5 mm dia.) and radial threaded bores with clamping screws at one end; at the other end plane milling parallel to the axis with three radial threaded bores (M3). The disc adapter serves for fixing of plane tool inserts, especially such with circular letter disc geometry.

### **Chucking adapter**

Clamping huck made of gunmetal finish steel with three-piece collet chuck se for 1/2.35/3 mm dia. The chucking adapter serves as a support for a cylindrical tool insert with spherical or pointed tip (pins, needles etc.).

### **Direct assembly**

Gauge slide with outside thread M2.5 (e.g. probe tip)

Subject to technical modifications.  
Group 14 - TBE 249 – XII/2009