

AUTOELREPHO®

Standard Spectroreflectometer Specification

ISO-standardization

AUTOELREPHO® conforms to ISO standards

Determination of color

The determination of color is accomplished according to the CIE Colorimetry Publication No. 15.2. (1986) Vienna

Optical design

- Measuring geometry $d/0^\circ$
- Diameter of the integrating sphere 150 mm
- Viewing aperture \varnothing 34 mm
- Effective measurement area \varnothing 30 mm
- Dual-beam optimized optical design
- \varnothing 32 mm achromatic lens system

Specular factor

Excluded or included

Light sources

- AUTOELREPHO® Combined Multisource
- Continuous lighting
- Simulated CIE illuminants C and D65 etc.
- Indoor lighting with adjustable UV-content (optional)
- Triplet-free illumination
- Sphere error eliminated, thus reliable detection of:
 - Total reflectance factor with UV
 - Reflectance factor without UV
(= Base chromaticity ; Grundweisse)
 - Fluorescence component W_F
 - Whiteness W and tint T_w

Calibration

- 16 different calibration scales
- White and black –calibration with neutral standards
- Multicalibration, neutral and/or color standards in same photometric scale
- Spectral calibration, up to 15 calibration standards in same photometric scale
- Fluorescence calibration with direct entry of numerical calibration values
- Automatic calibration capability

UV - control

Measurement and adjustment of the UV content in the integrating sphere by automatic adjustable, numerical constant UV-generator

UV - cut-off

UV totally eliminated, or one of: 380 nm, 400 nm, 420 nm, 435 nm, 455 nm, 460 nm

Colorimetric functions

- Observation angles: 2° and 10°
- ISO - brightness (R457 nm)
- Calculated TAPPI-brightness (R457 nm)
- D65 - brightness (R457 nm), (UV-off, R457 nm)
- Reflectance factors R_x, R_y, R_z
- CIE Tristimulus values X, Y, Z . Ratios $X / X_0, Y / Y_0, Z / Z_0$
- CIE Dominant wavelength λ_D (380-780 nm incl. purple area)
- CIE Excitation purity $Pe\%$
- CIE 1931 and 1964 chromaticity coordinates x, y
- Y-value (luminance)
- CIE $L^*a^*b^*$ color coordinates
- CIE $L^*a^*b^*$ color differences $\Delta L^*, \Delta a^*, \Delta b^*, \Delta E^*$
- CIE Whiteness W . CIE Tint T_w
- CIE Whiteness W_{10} . CIE Tint T_{w10}
- Δ CIE - Whiteness ($Whiteness_{D65} - Whiteness_{UV-off}$)
- Δ Fluorescence - R457 ($R457_{D65} - R457_{UV-off}$)
- Residual fluorescence
- Yellowness
- ISO - opacity
- Transparency
- Light scattering coefficient, s
- Light absorption coefficient, k
- K & N - test
- Density
- Metamerism index
- CMC Color difference

MEASUREMENT MODES

1. ISO Brightness measurement mode

Filter function R457 nm, 44 nm HBW

2. CIE tristimulus X,Y,Z measurement mode

3. Fluorescence mode (option)

- Total reflectance factor with UV (C, D65 etc.)
- Reflectance factor without UV (C, D65 etc.)
- Fluorescence component W_F

4. Spectral measurement mode (option)

- Spectral data 380 nm – 700 nm
- Optional 360 nm -700 nm
- Numerical and graphic spectral reflectance data

5. Residual ink 950 nm mode (option)

(Determination of effective residual ink concentration = ERIC by infrared reflectance measurement)

6. Light fastness test (option)

- Adjustable timing 5 min – 24 hrs
- Adjustable UV content in the integrating sphere

Measurement range

- Photometric range 0.000 to 500.000 % R
- Dynamic range from +2 500 000 units to -2 500 000 units

Reproducibility

- Short time reproducibility 0.001 % R
- Long term stability 0.01 % R/24 h

Accuracy of reading

- Reflectance factors 0.001 % R
- Dominant wavelength 0.01 nm
- Excitation purity 0.01 Pe%
- Chromaticity coordinates $x, y < 0.0001$
- CIE $L^*a^*b^*$ color coordinates 0.001

Measurement time

Adjustable measurement time, from 10 ms to 2.5 s / reflectance factor.

Measurement principle

- Optical integrating system
- Continuous lighting with AUTOELREPHO® Combined Multisource
- Latest filter technology
Enables determination of up to $100 \cdot 10^9$ different colors, meaning ultra high precision in detection of very small color differences and in low level detection, for example measurement of dominant wavelength of perfect diffuser; reflectance values near 100 % R or of black velvet; reflectance values near zero.

OPTIONS**1. CIE Colorimetric calculator (software package)**

- Manual entry of values
- Calculates from full spectral data, according to 1 nm, 5 nm, 10 nm or 20 nm tables for example:
 - CIE Tristimulus functions X,Y,Z
 - CIE 1931 and 1964 chromaticity coordinates x, y
 - Reflectance factors R_x, R_y, R_z
 - CIE Dominant wavelength λ_D (380-780 nm incl. Purple = negative wavelength area)
 - CIE Excitation purity Pe%
 - CIE Whiteness W. CIE Tint Tw
 - CIE Whiteness W_{10} . CIE Tint Tw_{10}
 - CIE $L^*a^*b^*$ color coordinates
 - ISO brightness function 457 nm
- Cross-calculation possibility between all above mentioned parameters
- Useful, accurate calibration and measurement data cross-checking tool

2. Reference-reflectometer

Absolute reference-reflectometer equipment
(Ultra precision mode 0.0001 % R, all wavelengths)

3. AUTOELREPHO built-in optical memory

Equipment for self-testing of photometric linearity, realized up to over 500 % R, all wavelengths, using superposition light adding and subtracting method by Alfred Reule

4. Self diagnostics

Enhanced self diagnostics capability for checking of contamination, dust etc.

5. On-line sensor integration

Provides reliable high-accuracy calibration values to e.g. paper machine on-line sensors

6. Remote access control

Remote access connection with modem and diagnostics software package for control and testing of Autoelrepho®-equipment via modem

7. Special software packages for product control

- Graphical CIE 1931 and 1964 Chromaticity Diagram presentation
- Graphical CIE L*a*b* Color Space presentation
- Reference product register for targets
- Global Color Navigation System
- Extended Markup Language (XML) etc. data transfer capabilities

Equipment includes

Main unit, color monitor, printer and keyboard

Computer

- Built-in computer
- Hard disk selectable
- Connections to mill systems: RS232, Ethernet etc.

Dimensions (main unit; width x height x depth)

360 mm x 450 mm x 516 mm

Weight (main unit)

ca. 35 kg

Ambient conditions

- Temperature 18 - 30 °C
- Relative humidity 40 - 60%, no condensation

Operating voltage

- 90 - 130 VAC; 50 - 60 Hz
- 200 - 260 V AC; 50 - 60 Hz