BS EN ISO 7887:2011

BSI Standards Publication

Water quality — Examination and determination of colour

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN ISO 7887:2011. It supersedes BS EN ISO 7887:1995 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee EH/3, Water quality, to Subcommittee EH/3/2, Physical chemical and biochemical methods.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2012

ISBN 978 0 580 60665 6

ICS 13.060.60

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 29 February 2012.

Amendments issued since publication

Amd. No.	Date	Text affected

BS EN ISO 7887:2011

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 7887

December 2011

ICS 13.060.60

Supersedes EN ISO 7887:1994

English Version

Water quality - Examination and determination of colour (ISO 7887:2011)

Qualité de l'eau - Examen et détermination de la couleur (ISO 7887:2011)

Wasserbeschaffenheit - Untersuchung und Bestimmung der Färbung (ISO 7887:2011)

This European Standard was approved by CEN on 14 December 2011.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN ISO 7887:2011: E

Foreword

This document (EN ISO 7887:2011) has been prepared by Technical Committee ISO/TC 147 "Water quality" in collaboration with Technical Committee CEN/TC 230 “Water analysis” the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2012, and conflicting national standards shall be withdrawn at the latest by June 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 7887:1994.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of ISO 7887:2011 has been approved by CEN as a EN ISO 7887:2011 without any modification.

Contents

Page

INTERNATIONAL STANDARD **ISO 7887:2011(E)**

Water quality — Examination and determination of colour

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

IMPORTANT — It is absolutely essential that tests conducted in accordance with this International Standard be carried out by suitably qualified staff.

1 Scope

This International Standard specifies four different methods, designated A to D, for the examination of colour.

The previously most employed method for assessment of water colour in water treatment plants, limnological surveys, etc. was based on the hexachloroplatinate scale (Reference [1]). Methods C and D are harmonized with this traditional procedure (References [2][3]).

Method A involves examination of apparent colour by visually observing a water sample in a bottle. This gives only preliminary information, for example for use in field work. Only the apparent colour can be reported.

Method B involves determination of the true colour of a water sample using optical apparatus and is applicable to raw and potable water and to industrial water of low colour. A subclause on interferences is included.

Method C involves determination of the true colour of a water sample using optical apparatus for comparison with hexachloroplatinate concentration at wavelength, $\lambda = 410$ nm. A subclause on interferences is included.

Method D involves determination of colour by visual comparison with hexachloroplatinate standard solutions and can be applied to raw and drinking water. A subclause on interferences is included.

Methods A and B are appropriate if the colour hue of the sample differs from the hue of the matching solution.

NOTE 1 Under certain circumstances, strongly coloured water samples require dilution before examination or determination. However, this can alter the physical-chemical conditions leading to a change in colour.

NOTE 2 An internal quality control procedure for all methods specified in this International Standard is given in Annex A. Precision data are given in Annex B.

When stating the result, the procedure used (methods A to D) is also recorded.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 5667-3, *Water quality — Sampling — Part 3: Preservation and handling of water samples*

ISO 10523, *Water quality — Determination of pH*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
apparent colour of water
colour due to dissolved substances and undissolved suspended matter, determined in the original water sample without filtration or centrifugation

3.2
colour of water
optical property that causes the changing of the spectral composition of transmitted visible light

3.3
dissolved organic carbon
DOC
sum of organically bound carbon present in water originating from compounds passing through a membrane filter of 0,45 µm pore size, including cyanate and thiocyanate

[ISO 8245:1999,[6] 3.4]

NOTE DOC in natural waters often originates from natgural organic matter (NOM), a complex mixture of compounds formed as a result of the breakdown of animal and plant material in the environment. The composition of the mixture is strongly dependent on the environmental source. Spectroscopic methods are often used to characterize the dissolved organic matter in natural waters (Reference [4]). The ratio of UV absorbance and DOC concentration (specific UV-absorption, SUVA) has proved to be useful for optimization of water treatment processes.

3.4
specific colour
ratio between the true colour of a sample and its concentration of dissolved organic carbon

3.5
true colour of water
colour due only to dissolved substances, determined after filtration of the water sample through a membrane filter of pore size 0,45 µm

4 Method A: Visual examination

4.1 Sampling bottles

Colourless bottle, see ISO 5667-3.

Maintain all glassware that comes into contact with the sample in a scrupulously clean condition by washing with hydrochloric acid [c(HCl) ≈ 2 mol l^{-1}] or with surfactant cleaning solution which is recommended for laboratory use. Finally rinse with water for washing (5.4.2) and allow to drain.

4.2 Sampling and samples

Collect samples in bottles (4.1) and carry out the colour test as soon as possible. If storage is unavoidable, the samples can be stored for up to 5 days in the dark at 4 °C ± 2 °C. Prevent extensive aeration during storage, especially in cases where colour-changing redox reactions are likely to occur.

4.3 Procedure

Shake the sample to solubilize any matter that can dissolve.

Put the unfiltered sample into a bottle (4.1) and examine the sample in diffused light against a white background for colour intensity and hue. Allow any suspended matter that settles to do so before examination.

4.4 Qualitative description

State the intensity of the colour (nil, pale, light or dark) and the hue (e.g. yellow, yellowish brown).

EXAMPLE Apparent colour in accordance with ISO 7887, method A: pale, yellowish brown.

5 Method B: Determination of the true colour using optical instruments

5.1 General

The intensity of the colour of a water sample is characterized by its light absorption at the wavelength of maximum absorption and quantified by measuring the absorption coefficient with a filter photometer or spectrophotometer. Normally, most of the yellow-brown coloured natural waters, and the coloured waste water samples of discharges of domestic treatment plants can be measured at 436 nm. Waste water from industrial waste water treatment plants does not show sufficiently sharp and distinguished absorption maxima. Those waters shall be examined using the wavelengths specified in 5.2.

5.2 Principle

Characterization of the intensity of colour of a water sample is performed by measuring the attenuation (absorption) of light. Different colours cause maximum absorption at different wavelengths of the incident radiation. In accordance with Method B of this International Standard, the colour of the water is determined using a photometer or a spectrometer at a minimum of three different wavelengths, distributed over the range of the visible spectrum:

a) $\lambda(1) = 436$ nm;

b) $\lambda(2) = 525$ nm;

c) $\lambda(3) = 620$ nm.

Always use the wavelength $\lambda = 436$ nm (Hg 436 nm); wavelengths $\lambda(2)$ and $\lambda(3)$ can differ slightly from those specified above, depending on the type of optical filter employed. For a better characterization, measurements at additional wavelengths near the absorption maximum can be performed.

5.3 Interferences

Prior to measurement, the water sample is filtered (5.7) to avoid interferences by undissolved matter. This filtration can, however, lead to further interferences (e.g. due to oxidation reactions caused by contact with air or due to precipitations initiated by the filtration step). As an example, iron and manganese compounds can be retained on the filter or transferred to a coloured oxidation state. In some cases, particularly in the presence of colloidal solids, e.g. clay or other finely dispersed matter, it can prove impossible to obtain a clear filtrate. In this case, mention in the test report that colloidal solids are present.

NOTE Colours often depend on pH. Therefore, the pH of the water sample is regularly determined in parallel with optical measurements and these results are reported with the other findings.

5.4 Reagents

5.4.1 Optically pure water

Soak a membrane filter, of pore size 0,2 µm, in distilled or deionized water for approximately 1 h. Pass approximately 1 l of water, grade 1, as specified in ISO 3696 through the prepared filter, discarding the first 50 ml of filtrate.

NOTE If freshly distilled or deionized water has no measurable absorbance, it can be used.

5.4.2 Water for washing

Water, grade 3, as specified in ISO 3696.

5.5 Apparatus

5.5.1 Spectrophotometer (option 1), for continuous or discontinuous measurement, suitable for the visible range of the spectrum (approximately from 330 nm to 780 nm), preferably a scanning double beam instrument with bandwidth $\leq$10 nm.

5.5.2 Filter photometer (option 2), for discontinuous measurements, equipped with spectral line filters having a bandwidth which is as small as possible (about 20 nm), allowing measurements to include wavelengths 436 nm, 525 nm and 620 nm.

5.5.3 Membrane filter assembly, with filters of pore size 0,2 µm and 0,45 µm.

5.5.4 pH-meter.

5.6 Sampling and samples

See 4.2.

5.7 Procedure

Set up either the spectrophotometer (5.5.1) or filter photometer (5.5.2) and strictly observe the operating manual supplied by the manufacturer of the instrument. Prior to examination, filter the water sample through a membrane filter of pore size 0,45 µm (5.5.3). In parallel with each colour determination, measure the pH of the filtered sample in accordance with ISO 10523. In the case of strong colours, it can be necessary to use optical cells with suitable pathlengths down to 1 mm. The water sample can also be diluted with a measured volume of optically pure water (5.4.1), as appropriate, after filtration. The pH shall be measured before and after dilution.

Transfer the sample to the optical cell of the spectrophotometer or filter photometer and place optically pure water (5.4.1) in the reference cell.

If the spectral absorption coefficient, α, at the wavelength, λ, is less than 0,1 cm^{-1}, the optical pathlength of the cell should be 10 mm or more.

NOTE 1 A cell of optical pathlength down to 1 mm can be used to avoid diluting the sample.

Measure natural waters at 436 nm against optically pure water (5.4.1). Perform further measurements at 525 nm and 620 nm.

NOTE 2 In order to determine the absorption maximum, the entire absorption spectrum between 350 nm and 780 nm can be taken, using a scanning spectrophotometer (5.5.1).

5.8 Calculation

Calculate the spectral absorption coefficient, $\alpha(\lambda)$, absorbance per metre, using Equation (1):

$$\alpha(\lambda) = \frac{A}{d} f \tag{1}$$

where

A is the absorbance of the water sample at wavelength λ;

d is the optical pathlength, in millimetres, of the cell;

f is a factor to give the spectral absorption coefficient, in reciprocal metres ($f = 1\,000$).

The volume of water used for dilution should be taken into account when stating the result.

NOTE Most spectrophotometers are calibrated directly in terms of absorbance units. For instruments calibrated only in terms of transmittance, $T = \Phi_{tr}/\Phi_0$, the absorbance, A, is given by Equation (2):

$$A = -\lg\left(\frac{\Phi_{tr}}{\Phi_0}\right) \tag{2}$$

where

Φ_0 is the incident flux;

Φ_{tr} is the transmitted flux.

5.9 Expression of results

Apart from the absorption coefficient, $\alpha(\lambda)$, the wavelength of the incident light (e.g. 436 nm) shall be reported. For radiation which is not strictly monochromatic, the spectral half-intensity width ($\Delta\lambda$ bandwidth) shall also be reported. The spectral absorption coefficient shall be rounded to the nearest 0,1 m^{-1}.

EXAMPLE True colour in accordance with ISO 7887, method B.

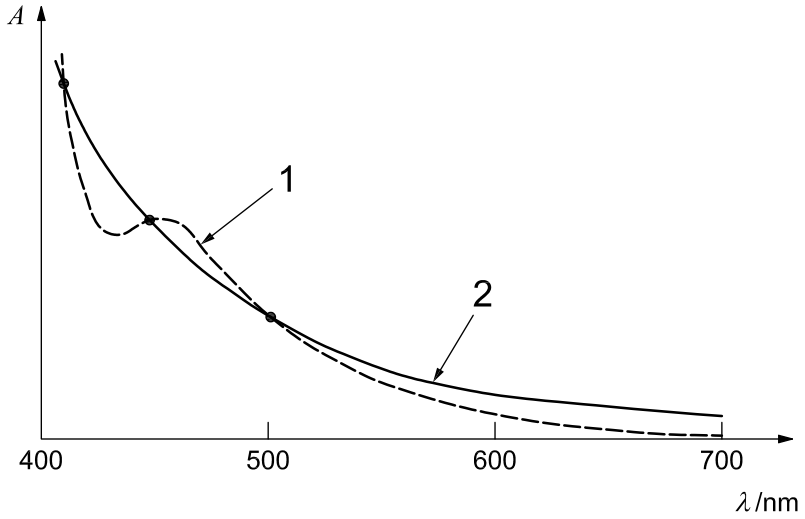
Spectral absorption coefficient, Hg $\lambda = 436$ nm:	5,2 m^{-1}
Spectral absorption coefficient, $\lambda = 525$ nm, $\Delta\lambda = 21$ nm:	1,8 m^{-1}
Spectral absorption coefficient, $\lambda = 620$ nm, $\Delta\lambda = 18$ nm:	2,3 m^{-1}
pH-value after filtration:	6,4

6 Method C: Determination of true colour using optical instruments for determination of absorbance at wavelength $\lambda = 410$ nm

6.1 Principle

The intensity of the yellowish brown colour of a sample is determined by measurement of the absorption coefficient at $\lambda = 410$ nm. Comparison with the specific absorption coefficient for a defined calibration solution of potassium hexachloroplatinate and cobalt chloride at the same wavelength gives the colour value in terms of mg l^{-1} Pt. This procedure can only be applied for true colour of optically clear samples (e.g. after filtration with pore size 0,45 µm).

NOTE The wavelength, $\lambda = 410$ nm, is chosen as the shortest at which the absorption spectra of a natural water sample visually denominated as 100 mg l^{-1} Pt in accordance with method D and the corresponding matching calibration solution of 100 mg l^{-1} Pt intersect (see Figure 1) (Reference [2]).



Key

1 matching solution
2 natural water
A absorbance, relative scale
λ wavelength

Figure 1 — Absorbtion spectra for a sample of natural water and a visually matching calibration solution both 100 mg l^{-1} Pt

6.2 Interferences

Finely dispersed suspended matter that interferes with the absorbance measurement shall be removed by filtration using a 0,45 µm membrane filter. Problems can arise, however, if air should enter the sample and result in formation of differently coloured oxidized species, e.g. iron or manganese can be retained on the filter or can be transformed into differently coloured oxidized species.

In some cases, especially in the presence of colloidal clay particles, it can prove impossible to obtain filtrates without turbidity. In such cases, a statement that the sample was turbid shall be reported together with the test result.

Clogging of the pores in a membrane filter reduces the pore size and can increase the retention of humus colloids, which decreases the colour values.

6.3 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade.

6.3.1 Stock colour calibration solution, corresponding to 500 mg l^{-1} Pt.

Dissolve 1,245 g ± 0,005 g potassium hexachloroplatinate(IV) (K_2PtCl_6) and 1,000 g ± 0,005 g cobalt(II) chloride hexahydrate ($CoCl_2 \cdot 6H_2O$) in about 500 ml water (5.4.1). Add 100 ml ± 1 ml hydrochloric acid ($\rho = 1{,}18$ g ml^{-1}) and make up to the mark with water in a 1 000 ml one-mark volumetric flask.

Store the solution in darkness at 4 °C ± 2 °C in a well-stoppered dark brown glass bottle.

The solution is stable for at least 3 years.

CAUTION — Potassium hexachloroplatinate is a sensitizer and toxic compound. Use protection when handling the compound.

6.3.2 Colour calibration solution, for use, corresponding to 100 mg l^{-1} Pt.

Transfer by means of a volumetric pipette 20 ml of the stock solution (6.3.1) to a 100 ml one-mark volumetric flask and make up to the mark with water (5.4.1).

The solution is stable for at least 1 month when stored in a well-stoppered bottle in darkness at 4 °C ± 2 °C.

6.4 Apparatus

6.4.1 Spectrophotometer (option 1), for continuous or discontinuous measurement, suitable for measurement at $\lambda = 410$ nm with a bandwidth of ≤5 nm equipped with optical cells of glass or quartz with optical pathlength of 40 mm or 50 mm. Optical cells with 10 mm optical pathlength can be used for strongly coloured samples.

6.4.2 Filter photometer (option 2), for discontinuous measurements, equipped with spectral line filters having a bandwidth which is as small as possible (about 20 nm), allowing measurements to include the wavelength 410 nm.

6.4.3 Membrane filter assembly, with filters of pore size 0,2 µm and 0,45 µm.

6.4.4 pH-meter.

6.5 Sampling and samples

See 4.2.

6.6 Procedure

Set up either the spectrophotometer (6.4.1) or filter photometer (6.4.2) in accordance with the manufacturer's instructions.

Prior to examination, filter the water sample through a membrane filter of pore size 0,45 µm (6.4.3). Let the sample equilibrate to room temperature. In parallel with each colour determination, measure the pH of the filtered sample.

In the case of strong colours, the water sample can be diluted with a measured volume of optically pure water (5.4.1) to an intensity within the calibration range. Alternatively, after filtration, dilution can be omitted by use of an optical cell with suitable pathlength. Then measure the pH in accordance with ISO 10523.

Transfer the sample to the optical cell of the spectrophotometer or filter photometer and place optically pure water (5.4.1) in the reference cell.

6.7 Calculation

6.7.1 Determination of specific absorption for the calibration solution

Set up either the spectrophotometer (6.4.1) or filter photometer (6.4.2) in accordance with the manufacturer's instructions.

Measure A_{410} of the colour calibration solution (6.3.2) with optically pure water (5.4.1) in the reference cell.

Calculate the specific absorption coefficient, a, of the calibration solution given as A_{410} [mm^{-1} ($mg\ l^{-1}$ Pt)$^{-1}$] using Equation (3):

$$a = \frac{A_{410}}{100\ d} \tag{3}$$

where

A_{410} is the absorbance of the colour calibration solution;

100 is the colour of the calibration solution in mg l^{-1} Pt;

d is the optical pathlength, in millimetres, of the optical cell.

The calibration curve should be a straight line.

NOTE The specific absorption coefficient for the calibration solution is a physical constant of about $5{,}4 \times 10^{-5}$ mm^{-1} (mg l^{-1} Pt)$^{-1}$. The use of this constant for calculation of results depends on carefully verified constant instrumental conditions.

6.7.2 Calculation of the colour intensity of the sample

The volume of water used for dilution shall be taken into account when stating the result.

Calculate the true colour of the sample, C, in mg l^{-1} Pt, using Equation (4):

$$C = \frac{A_{410}}{ad} \tag{4}$$

where

A_{410} is the absorbance of the sample at $\lambda = 410$ nm;

a is the specific absorption coefficient of the calibration solution given in reciprocal concentration and millimetres [mm^{-1} (mg l^{-1} Pt)$^{-1}$];

d is the optical pathlength, in millimetres, of the cell.

6.8 Expression of results

Report the value to the nearest mg l^{-1} Pt in the range of 2 up to but not including 250 mg l^{-1}.

Report values ≥250 mg l^{-1} Pt rounded to the nearest 10 mg l^{-1} Pt.

Report values in the range 0 mg l^{-1} Pt up to but not including 2 mg l^{-1} Pt as <2 mg l^{-1} Pt.

The light absorption of certain natural dissolved substances in water is pH-dependent. It is therefore recommended that the pH-value of the sample be quoted together with the colour.

EXAMPLE True colour in accordance with ISO 7887, Method C.

Water colour 18 mg l^{-1} Pt

pH-value 6,4

7 Method D: Visual method for the determination of the colour in natural water

7.1 Principle

Determination of the intensity of the yellowish brown colour of a sample by visual comparison against a series of matching solutions. Expression of the colour in terms of mg l^{-1} Pt units representing the intensity of colour produced by the matching solutions.

7.2 Interferences

Interferences arise if the hue of the sample differs appreciably from the hue of the matching solutions. In these cases, a meaningful comparison can prove impossible to obtain and the determination shall be carried out in accordance with method A or B. For additional interferences, see 5.3.

7.3 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade.

7.3.1 Stock colour-matching solution, corresponding to 500 mg l^{-1} Pt units.

See 6.3.1.

7.3.2 Colour-matching solutions.

Pipette: 2,5 ml; 5,0 ml; 10,0 ml; 15,0 ml; 20,0 ml; 25,0 ml; 30,0 ml; and 35,0 ml of stock solution (6.3.1) into a series of 250 ml volumetric flasks and make up to the mark with water (5.4.1).

These solutions contain: 5 mg l^{-1} Pt; 10 mg l^{-1} Pt; 20 mg l^{-1} Pt; 30 mg l^{-1} Pt; 40 mg l^{-1} Pt; 50 mg l^{-1} Pt; 60 mg l^{-1} Pt; and 70 mg l^{-1} Pt, respectively. Store the solution in darkness at 4 °C $\pm$ 2 °C in well-stoppered glass bottles.

The solutions are stable for 1 month.

7.4 Apparatus

7.4.1 Standard observation tubes, for example Nessler tubes, tall form, length about 20 cm, of capacity 50 ml, made of optically clear glass with shadowless bottoms, or special observation tubes.

NOTE Larger non-standard tubes can be used.

7.4.2 Comparator

The manufacturer's operating instructions shall be observed. The cell for the blank, or for the reference, shall be filled with optically pure water (5.4.1).

7.4.3 Permanent glass standards, covering a similar range of standard colours, in terms of mg l^{-1} Pt, as the matching solutions.

Their use is permissible provided that they are checked at intervals of 6 months against the matching solutions (7.3.2) and recalibrated if necessary. For samples with darker colour, it may be convenient to use glass standards covering a higher range. These glass standards shall also be checked at intervals of 6 months against corresponding matching solutions prepared from the stock colour-matching solution (7.3.1) and recalibrated if necessary.

7.5 Sampling and samples

See 4.2.

7.6 Procedure

If the sample is turbid, filter it through a membrane filter of pore size 0,45 µm (5.5.3) before carrying out the determination of colour (see paragraph 3).

In the presence of clay or other finely dispersed suspended matter, it can prove impossible to obtain a clear filtrate, in which case only apparent colour is measured.

If the membrane filter absorbs coloured substances, another filter type, e.g. a glass fibre filter should be used and this should be stated in the test report.

If the colour is beyond the range covered by the glass standards, dilute the sample with measured amounts of optically pure water (5.4.1) until the colour is within the range of the matching solution or glass standards. The pH of the sample can change because of the dilution. Therefore measure pH in accordance with ISO 10523 prior to and after dilution.

Fill a series of standard observation tubes (7.4.1) to the mark with the colour-matching solutions (7.3.2). Fill another standard observation tube to the mark with the test portion. Place the observation tubes on a white surface placed at such an angle that light (not direct sunlight), or light from a white cabinet, is reflected upwards through the columns of liquid. Look vertically downwards through the columns of liquid. Match the intensity of the colour of the test portion with that of the nearest matching solution.

Alternatively, fill the tube of a comparator (7.4.2) to the mark with the sample and compare with the glass standards (7.4.3).

7.7 Expression of results

Report the value, in mg l^{-1} Pt, as that of the nearest matching solution, to the nearest 5 mg l^{-1} Pt in the range 0 up to but not including 40 mg l^{-1} Pt, and to the nearest 10 mg l^{-1} Pt in the range 40 mg l^{-1} Pt to 70 mg l^{-1} Pt.

If the sample has been diluted, report the original colour, C_0, in terms of mg l^{-1} Pt, given by Equation (5):

$$C_0 = \frac{V_1}{V_0} C_1 \tag{5}$$

where

V_1 is the volume of the sample after dilution;

V_0 is the volume of the sample before dilution;

C_1 is the estimated colour of the diluted sample.

If the colour of the sample does not match that of the standards, an approximate value may be reported with an appropriate note.

If matching is impossible, it is recommended that a description of the sample be given.

The absorption spectra of certain dissolved natural substances in water are pH-dependent. Therefore it is recommended that the pH-value of samples be quoted together with the colour.

8 Test report

This test report shall contain at least the following information:

a) the test method used, together with a reference to this International Standard (ISO 7887:2011);

b) precise identification of the sample;

c) the results expressed as specified in 4.4, 5.9, 6.8 or 7.7;

d) the pH-value of the sample, if required;

e) any deviation from the procedure specified or any circumstance that may have affected the results (e.g. filtration or dilution).

Annex A
(informative)

Quality control

A.1 General

Internal quality control may be performed with a control solution (A.3.2), which may be used for all the methods specified in this International Standard.

A.2 Reagents

A.2.1 Humic acid, e.g. Fluka 53680[1)].

A.2.2 Sodium hydrogen carbonate, $NaHCO_3$.

A.3 Solution preparation

A.3.1 Stock control solution, about 3 000 mg l^{-1} Pt, and $A_{254} \approx 6$ cm^{-1}.

Mix 4,2 g $NaHCO_3$ (A.2.2) and 92 mg humic acid (A.2.1) in a 500 ml volumetric flask. Add about 50 ml water (5.4.1) and shake vigorously for some minutes to dissolve the solids. Make up to the mark with water. Filter the solution if some undissolved particles remain. Thereafter, make up to the mark with water.

Store the solution in darkness at 4 °C $\pm$ 2 °C in a well-stoppered glass bottle.

The solution is stable for at least 3 months.

A.3.2 Control solution, for use.

Dilute the stock control solution (A.3.1) tentatively to a colour in the range of the test samples. The exact colour of the control solution used is determined in accordance with method B, C or D. Only freshly made solutions shall be used. The exact colour of the control solution is not important, since the purpose of measuring at least one control solution in each series of test samples is quality control and assessment of precision.

1) Fluka 53680 is the trade name of a product supplied by Sigma Aldrich. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Annex B
(informative)

Precision data

An interlaboratory trial was organized by the Norwegian Institute for Water Research, Oslo, in 2010-06/07. A total of 25 laboratories from the Czech Republic (1), Denmark (2), Finland (6), Germany (3), Hungary (1), Ireland (4), and Norway (8) participated in this trial. Three different water samples were analysed:

Sample A: Drinking water sample (public water supply of Oslo, Norway),

Sample B: Filtered surface water sample (high DOC),

Sample C: Synthetic sample prepared from humic acid [53680-10G[2)]].

The median value within each group of results was used as the “assigned value” because no certified value was available for these three samples.

Table B.1 — Precision data for method B, determination of true colour using optical instruments, 436 nm

Sample	Matrix	l	n	o	m	$\overline{x}$	η	s_R	$C_{V,R}$	s_r	$C_{V,r}$
				%	m^{-1}	m^{-1}	%	m^{-1}	%	m^{-1}	%
A	Drinking water	6	18	14,3	0,15	0,14	93,3	0,02	13,2	0,01	8,8
B	Filtered surface water	7	21	0	2,40	2,38	99,2	0,02	0,9	0,01	0,5
C	Synthetic sample	7	21	0	0,67	0,63	94	0,03	3,6	0,03	4,1

l	number of laboratories after outlier rejection
n	number of individual test results after outlier rejection
o	percentage of outliers and excluded results
m	median value of reported results
$\overline{x}$	overall mean of results
η	"recovery" in relation to median value
s_R	reproducibility standard deviation
$C_{V,R}$	coefficient of variation of reproducibility
s_r	repeatability standard deviation
$C_{V,r}$	coefficient of variation of repeatability

2) 53680-10G is the trade name of a product supplied by Sigma Aldrich. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.

Table B.2 — Precision data for method B, determination of true colour using optical instruments, 525 nm

Sample	Matrix	l	n	o	m	$\overline{\overline{x}}$	η	s_R	$C_{V,R}$	s_r	$C_{V,r}$
				%	m^{-1}	m^{-1}	%	m^{-1}	%	m^{-1}	%
B	Filtered surface water	6	18	0	0,74	0,76	102,7	0,03	3,2	0,01	1,9
C	Synthetic sample	5	15	20	0,30	0,26	86,7	0,02	6,7	0,02	5,9
Explanation of symbols, see Table B.1.											

Table B.3 — Precision data for method B, determination of true colour using optical instruments, 620 nm

Sample	Matrix	l	n	o	m	$\overline{\overline{x}}$	η	s_R	$C_{V,R}$	s_r	$C_{V,r}$
				%	m^{-1}	m^{-1}	%	m^{-1}	%	m^{-1}	%
B	Filtered surface water	5	15	16,7	0,21	0,29	138,1	0,02	5,4	0,02	4,9
C	Synthetic sample	5	15	16,7	0,12	0,13	108,3	0,03	12,4	0,02	18,8
Explanation of symbols, see Table B.1.											

Table B.4 — Precision data for method C, determination of true colour using optical instruments for determination of absorbance at 410 nm

Sample	Matrix	l	n	o	m	$\overline{\overline{x}}$	η	s_R	$C_{V,R}$	s_r	$C_{V,r}$
				%	mg l^{-1} Pt	mg l^{-1} Pt	%	mg l^{-1} Pt	%	mg l^{-1} Pt	%
A	Drinking water	15	45	0	4,80	4,69	97,7	0,70	14,9	0,45	9,6
B	Filtered surface water	15	45	0	70,50	70,81	100,4	0,78	1,1	0,75	1,1
C	Synthetic sample	15	45	0	15,87	15,81	99,6	1,04	6,6	0,64	4,1
Explanation of symbols, see Table B.1.											

Table B.5 — Precision data for method D, visual method for the determination of the colour in natural water, using comparator

Sample	Matrix	l	n	o	m	$\overline{\overline{x}}$	η	s_R	$C_{V,R}$	s_r	$C_{V,r}$
				%	mg l^{-1} Pt	mg l^{-1} Pt	%	mg l^{-1} Pt	%	mg l^{-1} Pt	%
A	Drinking water	7	21	12,5	5,00	4,71	94,2	1,08	16,8	0,82	9,0
B	Filtered surface water	8	24	0	68,33	68,96	100,9	2,18	3,3	1,44	2,1
C	Synthetic sample	8	24	0	15,00	15,06	100,4	1,03	6,2	1,03	2,9
Explanation of symbols, see Table B.1.											

Bibliography

[1] HAZEN, A. A new color-standard for natural waters. *Am. Chem. J*. 1892, **14**, pp. 300-310

[2] HONGVE, D., ÅKESSON, G. Spectrophotometric determination of water color in Hazen units. *Water Res*. 1996, **30**, pp. 2771-2775

[3] CROWTHER, J., EVANS, J. Estimating colour in Hazen units by spectrophotometry. *J. Am. Water Works Assoc*. 1981, **73**, pp. 265-270

[4] MACCARTHY, P., RICE, J.A. Spectroscopic methods (other than NMR) for determining functionality in humic substances. In: AIKEN, G.R., MCKNIGHT, D.M., WERSHAW, R.L., MACCARTHY, P., editors. *Humic substances in soil, sediment and water*, pp. 527-559. New York, NY: Wiley-Interscience,1985

[5] IEC/CIE Publication No. 17.4:1987, *International lighting vocabulary*[3)]

[6] ISO 8245:1999, *Water quality — Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC)*

3) Technically identical to IEC 60050-845:1987, *International Electrotechnical Vocabulary — Lighting*

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™