General catalogue

Optical Properties Measuring Instruments

Colour is becoming more and more important in many industrial fields. This means that we have become more articulate with sensing colour. As accurate expression of colour with numerical values has now become a necessity, Suga Test Instruments provides advanced colour meters, gloss meters, haze meters, and image clarity meters, contributing to the precise colour management in many different industries.

We continue to serve the society with its "Suga-only" products by taking on many different optical properties.

OnlySUGA

Achieving supremacy as the pioneer of optical properties measuring instruments.

CONTENTS

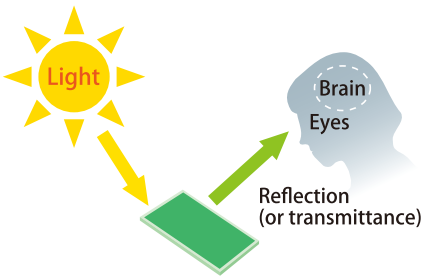
Please inquire us additionally about transportation, installation and other supplementary works. Also there are locations where some of our products cannot be exported. For more details, please contact our international sales department.
i_sales@sugatest.co.jp

1. Colour

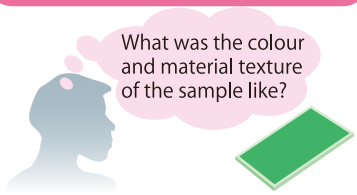
The Importance of Colour Meters

We humans sense colour by receiving light reflected off objects with our eyes. The information is then sent to the brain and processed as colour.

How colour is seen



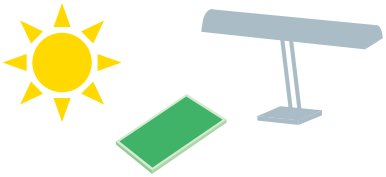
Humans cannot memorize colour and material texture.



Colour perception differs by individuals.

Colour and material texture change as the material degrades.

Different light source will also have an effect on the appearance of colour.

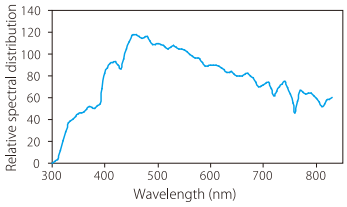


Colour and the material texture must be expressed numerically.

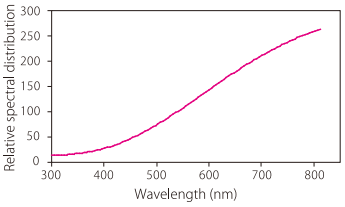
Light Source

(Same samples observed under different light sources)

D_{65} light (6504K average daylight)

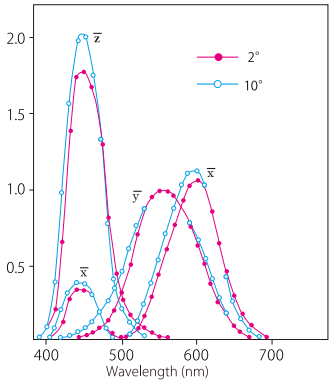


A light
(2856K average tungsten bulb light)

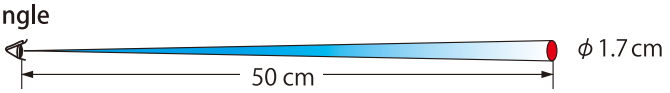


View Angle

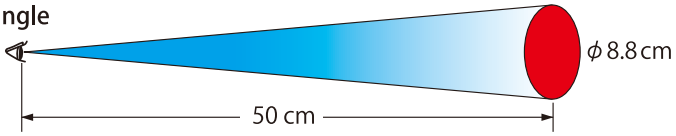
Sensitivity of human eyes
(2˚and 10˚view angle)



2˚view angle



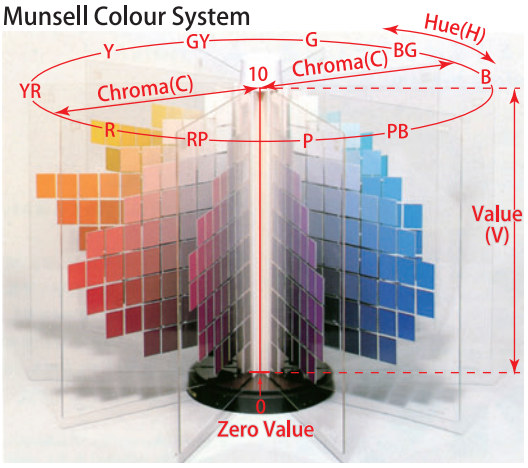
10˚view angle



Munsell Colour System

Munsell colour system is a chart where colour is expressed in three dimensions of hue (H), value (V), and chroma (C).
Hue is expressed in a horizontal circle in the order of red, yellow, green, blue and purple. Value (brightness) is expressed by the height of the central axis, where the highest value 10 represents complete whiteness and 0 represents complete blackness. Chroma (colour purity) is measured radially from the central axis outward, where the value increases as the distance from the axis increases.

Expression: H V/C = Hue Value/Chroma

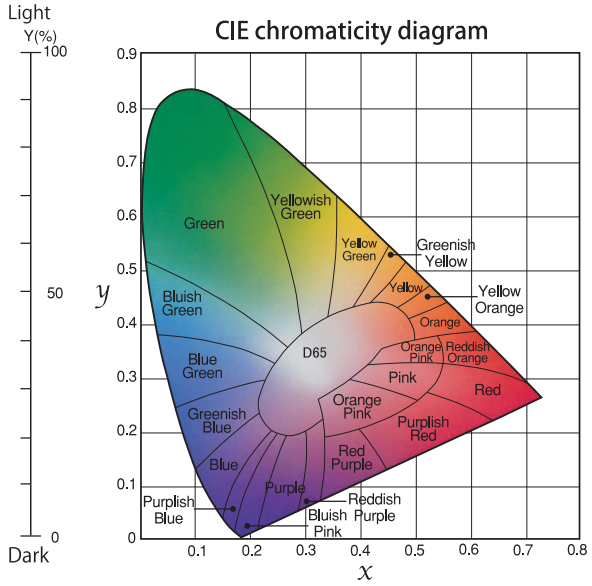


CIE XYZ

The chromaticity diagram, expressed in values x y and Y, is the basic form of colour expression, specified by CIE in 1931.

$$x = \frac{X}{X+Y+Z} \qquad y = \frac{Y}{X+Y+Z}$$

The chromaticity is determined by the point on the diagram which the coordination corresponds to the values x and y determined by the above formula. Y indicates the brightness: 0% represents complete black, and 100% represents complete white.



CIE LAB

CIE LAB, also known as LAB colour space, is a colour diagram—recommended by CIE in 1976—designed to approximate human vision. It is a rectangular coordinate system composed of a* and b* axes, with the vertical L* axis indicating the brightness. It is used to display colour and determine colour difference.

$L^* = 116(Y/Y_n)^{1/3} - 16$

$a^* = 500\ [(X/X_n)^{1/3} - (Y/Y_n)^{1/3}]$

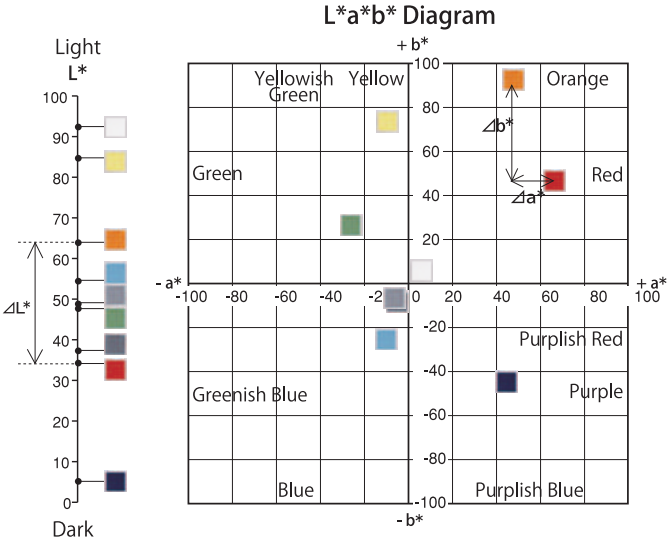
$b^* = 200\ [(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}]$

(Xn, Yn, Zn: the tristimulus values of the absolute diffuse reflector of the view angle for each light source)

Colour difference formula:

$$\Delta E^*_{ab} = ((\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2)^{1/2}$$

(This indicates the colour difference between red and orange in the diagram on the right)



Measurement samples: CCS Series II (CERAMIC COLOR STANDARDS-SERIES II)

L* 92.37 a* 0.41 b* 2.95	49.76 -1.09 -1.41	38.48 -0.23 -2.56	36.65 63.19 44.87	63.87 47.60 93.34	84.67 -8.39 77.25	48.95 -26.04 23.72	54.16 -11.80 -27.27	4.79 40.81 -45.38

There are also many other colour systems used for many different purposes. Refer to page 14 for details.

1. Colour Meter

Refer to page.14 for Colour Systems to be measured.

Spectro Colour Meter

CC-m/CC-m45

Portable Spectro Colour Meter

Quality color measurement within your grasp

Its large color LCD touch panel makes it easy to read, prevents mistakes, and reduces fatigue. The light source is SUGA's distinctive VI-LED (High color-rendering index white LED) with long lifespan and light suitable for color measurement. Its dual synchro sensor method with two spectroscopes gives it an outstanding long-term stability.

Model	CC-m45	CC-m
Geometry	45° illumination/0° viewing (45° : 0°) reflectance measurement	Diffuse light source, 8° observer angle (switchable between de:8° and di:8°), reflectance measurement
Measurement aperture diameters	10 mm, 5 mm	
Photometry	Dual synchro sensor method	
Wavelength range	400 – 700 nm, 10 nm interval	
Light source	VI-LED (High color-rendering index white LED)	
Stability	The standard deviation of ⊿E*ab within 0.04 (measuring a white standard 30 times consecutively)	
Approximate dimension and weight	82(W) × 112(D) × 248(H) mm [weight: 980g]	

Tristimulus Colour Meter

CC-*i* Colour Cute *i*

Striving for the highest stability, operability and cost performance of its class

Colour Cute i is an all-in-one photoelectric tristimulus colour meter, capable of measuring both reflectance and transmittance.

Colour measurement conditions	C light with 2° view angle / D_{65} light with 10° view angle / D_{65} light with 2° view angle	
Geometry	Reflectometry	8° incidence diffused light viewing (switchable between 8°:de and 8°:di)
	Transmission	0° incidence diffused light viewing
Photometry	TM double beam method (Photoelectric tristimulus colorimetry)	
Aperture diameter	Reflection: ϕ30mm, ϕ15mm, ϕ5mm	
	Transmittance: ϕ30mm	
Tolerance	Standard deviation of ⊿E*ab within 0.02 (after 30 measurements of white calibration standard plate)	
Approximate dimension and weight	Width 43 cm, depth 39 cm, height 23cm [weight: 12.5 kg]	

This product is also available as CE model upon request.
Other models available are: CC-iS(Spectro Colour Meter).

Spectro Colour Meter

SC-T / SC-T45

Spectro Colour Meter

SC-T

Integrated sphere method and 45°incidence 0°viewing method

Valued in the fields of precise colour management, the SC series is our high-end model with the highest accuracy of its class, along with variety of measurement and graph display options. This single unit can measure both reflectance and transmittance.

Model		SC-T
Geometry	Reflectometry	Diffused incidence, 8° viewing (switchable between de:8° and di:8°)
	Transmittance	0° incidence, 0° viewing
Spectroscopy		Reflection grating
Measurement wavelength Wavelength interval		380 to 780 nm , 5 nm interval
Photometry		Total wavelength measurement method (TM double beam method)
Aperture diameter		Reflection: ϕ30, ϕ15, ϕ5 mm Transmittance: ϕ30 mm
Colour measurement conditions		2° and 10° view angle of A, C, D_{65}, F_6, F_8, F_{10} and F_{11} lights
Tolerance		Standard deviation of ⊿E*ab within 0.01 (after 10 measurement of white calibration standard plate)
Approximate dimension and weight		Optical unit: width 27 × depth 42 × height 23 cm [weight: 15 kg]
		Measurement unit: width 23 cm, depth 33 cm, height 16 cm [weight: 4 kg]

Refer to page.14 for Colour Systems to be measured.

Spectro Colour Meter

SC-50μ

Micro Spectro Colour Meter

Capable of measuring colour of an area with a surface diameter of 0.05mm

This colour meter is widely used to measure the colour of microscopic surface area of materials such as fabric, printed materials, and electronic parts such as PCB, IC and wires. The magnified measurement area is displayed on a screen for easy observation and focusing.

Geometry	45˚incidence 0˚viewing(Option: incidence angle adjustment of 45˚to 75˚) (reflectometric measurement)
Measurement wavelength / Wavelength interval	400 to 700 nm 10 nm intervals
Aperture diameter	ϕ0.05, ϕ0.1, ϕ0.2 mm
Colour measurement conditions	2˚ and 10˚ view angles of A, C, D_{65}, F_6, F_8 and F_{10} lights
Image output	CMOS colour camera
Monitor	Includes a micrometer
Tolerance	Standard deviation of ⊿E*ab within 0.02 (after 10 measurement of white calibration standard plate)
Approximate dimension and weight	Optical unit: width 36 × depth 45 × height 56 cm [weight: 33 kg](monitor separate) Measurement unit: width 23 cm, depth 33 cm, height 16 cm [weight: 4 kg]

Spectro Colour Meter

SC-WT

Spectro Whiteness Colour Meter

Measures the brightness (whiteness) of paper as according to ISO standards

This instrument, used widely in the paper manufacturing industry, measures the ISO brightness*1 and the opacity*2 of paper. The UV light intensity can be adjusted to a standard value by using a reference sample sheet(INNVENTIA AB). Fluorescent intensity can also be measured.

Geometry	Diffuse incidence 0˚ viewing (Reflectometry)
Measurement wavelength / Wavelength interval	400 to 700 nm 10 nm intervals
Light receptor	Silicon photodiode array
Aperture diameter	ϕ30 mm
Colour measurement conditions	2˚ and 10˚ view angle of A, C, D_{65}, F_6, F_8, F_{10} and F_{11} lights
Tolerance	Standard deviation of ⊿E*ab within 0.01 (after 10 measurement of white calibration standard plate)
Approximate dimension and weight	Optical unit: width 32 cm, depth 40 cm, height 52 cm [weight: 30 kg] Measurement unit: width 23 cm, depth 33 cm, height 16 cm [weight: 4 kg]

*1 ISO 2470 (brightness) *2 ISO 2471

Other models available are: CC-iW

Tristimulus Colour Meter

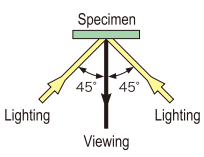
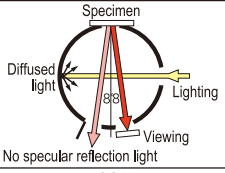
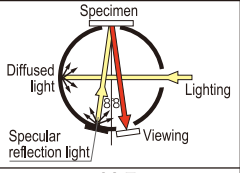
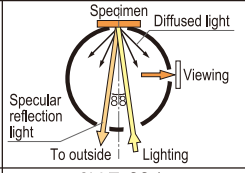
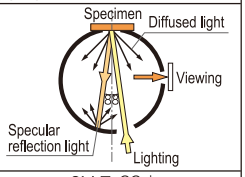
VC-2

Variable-angle Colour Meter

Variable-angle colour meter for evaluating metallic coatings

This instrument is best suited for evaluating specimens that has different colour and brightness depending on the angle where it is observed from, such as metallic coatings. It can measure both reflectance and transmittance. The angle of the specimen can be adjusted three-dimensionally, allowing for measurements from many different viewpoints.

Geometry	Incidence: ±45˚vertical ±70˚ horizontal; Receptor: All angle except ±10˚ of incidence angle (receptor angle adjusts automatically)
Aperture diameter	ϕ20 mm
Colour measurement conditions	C light 2˚ view angle, or D_{65} light 10˚ view angle (select either of the two)
Specimen dimension	Between 20 × 20 mm and 150 × 150 mm
Tolerance	Standard deviation of ⊿E*ab within 0.05 (after 10 measurement of white calibration standard plate with geometry set at 45˚to 0)
Approximate dimension and weight	Optical unit: width 65 cm, depth 40 cm, height 39 cm [weight: 40 kg] Measurement unit: width 40 cm, depth 40 cm, height 19 cm [weight: 12 kg] (Windows PC for data processing is separate)

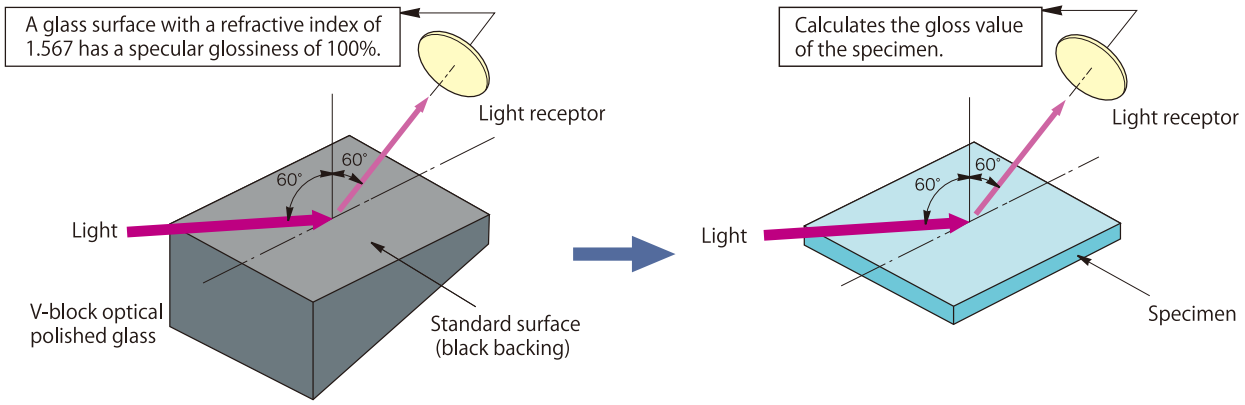
Geometry	45˚c:0˚	Diffused incidence 8˚ viewing		8˚ incidence diffused light viewing	
		de:8˚	di:8˚	8˚:de	8˚:di
JIS condition	Condition a	Condition c		Condition d	
Optical unit					
Model	SC-T45・SM-T45・SC-50μ	SC-T	SC-T	SM-T, CC-i	SM-T, CC-i

Source: JIS Z 8722:2009 "Methods of colour measurement – Reflecting and transmitting objects"

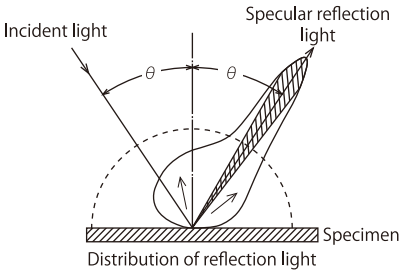
2. Gloss

What is gloss (specular glossiness) ?

Gloss (specular glossiness) is a value that indicates the intensity of the specular reflection of the surface of an object. High gloss will indicate that the reflected light is intense.



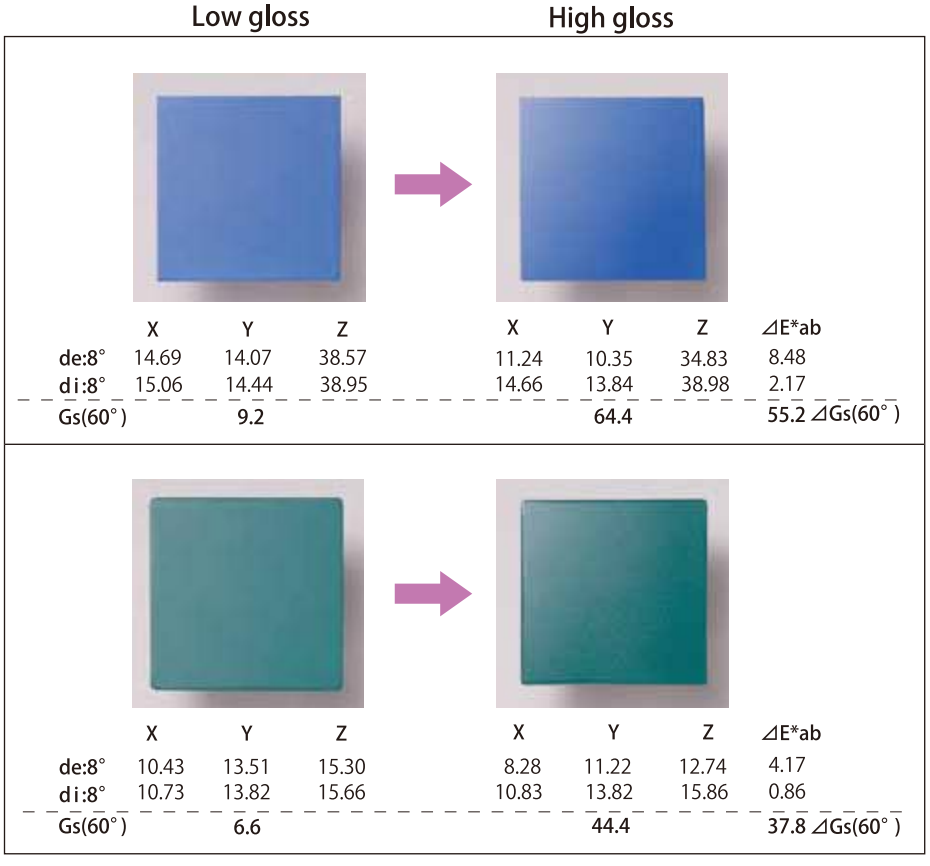
There are five angles for measuring specular glossiness, with recommended examples shown below



Test methods	Method 1	Method 2	Method 3	Method 4	Method 5
Method name	85° specular gloss	75° specular gloss	60° specular gloss	45° specular gloss	20° specular gloss
Representation	Gs(85°)	Gs(75°)	Gs(60°)	Gs(45°)	Gs(20°)
Examples	Paint, anodized aluminum, etc.	Paper, etc.	Plastic, paint, vitreous enamel, anodized aluminum, etc.	Plastic, paint, vitreous enamel, anodized aluminum, etc.	Plastic, paint, vitreous enamel, anodized aluminum, etc.
Applicable range	Surfaces with glossiness less than 10 when measured with method 3	——	——	——	Surfaces with glossiness over 70 when measured with method 3

Source: JIS Z 8741 "Specular Glossiness—Method of Measurement"

Although colour will appear differently depending on the intensity of the gloss, the colour value between high and low-gloss specimens may not be so different depending on the colour meter's geometry. For this reason, gloss should be measured along with colour.



Measurement items (for all models)

GsS : (Initial specular glossiness)　RRG : (Residual gloss rate or gloss retention rate:Gs / GsS)
Gs : (Specular glossiness)　⊿Gs : (Difference between the initial value: GsS – Gs)

GC-1
Gloss Meter

Compact Ergonomic Gloss meter

A new paradigm in Gloss and Appearance Measurement – CG-1 Gloss Meter.SUGA is the standard in Japan. The ergonomic design, one button operation and intuitive menu system make this fully featured Gloss Meter easier to operate and better than all the rest.

Measurement angles	20˚, 60˚
Statistical processing	Mean of up to 99 readings
Data storage	Up to 1,000 readings
Tolerance	Standard deviation of ⊿Gs within 0.5 (after 30 measurements of gloss calibration standard plate)
Approximate dimension and weight	Width 10 cm, depth 4 cm, height 9 cm [weight: 270 g]

GM-1
Gloss Mobile

A mobile gloss meter capable of simultaneous three-angle measurement

Capable of measuring the specular gloss from three angles (20˚, 60˚and 85˚) with a touch of a button, this is an ideal instrument for field measurement.

Measurement angles	20˚, 60˚, 85˚
Statistical processing	Mean of up to 99 readings plus standard deviation
Data storage	Up to 1,000 readings
Tolerance	Standard deviation of ⊿Gs within 0.5 (after 30 measurements of gloss calibration standard plate)
Approximate dimension and weight	Width 15 cm, depth 4 cm, height 8 cm [weight: 500 g]

GS Series
Multi-angle Gloss Meter

Fixed-angle gloss meters that provide accurate angle setting.

Up to 4 highly precise, fixed measurement angles can be selected from 20˚, 45˚, 60˚, 75˚ and 85˚ (75˚ and 85˚ cannot be selected together). It can measure specimens of large size with its flat measurement surface. Measurement value can be displayed simply by placing the specimen on the stage. The TAPPI converging beam method (20, 75 ˚) is also available by request.

Models	GS-1K (1angle), GS-2K (2angles), GS-3K (3angles), GS-4K (4angles)
Measurement angles (fixed)	Up to 4 angles from 20˚, 45˚, 60˚, 75˚ and 85˚ (75˚ and 85˚ cannot be selected together)
Statistical processing	Mean of up to 99 readings plus standard deviation
Data storage	Up to 1,000 readings
Tolerance	Standard deviation of ⊿Gs within 0.1 (after 10 measurements of gloss calibration standard plate)
Approximate dimension and weight	Optical unit: width 44 cm, depth 17.5 cm, height 24 cm [weight: 9 kg] Measurement unit: width 23 cm, depth 33 cm, height 14 cm [weight: 4 kg]

UGV-6P
Variable-angle Gloss Meter

Complete gloss measurement with one meter

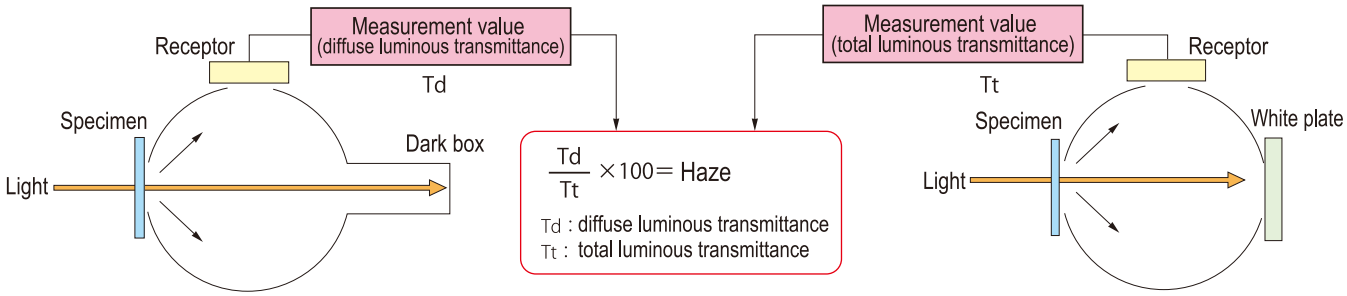
The incidence angle and the receptor angle can be adjusted individually by 1˚ margin using the meter at the center of the instrument. A marker is included at the center for precise angle setup. The measurement value is displayed simply by placing the specimen on the specimen stage.

Measurement angle range	Incidence from 20˚ to 85˚, receptor from 0˚ to 85˚ (incidence + receptor must be over 30˚)
Aperture diameter	ϕ45 mm (ϕ8 mm optional)
Statistical processing	Mean of up to 99 readings plus standard deviation
Data storage	Up to 1,000 readings
Tolerance	Standard deviation of ⊿Gs within 0.1 (after 10 measurements of gloss calibration standard plate)
Approximate dimension and weight	Width 51 cm, depth 37 cm, height 36 cm [weight: 15 kg]

3. Haze

What is haze ?

Haze is the level of fogginess used to measure the level of translucency of materials such as glass and plastics. Materials that are totally transparent will have a haze value of 0; this value will increase as the material becomes foggier.



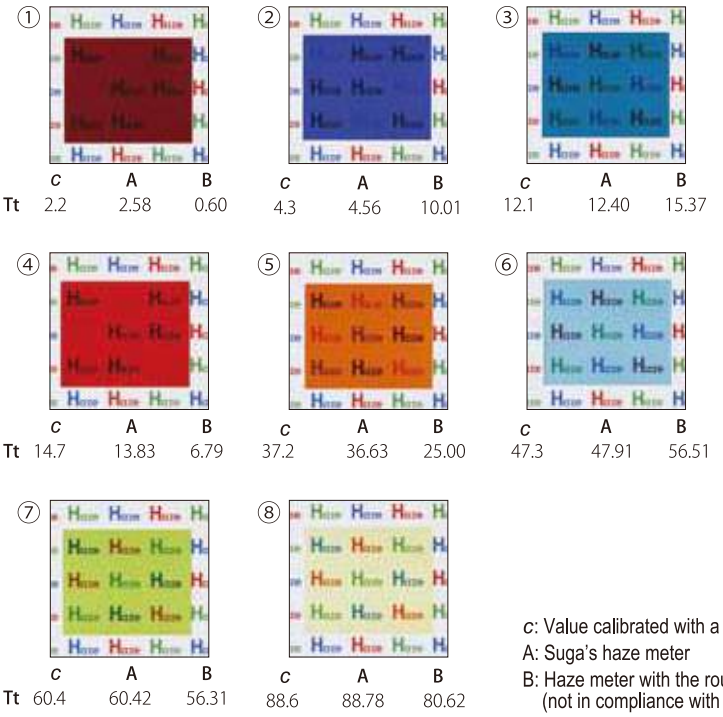
Standard used for haze measurement: NPL (National Physical Laboratory) standard plate

Example of measuring a plastic plate

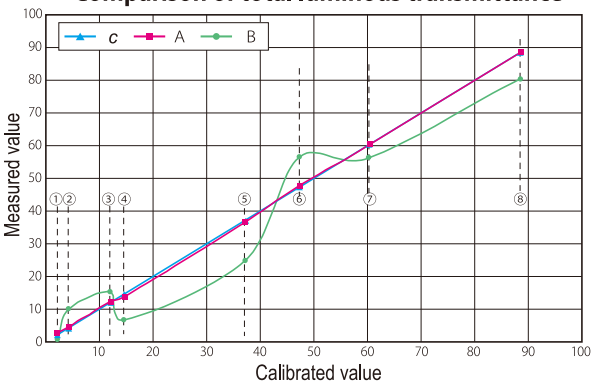
The haze value will differ depending on the total luminous transmittance (Tt) and diffuse luminous transmittance (Td).

Haze	4.14	13.19	18.71
Tt	91.49	89.25	90.01
Td	3.79	11.77	16.84

Total luminous transmittance (Tt)



Comparison of total luminous transmittance



The value A (Suga's haze meter), and the colored glass filter's haze value calibrated with the transmittance read from a spectrophotometer will have similar measurement results.
Correctly calibrated haze meter will not be affected by the specimen's colour.

c: Value calibrated with a spectrophotometer.
A: Suga's haze meter
B: Haze meter with the router condition not satisfactory (not in compliance with human vision).

Measurement items (for all models)
Haze, total luminous transmittance (Tt), parallel luminous transmittance (Tp), diffused luminous transmittance (Td)

HZ-V3 Haze Meter

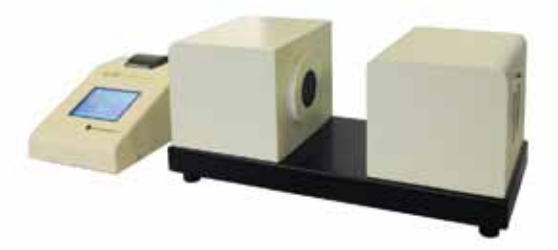
Capable of either vertical or horizontal positioning for measuring many different specimens

Suga's TM double beam method allows this instrument to perform stable measurement for an extensive period of time. The repositioning of the samples during ISO 14782 and ISO 13468 measurements is not needed.

Photometry	TM double beam method*1
Measurement light	C and D_{65} light (A light also available on request)
Specimen dimension	Maximum 260 × 180 × thickness 30 mm Maximum 260 × 145 × thickness 25 mm(use specimen stage)
Tolerance	Standard deviation of ⊿Tt within 0.02 (measuring 30 times in a row using air space after adjusting to standard)
Approximate dimension and weight	Approx. width 32 cm,depth 32 cm, height 48 cm (at vertical position) [weight: 18 kg]

This product is also available as CE model upon request.

HZ-O Haze Meter (open chamber)



Measures large specimens without the need for shading

Specimens of large size can be measured by simply placing it directly on the open-space specimen stage.

Photometry	TM light modulation single beam method
Measurement light	C and D_{65} light (A light also available on request)
Specimen dimension	Minimum ϕ30 mm × maximum thickness 130 mm
Tolerance	Standard deviation of ⊿Tt within 0.2 (after calibration and then 10 measurements of air chamber)
Calibration standard plate	One piece (approx. 1 % haze) (option: haze approx. 10, 20 %)
Approximate dimension and weight	Optical unit: Width 60 cm, depth 26 cm, height 23 cm [weight:15 kg] Measurement unit: Width 23 cm, depth 33 cm, height 16 cm [weight: 4 kg]

HZ-T Haze Meter

Measures large specimens without the need for shading

With its flat, open-spaced chamber, this instrument can measure specimens of large size by simply placing the specimen directly on the specimen stage. It includes a foot switch that allows the user to make measurements while holding the specimen with both hands.

Photometry	TM light modulation single beam method
Measurement light	C and D_{65} light (A light also available on request)
Specimen dimension	Min. ϕ30 mm × max. height 1,700 mm × max thickness 100 mm
Tolerance	Standard deviation of ⊿Tt within 0.2 (after calibration and then 10 measurements of air chamber)
Calibration standard plate	One piece (approx. 1 % haze) (option: haze approx. 10, 20 %)
Approximate dimension and weight	Width: select from 90, 120, 180 cm; depth: select from 60, 75 cm; max. height: 110 cm (specimen stage height: 74 cm from floor); [weight: 90 kg (when width is 80 cm and depth is 75 cm)]

HZ-G Haze Meter for Large Specimens

Capable of measuring the haze of large glass

This instrument automatically measures the haze of large glass specimens fixed on its flat specimen stage. The optical unit is controlled by a PC. The Suga-developed TM light modulation single beam method prevents outside light source from influencing the measurement.

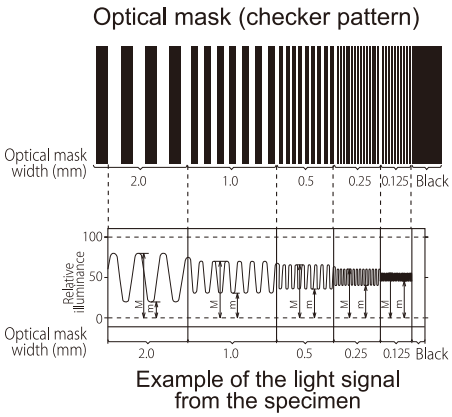
Photometry	TM light modulation single beam method
Measurement light	C and D_{65} light (A light also available on request)
Specimen dimension	From 300 × 300 mm to 1,450 × 1,850 mm; thickness 1.1 to 5.0 mm
Measurement unit	Windows PC
Accuracy	Reproducibility ± 0.2 %, tolerance ± 0.2 % (repeated accuracy with fixed specimen)
Measurement time	Approx. 5 minutes per specimen (measuring 9 locations of a 1,100 × 1,400mm specimen)

4. Image Clarity (Distinction)

What is Image Clarity ?

Image clarity (distinction) is the degree of clarity and lack of distortions of an image of an object appearing on a painted / colored alumite surface or through a transparency film, plastic etc. The clearer the image, the higher the value will be.

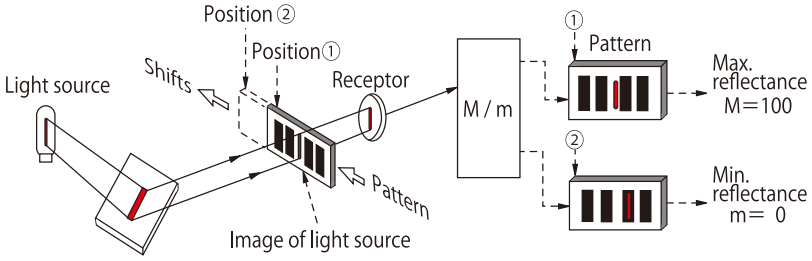
Measurement of Image Clarity (Reflectance)



Example of the light signal from the specimen

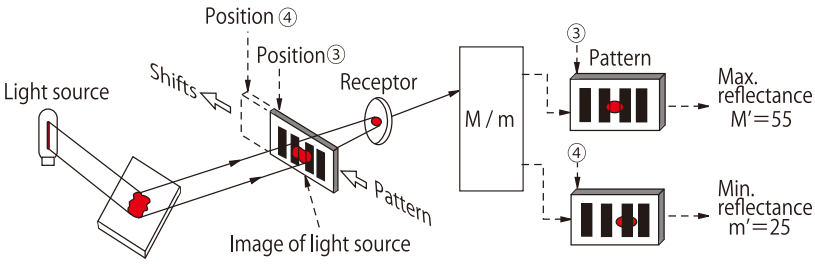
Image clarity is determined by obtaining values M and m, then applying them to a formula.
Image clarity meter calculates these values internally and displays the result on its screen.

Reflective surfaces



$$\text{Image clarity} = \frac{M-m}{M+m} \times 100 = 100\%$$

Painted surfaces



$$\text{Image clarity} = \frac{M'-m'}{M'+m'} \times 100 = 37.5\%$$

Example of measuring the image clarity (reflection) of a colored alumite plate

Image clarity (reflection) C% (optical mask width 0.5mm)


87.8%


58.6%


18.6%

Example of measuring films: comparison between image clarity (transmission) and haze

Haze	14.41
Tt	85.64
Td	12.34
C%	89.5

Haze	14.63
Tt	89.26
Td	13.06
C%	36.5

The image clarity (transmission) may be different even when the haze value is the same. This is because the method for measuring haze and image clarity are different. It is important to perform the test that correlates best with human vision.

Tt : Total luminous transmittance
Td : Diffuse luminous transmittance
C% : Image clarity (optical mask width 2mm)

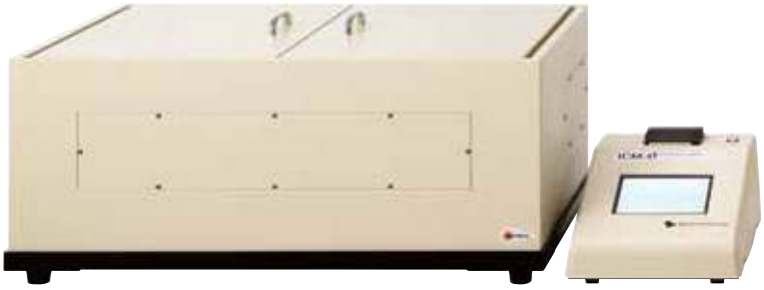
An example of measuring different materials: comparison between image clarity (reflection) and gloss

	Black glass	Tile	PVC
Gs(60°)%	90.8	87.1	90.9
C%	99.5	1.6	32.0

	Painted plate	Painted plate	Steel plate
Gs(60°)%	87.7	92.0	91.5
C%	18.9	84.2	1.2

The image clarity (reflection) may be different even when the specimens have equal glossiness. This is because the method for measuring gloss and image clarity are different. It is important to use the method that best correlates with human vision.

Gs(60°)%: 60 degree specular glossiness
C% : Image clarity (optical mask width 0.25mm)



ICM-1T Image Clarity Meter

The technology that expresses the image's clearness with numerical values
(complying with ISO 10216, ASTM D5767)

With our highly precise optics design and manufacturing technology, this instrument is capable of accurately expressing the delicate image clarity in a numerical value. It prides with high reproducibility and tolerance at minimum optical mask width of 0.125 mm.
Reference standard plate (as specified in JIS K 7374) comes as a standard attachment, allowing the user to confirm the accuracy of the instrument's measurement at any time.

Measuring method (use)	Transmission (plastic films etc.) and reflection (coatings, paintings, colored aluminum, paper, films for LCD, etc.)
Values to be measured	Image clarity C%, maximum reflectance (transmittance) M, minimum reflectance (transmittance) m
Measuring angles	Reflectance : 45° incidence and viewing, or 60° incidence and viewing (switchable between the two) Transmittance: 0° incidence and viewing of transmitted light
Light source slit	0.03 mm (JIS K 7105, JIS K 7374) or 0.1 mm (ISO 10216), either to be selected upon request
Aperture diameter	ϕ25 mm
Optical mask width	0.125 mm, 0.25 mm, 0.5 mm, 1.0 mm and 2.0 mm
Tolerance	Standard deviation of C within 0.2 % (after a transmittance test of the empty chamber with the optical mask width of 0.125 mm)
Electrical requirements	Single-phase 100 V approx. 2 A
Approximate dimension and weight	Optical unit: Width 70 cm, depth 48 cm, height 31 cm [weight: 35 kg] Measurement unit: Width 23 cm, depth 33 cm, height 16 cm [weight: 4 kg]

Diagram of measurement using the reflection method

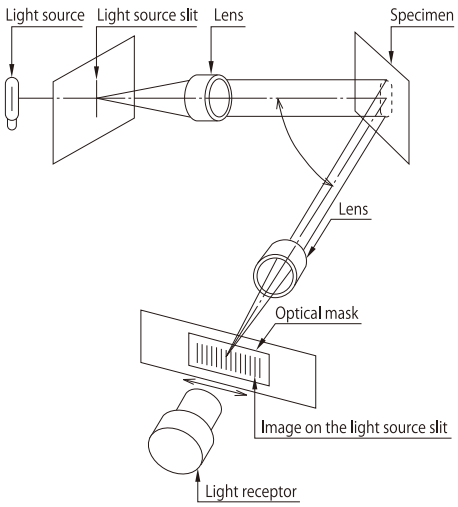
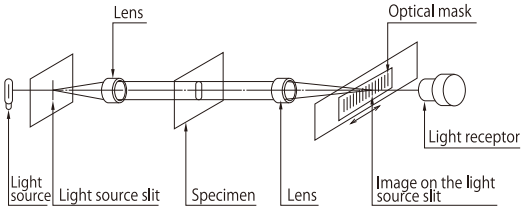


Diagram of measurement using the transmission method



Source: JIS K 7374:2007 Plastics – Determination of image clarity

5. Other Optical Properties

D65AC • D65A CIE D_{65} Standard Light Source

Determining an accurate visual evaluation

This is a standard light source used to visually evaluate the colour of an object, as specified in JIS Z 8720 “Standard illuminants and sources for colorimetry.” It can perform metamerism tests, with the equipped D_{65} and A light sources*. D65AC allows the user to adjust the brightness.

Models		D65A	D65AC
Approximate central illuminance	D_{65}	1,000 lx	600 to 2,000 lx
	A	1,000 lx	600 to 2,000 lx
Approximate observation chamber dimension		Width 60 × depth 48 × height 45 cm	
Electrical requirement		AC 100V approx. 3A	AC 100V approx. 5A
Approximate dimension and weight		Width 68 cm, depth 50 cm, height 64 cm [weight: 25 kg]	Width 68 cm, depth 50 cm, height 64 cm [weight: 27 kg]

*White fluorescent and black light can also be added as options. Also available is the DAW model where D_{65}, A and white fluorescent lights are installed parallel to each other, allowing the user to test for colour rendering under the two sources.

NS-1 Retroreflection Meter

Determines the performance of reflective boards and evaluate their quality

This instrument evaluates the retroreflectivity of reflectors for cars, reflective safety signs, reflective traffic warning signs etc. by shining them with light and measuring the light reflected back. It does not require a dark room, and it comes with a calibration standard plate for comparison with the test result (value set by Japan Vehicle Inspection Association comes separately).

Geometry	Incidence variable between -50˚ and + 50˚, observation angle 0.2˚
Incident beam	Approx. 3 × 8cm on specimen surface (at 0˚ incident angle)
Measuring light source	A light
Approximate dimension and weight	Optical unit: Width 40 cm, depth 40 cm, height 192 cm [weight: 35 kg] Measurement unit: Width 30 cm, depth 30 cm, height 18 cm [weight: 6 kg]

NS-1S Retroreflection Meter for Production Line

Excellent for use in production lines

This instrument observes the retroreflectivity of reflective sheets on the production line on a 24-hour basis. It is calibrated with the calibration plate prepared by the user, and the measurement data is stored in the multi-range recorder.

Geometry	Incidence +5˚ and +30˚, observation angle 0.2˚ and 0.5˚ for each incidence, simultaneous viewing
Incident beam	Approx. 2 × 8 cm on specimen surface (at 0˚ incident angle)
Measuring light source	A light
Approximate dimension and weight	Optical unit: Width 160 cm, depth 27 cm, height 55 cm [weight: 60 kg] Measurement unit: Width 70 cm, depth 67 cm, height 43 cm [weight: 40 kg]

HA-TR/HA-T Visible Light Transmittance /Reflectance Meter

Measures transmittance of car windows and films in field environments.

This product is used for measuring visible light transmittance and/or reflectance of car windows, plastic films, etc. HA-TR is reflectance/transmittance measuring type, while HA-T is dedicated transmittance measuring type.

Geometry	Transmittance: 0°illumination, 0°viewing (measuring transmittance of parallel light beam) Reflectance: 45°illumination, 45°viewing (conforming to JIS Z 8722)
Measured Values	Y values of two-degree-field A light source
Power Source	Ni-Cd battery (with single phase 100V charger)
Light Projection Unit for Transmittance Measurements	Attached to glass surface by vacuum suction (external dimensions ϕ6 x 11 cm)
Dimensions of Main Unit	Approx. 16 (W) x 7 (D) x 14 (H) cm, [weight: 0.7 kg]

This product is also available as CE model upon request.

Example of Typical Colour Systems

Name	Symbol	Formula	Description	CC-m CC-m45	CC-iS SC-T SC-T45	CC-i SM-T SM-T45	SC-50μ	CC-iW SC-WT	VC-2	Standards
Tristimulus values	XYZ, xyY, xy chromaticity diagram	$x=\frac{X}{X+Y+Z}$ $y=\frac{Y}{X+Y+Z}$	Colour system defined by CIE in 1931, used as a base for other colour systems (10 observer angle defined in 1964)	○	○	○	○	○	○	ISO 11664-1 ISO 11664-2 ISO 11664-3 JIS Z 8701 JIS Z 8722 JIS Z 8781-1 JIS Z 8781-2
L*a*b* (CIELAB)	L*a*b*, L* C*hab ⊿L*⊿a*⊿b* ⊿C*ab, ⊿H*ab ⊿E*ab	$L^*=116(Y/Y_n)^{1/3}-16$, $a^*=500[(X/X_n)^{1/3}-(Y/Y_n)^{1/3}]$ $b^*=200[(Y/Y_n)^{1/3}-(Z/Z_n)^{1/3}]$ $C^*_{ab}=(a^{*2}+b^{*2})^{1/2}$, $h_{ab}=\arctan(b^*/a^*)$ $\Delta E^*_{ab}=[(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2]^{1/2}$ $\Delta H^*_{ab}=k[(\Delta E^*_{ab})^2-(\Delta L^*)^2-(\Delta C^*_{ab})^2]^{1/2}$	Colour system recommended by CIE in 1976. Designed to approximate human vision, it is used to evaluate colour difference.	○	○	○	○	○	○	ISO 11664-4 JIS Z 8730 JIS Z 8781-4
L*u*v* (CIELUV)	L*u*v* L*C*huv u′ v′ ⊿L*⊿u*⊿v* ⊿C*⊿H*⊿E*uv	$u'=4X/(X+15Y+3Z)$, $v'=9Y/(X+15Y+3Z)$ $L^*=116(Y/Y_n)^{1/3}-16$, $u^*=13L^*(u'-u'_n)$ $v^*=13L^*(v'-v_n)$ $\Delta E^*_{uv}=[(\Delta L^*)^2+(\Delta u^*)^2+(\Delta v^*)^2]^{1/2}$	Colour system recommended by CIE in 1976. It is used to evaluate colour difference and rendering of illuminants.	○	○	○	○	○	○	ISO 11664-5 JIS Z 8730 JIS Z 8781-5
Colour difference formula	⊿E00 (CIE DE2000)	$\Delta E_{00}=[(\Delta L'/k_L S_L)^2+(\Delta C'/k_C S_C)^2+(\Delta H'/k_H S_H)^2+\{R_T(\Delta C'/k_C S_C)(\Delta H'/k_H S_H)\}]^{1/2}$	Colour system recommended by CIE in 2001 to obtain better correlation of colour difference with human vision.	○	○	○				JIS Z 8730
	⊿E94 (CIE1994)	$\Delta E_{94}=[(\Delta L^*/S_L)^2+(\Delta C^*_{ab}/S_C)^2+(\Delta H^*_{ab}/S_H)^2]^{1/2}$	Colour system recommended by CIE in 1994.	○	○	○	○	○		
	⊿ECMC (ISO minuscule colour difference)	$\Delta Ecmc=[(\Delta L^*/lS_L)^2+(\Delta C^*_{ab}/cS_C)^2+(\Delta H^*_{ab}/S_H)^2]^{1/2}$ S_L: Value difference S_C: Chroma difference S_H: Hue difference	Colour difference formula for obtaining better orrelation with various dye samples.	○	○	○	○	○		
Munsell	H V / C	Hue(H), Value(V), Chroma(C)	System using the Munsell colour system of hue(H), value(V) and chroma(C).	○	○	○	○	○		JIS Z 8721
Whiteness	W_{10}	$W_{10}=Y_{10}+800(0.3138-x_{10})+1700(0.3310-y_{10})$	Whiteness standard of ISO105 recommended by CIE.	○	○	○	○	○		ISO 105-J02 JIS Z 8715 JIS L 1916
	T_{W10}	$T_{W10}=900(0.3138-x_{10})-650(0.3310-y_{10})$	Tint value by ISO105. Negative indicates a red tint, while positive indicates green tint.	○	○	○	○	○		
	B(paper; blue reflectance) ※	B=0.847Z	Whiteness B is the blue reflectance of paper.	○	○	○	○	○		JIS P 8123 (withdrawn)
	W′	W′=4B−3G=4×0.847Z−3G	Whiteness W is the reflectance difference between blue and green.	○	○	○	○	○		
	IBR	$IBR=\Sigma F(\lambda)\times R_\infty(\lambda)/\Sigma F(\lambda)$	Indicates the whiteness of paper and paperboards. It is also known as ISO brightness.					○		JIS P 8148 ISO 2470
	Opacity	$O_p=(100\times R_0)/R_\infty$	Indicates the opacity of paper and paperboards.					○		JIS P 8149 ISO 2471
	W_L (fabric)	$W_L=L^*+3a^*-3b^*$	Indicates the whiteness of fabrics.	○	○	○		○		JIS L 1916
Yellowness index and its change	YI ⊿YI	YI=100(1.2769X−1.0592Z)／Y (C light 2°observer angle) YI=100(1.3013X−1.1498Z)／Y (D_{65} light 10°observer angle) $\Delta YI=YI-YI_0$ (YI: Yellowness after test YI_0: Yellowness before test)	YI indicates the yellowness index. YI indicates the change in the yellowness index.	○	○	○	○	○		ISO 17223 JIS K 7105 (withdrawn) JIS K 7373
Adams-Nickerson	Vx, Vy, Vz, ⊿EAN ※	$\Delta E_{AN}=40[\{0.23\Delta V_y\}^2+\{\Delta(V_x-V_y)\}^2+\{0.4\Delta(V_z-V_y)\}^2]^{1/2}$	Colour difference formula introduced by E.Q.Adams. Its interval is equal to human vision. Vy is equal to Munsell		○	○	○	○		Old JIS Z 8729 JIS Z 8730
Hunter	L a b L C h ⊿EH	$L=10Y^{1/2}$, $a=17.5(1.02X-Y)/Y^{1/2}$, $b=7.0(Y-0.847Z)/Y^{1/2}$, $\Delta E_H=[(\Delta L)^2+(\Delta a)^2+(\Delta b)^2]^{1/2}$	The Hunter colour scale with a long history as an evaluation tool for colour difference.	○	○	○	○	○	○	Old JIS Z 8729
Colour fastness	Nc# discoloration gray scale	$N_{c\#}=5.5-\log_{10}[\varepsilon(\Delta E^\sharp/D_{X10})/(0.015+1)]/\log_{10}(2)$	Used to determine the grade of the colour fastness of dyes for fabrics.	○	○	○	○	○		JIS L 0809
	Ns soiling gray scale	$N_S=5.5-\log_{10}(\Delta D_X/0.18415+1)/\log_{10}(2)$		○	○	○	○	○		
Metamerism	M (D_{65}:C)	$\Delta E^*ab=[(L_1^*-L_2^*)^2+(a_1^*-a_2^*)^2+(b_1^*-b_2^*)^2]^{1/2}$	This indicates metamerism, which is colour difference of two specimens with equal tristimulus values under one light source (such as D under a different light source (such as C).	○	○	○	○	○		JIS Z 8719
ISO standard depth	L_{SD}	$20.4+C^*_{ab}P+6\cdot e^{-C^*_{ab}P/6}$	Method of determining the dye physical examination.		○	○	○	○		ISO 105-A01 JIS L 0808

※C light 2° observer angle only

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For the purpose of improvement, specifications of the products may change without notice.

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