Instruction for WTM-1
Digital Whiteness Meter

Content

I. Overview

WTM-1 digital whiteness meter is composed of light source, optical system, detection system, data processing and display system, etc. Its overall whiteness is Blue Whiteness R457.

The whiteness of ideal surfaces whose spectral diffuse reflectance is all 1 is defined as 100, and the whiteness of absolutely black surface whose spectral diffuse reflectance is all 0 is defined as 0.

This instrument is designed in full compliance with the standard light source and lighting conditions specified by International Commission on Illumination (CIE), passes strict detection and debugging, as well as is subject to enterprise standard Q/IMRJ1-2005. It applies to national standards such as GB2913, GB5950, GB8940.1, GB12097 and GB13025.2.

II. Purpose

WTM-1 digital whiteness meter is mainly used for whiteness measurement of white and nearly white object or powder surface. It can accurately figure out the whiteness consistent with luminosity factor. The whiteness of objects already processed with fluorescent brightener can be quantitatively reflected, and the opaqueness of paper can be measured accurately.

This instrument can be widely used for the whiteness measurement of objects such as textile, paint and coating, chemical building materials, paper and paper mold, plastics, white cement, ceramics, enamel, porcelain clay, talcum powder, starch, flour, common salt, detergent and cosmetic.

III. Working Principle

Following the principle of photoelectric conversion and adopting analog to digital conversion circuit, the instrument realizes signal amplification, A/D conversion and data processing of the reflected radiant energy value on the surface of the measured samples, and finally displays the corresponding value of brightness.

IV. Instrument Characteristic

1. AC and DC supply, low power consumption, and ease outdoor or laboratory use
2. Liquid crystal display and clear reading
3. High-precision integrated circuit and specially made high-efficiency light source with the service life of up to 100,000 hours to effectively ensure the instrument can work stably for a long time
4. Auto shut off function and low-voltage display function that remind the users to change battery, to ensure the accuracy of measurement results
5. Equipped with measurement valve output interface and able to be equipped with recording instrument
6. Using national calibration whiteboard to transfer correction value, so that the measurement is accurate

V. Main Technical Parameter

1. Measurement Range: 0～100.0, able to display value up to 199.9

2. Whiteness Mean: Blue whiteness R457

3. Light Source: Approximating A light source; simulating D65 light source

4. Measuring condition: 45/0

5. Zero drift: 0.1

6. Value drift: 0.2

7. Repeatability: 0.2

8. Indication error: 1.0

9. Ambient temperature: Working temperature (5～35)℃; storage temperature (-20～55)℃

10. Signal output: 0∽2V, equipped with recording instrument with input impedance ＞100KΩ

11. Power supply: five AA alkaline batteries or DC 7.5V power adapter

12. Size: 235×65.5×75

13. Weight: 350g

VI. Precautions

This instrument is used for measurement. It can not be disassembled randomly. Before use, please read the instruction carefully.

1. Its working environment should be free from corrosive gas and vibration source.

2. There should be no intense light source or intense magnetic field around.

3. The ambient air should be dry and have no dust or any other floater.

4. If the instrument is not used for a long time, the preheating time

should be prolonged accordingly to improve its stability.

5. The power voltage must meet the operating conditions.

6. The samples can not fall into the measurement barrel in case it might not be able to be zeroed.

7. The optical components can not be touched directly with hands in case its spectral characteristics might be affected.

8. The black drum and working whiteboard can not be polluted to prevent its accuracy from being affected.

VII. Instruction

(I) Notes

1. Before use of the instrument, be sure to read this instruction carefully and strictly comply with the specified operating conditions and application methods.

2. Standard whiteboards and working standard whiteboards are used for calibration when the instrument is working. Their surfaces must be kept clean and can not be exposed to dust. They should be preserved in desiccators containing silica gel, to avoid their nominal values from being artificially affected. Working standard whiteboards should be mainly used to calibrate the instrument during routine measurement. The quantity values of working standard whiteboards are transferred by random standard whiteboards. During measurement, the orientation of the whiteboard should be noted.

3. Never use hands to wipe or touch the optical elements of the instrument to keep them clean. If there is dust on the optical elements, blow away the dust on their surfaces with ear washing bulb or wipe them with lens

wiping paper. If there are oil stains, mildew, etc on the optical elements, absorbent cotton ball wetted by absolute alcohol should be used to wipe the surfaces of the elements. When the instrument is not used, it should be covered with self-made dust-proof boot.

4. Before starting the machine, use clean cotton cloth whose hair does not fall or paper to wipe the gauge hatch, so as not to pollute the whiteboards and measured samples.

5. The surfaces of the tested samples should be flat and even. During retest, the consistency of the measured samples should be kept horizontally and vertically. For uneven measured samples (e.g. samples in the form of powder, granule or fiber), see “sample making” for their sampling methods

(II) Sample Making

1. If the measuring plane of a sample is “uneven” which can not be improved or has both transverse and lengthwise streaking, measurement can be made of different positions of the samples or of the samples at different angles. The average value of the obtained whiteness represents the whiteness of this sample.

2. For paper, cloth and various fabrics, several overlapping layers of samples should be taken until they are lightproof (In case of paper, several overlapping pieces of samples in 50*70mm should be taken according to QB534-67 until it is lightproof. That is, it becomes lightproof when the whiteness value of the increased pieces of samples does no change).

3. Samples in the shape of powder or fine particle should be contained in powder machine. Glass plates whose surfaces are clean and shiny should be used to flatten the surfaces of the samples. Different test conditions will cause different test results. Therefore, to build the whiteness value

relationship among samples of the same type, sampling method of test samples should be specified uniformly including the weight, granularity and pressing method, to ensure the samples have nearly the same density and surface evenness. If high measurement accuracy is required, constant-pressure powder former manufactured by our factory should be purchased.

4. Fibriform objects such as cotton, chemical fiber, wool, and silk should be cleared up first, combed into a longitudinal surface, and then put into the self-made sample box for test. The sampling methods (including sample size) should be uniform and more samples are recommended to be prepared to measure their mean value.

(III) Value Transfer of Standard Whiteboard

1. Start-up preheating

Plug in and press the power switch on the left of the instrument to preheat for 30 seconds.

2. Zero Adjust

Put the black drum on the gauge hatch. Be sure there is no light leak between the black drum and the gauge hatch. When the displayed value stabilizes, adjust the “Zero Adjust” button to get the display screen to display 00.0.

3. Correction

Take down the black drum and put on the standard whiteboard (pay attention to the direction of the standard whiteboard). After the value stabilizes, adjust the “Correction” button to get the displayed value to be consistent with the whiteness value of the standard whiteboard. Then remove the standard whiteboard.

4. Calibration of Working Standard Whiteboard

Place the working standard whiteboard in the measuring hole for measurement. After the displayed value stabilizes, it is the calibration value of the working standard whiteboard.

The routine measurement should mainly include calibration of working standard whiteboard. As working standard whiteboard used for daily calibration of the apparatus value, standard whiteboard should be used for auto-calibration on a monthly basis. The average value obtained after calibration for more than three times is the whiteness value of the working standard whiteboard.

(IV) Measurement Procedure

1. Start-up preheating

Plug in and press the power switch on the left of the instrument to preheat for 30 seconds.

2. Zero Adjust

Put the black drum on the gauge hatch. Be sure there is no light leak between the black drum and the gauge hatch. When the displayed value stabilizes, adjust the “Zero Adjust” button to get the display screen to display 00.0.

3. Correction

Take down the black drum and put on the working standard whiteboard (pay attention to the direction of the working standard whiteboard). After the value stabilizes, adjust the “Correction” button to get the displayed value to be consistent with the calibration value of the working standard whiteboard. Then remove the working standard whiteboard.

4. Measurement

Place the samples in the measuring hole for measurement. After the

displayed value stabilizes, it is the measurement value.

(V) Measuring Method

For continuous test and samples test having high requirements for contrast, the black drum and working standard whiteboard should be used respectively from time to time for zero setting and calibration, to avoid the effects of value drift of the instrument. When the samples are put in the measuring hole, attention should be paid to their evenness.

1. Measurement of R457 whiteness

For whiteness measurement of non-fluorescence object, the sample to be tested can be put in the measuring hole after the instrument is preset. The whiteness value can be recorded when the displayed value stabilizes.

2. Measurement of fluorescent whitening quantity

a. After presetting of the instrument, first measure the non-fluorescence object and write down such whiteness value (set to be W1).

B. Measure the object added with fluorescent brightener and record the total whiteness value of whitening (set to be W2).

C. Calculation of fluorescent whitening quantity, F=W1-W2

3. Measurement of opaqueness T

Conduct test by using the method specified in ISO2471-77.

After presetting, the instruments test the samples. The size of samples should be in such enough layers as are able to make them opaque.

a. Put the test samples on the instruments for test. Then remove the uppermost layer of the test sample and put it down to the lowest layer. Measure a total of five layers of samples in sequence, and record the reflectance coefficient of each layer of test sample, i.e. $R\infty$.

b. Take the black drum as the underlay for the five layers of test

samples already tested, and record the reflectance coefficient R0 of each layer of surface.

c. Repeat step a and step b, and respectively measure the values of R∞ and R0 of each layer of the original sample.

d. Figure out the mean value of R∞ and R0 on the right and reverse sides.

$$T=100\frac{R0}{R\infty}$$

e. Figure out the opaqueness (T) of the right and reverse sides:

$$T=100\frac{R0}{R\infty}$$

Calculate the opaqueness of each side which should be accurate to 0.5%. If the difference is larger than 0.5%, the opaqueness of the right side and reverse side should be identified respectively. If the difference is not larger than 0.5%, report the average value.

VIII. Maintenance and Repair of Instrument

1. The random standard whiteboards should be sent to the higher measurement authority or industrial test center station for approval once a year. If they are polluted, they should be inspected after cleaned and then re-calibrated.

2. Both the standard whiteboards and working standard whiteboards should be kept in desiccator to get away from light.

3. The optical elements can not be touched with hands in case sweat might pollute them and thus affect spectrum transmittance. After the instrument is used for a long time, wet the absorbent cotton ball with

absolute alcohol, clamp it with a tweezer, and wipe it clean with dry absorbent cotton ball. Nonprofessionals can not operate it.

4. During test of samples in the shape of powder and fine particle, attention should be paid to avoid the samples from getting into the measuring holes in case the instrument might not be zeroed or measure accurately.

5. If the instrument is damaged or can not work due to quality problems within one year after its purchase even when the user uses the instrument according to the instruction, the manufacturer is responsible for repairing it for free. However, the manufacturer can charge appropriate parts costs and labor costs if such damage or inability to work is caused by the user’s improper use of it. The manufacturer is responsible for life-long maintenance of non warranty products.