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Water quality — Determination of turbidity —

Part 2: Semi-quantitative methods for the assessment of transparency of waters

Qualité de l'eau — Détermination de la turbidité —

Partie 2: Méthodes semi-quantitatives pour l'évaluation de la transparence des eaux

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 147, *Water quality*, Subcommittee SC 2, *Physical, chemical and biochemical methods*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This first edition of ISO 7027-2, together with ISO 7027-1:2016, cancels and replaces ISO 7027:1999, which has been technically revised.

A list of all parts in the ISO 7027 series can be found on the ISO website.

Introduction

Turbidity in waters is caused by the presence of undissolved and/or colloidal matter and small organisms (for example bacteria, phyto- and zooplankton) present in the water. Turbidity changes the lighting conditions in surface waters by absorption and scattering of the light and thus influences the trophic status of these waters. For the indicative assessment of the lighting conditions of waters or the transparency of the water, semi-quantitative methods can be used (Reference [2]).

Measurements of transparency can be affected by the presence of dissolved light-absorbing substances (substances imparting colour) as well as by particles (such as sediments).

In semi-quantitative methods such as the determination of transparency depth by Secchi disc, reflections on the water surface can cause interferences. These are often dependent on the light and wind conditions.

NOTE Results of a field study for the validation of this document is given in Annex B.

Water quality — Determination of turbidity —

Part 2: Semi-quantitative methods for the assessment of transparency of waters

WARNING — Working in or around water is inherently dangerous. Persons using this document should be familiar with normal laboratory practice. This document 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.

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

1 Scope

This document specifies the following semi-quantitative methods for the assessment of transparency of waters:

a) measurement of visual range using the transparency testing tube (applicable to transparent and slightly cloudy water), see Clause 4;

b) measurement of visual range in the upper water layers using the transparency testing disc (especially applicable to surface, bathing water, waste water and often used in marine monitoring), see 5.1;

c) measurement of visibility by divers in a destined depth, see 5.2.

NOTE The quantitative methods using optical turbidimeters or nephelometers are described in ISO 7027-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including amendments) applies.

CIE S 017/E, *ILV*:*International Lighting Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CIE S 017 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org./obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
transparency
permeability with respect to electromagnetic waves, here especially of light

Note 1 to entry: In this document, transparency is used in terms of visibility in waters.

3.2
turbidity
reduction of transparency of a liquid caused by the presence of undissolved and/or colloidal matter and small organisms

3.3
attenuation coefficient
fraction of an incident beam of light that is absorbed or scattered per unit thickness of the target absorber

Note 1 to entry: A large attenuation coefficient means that the beam is quickly "attenuated" (weakened) as it passes through the medium, and a small attenuation coefficient means that the medium is relatively transparent to the beam. The SI unit of attenuation coefficient is the reciprocal metre (m^{-1}).

4 Laboratory

4.1 General

In cases where measurements cannot be carried out on site, it may be an option to do it in the laboratory with the approach described in 4.2.

4.2 Measurement using the transparency testing tube

4.2.1 Apparatus

4.2.1.1 Transparency testing tube, consisting of a colourless glass tube 600 mm ± 10 mm long and of internal diameter 25 mm ± 1 mm, graduated in divisions of 10 mm. Typically, the transparency testing tube features a hole in the bottom of the tube or a suitable outlet, allowing the water level to be lowered in the tube.

4.2.1.2 Shield, close fitting, to protect the transparency testing tube from lateral light.

4.2.1.3 Print sample, to place under the tube (4.2.1.1), consisting of black print on a white background (height of characters 3,5 mm; line width 0,35 mm) or a test mark (for example, a black cross on white paper), provided with the apparatus.

4.2.1.4 Constant light source, low voltage tungsten lamp (3 W), to illuminate the print sample or test mark (4.2.1.3).

4.2.2 Sampling and samples

All sample bottles shall be clean. If necessary, wash bottles before use with hydrochloric acid (e.g. 1 mol/l) or a surfactant cleaning solution.

Collect samples in glass or plastic bottles, and carry out the determinations as soon as possible after collection. The bottles shall be filled completely (bubble free). If storage is unavoidable, store the samples in a cool, dark room (10 ± 5) °C but for no longer than 24 h. If the samples have been stored cool, allow them to come to room temperature before measurement. Prevent contact between the sample and air, and avoid unnecessary changes in the temperature of the sample.

The transparency testing tubes should be clean and not clouded. The individual tubes should be identical in their optical properties.

4.2.3 Procedure

The sample should be mixed by hand, without creating bubbles and turbulence, and then be transferred to the transparency testing tube (4.2.1.1). Steadily lower the sample level until the print sample or test mark (4.2.1.3) is clearly recognizable as viewed from above. Read the liquid height from the graduations on the tube.

If the procedure is repeated, the mean from all replicates has to be calculated and reported as the transparency depth.

4.2.4 Expression of results

Report the measured liquid height, to the nearest 10 mm, together with the apparatus used (name of the manufacturer).

5 In situ methods (field methods)

5.1 General

The in situ methods are performed as described in 5.2 to 5.3.

5.2 Measurement using the transparency testing disc

The depth at which a matt white, circular disc (5.2.1.1) is no longer visible is taken as a measure of the transparency of surface water bodies. The readings do not provide an exact measure of transparency, as the results are influenced e.g. by sun's glare on the water, water current and/or individually different eyesight of the staff.

NOTE 1 This method was originally developed by A. Secchi (1865)[4], and modified by George C. Whipple (1899)[5], and is commonly known as Secchi depth.

NOTE 2 For assessments in connection with phytoplankton investigations, the transparency depths are normally used.

NOTE 3 In very tide-influenced coastal waters or in reservoirs with turbidity currents (e.g. from tributaries), the results in relation to phytoplankton are not very informative because the results are influenced by very high concentrations of suspended mineral matter. Humic substances can considerably reduce the transparency.

5.2.1 Apparatus

5.2.1.1 Transparency testing disc, normalized circular matt white testing disc with a density and weight that it sinks (e.g. 1,7 kg) to determine transparency depth.

This disc hangs from a measuring tape or rope (5.2.1.2) so as to be precisely horizontal. To facilitate the horizontal position of the disc, six large holes [see Figure A.1 a)] may be helpful.

For the measurement of the transparency depth, the discs shall be clean and without scratches and shall be maintained to limit the loss of their original colour.

The following diameters are recommended:

a) for inland waters: 20 cm; e.g. with six holes or black and white sectors (see A.1);

b) for marine waters: 30 cm, e.g. without holes and sectors (see A.1).

NOTE Other diameters of the discs might also be suitable, depending on the requirements of the sampling programme (e.g. disks with a diameter of 10 cm connected to Limnos water samplers, see Figure A.2).

If other types of testing discs are used, the comparability of results is not given. If for example custom made testing discs are required, it is important to ensure that within a monitoring study or period and

for the defined monitoring sites the same type of device is always to be used. Whenever possible, it is also recommended that the measurements are carried out by the same staff.

5.2.1.2 Measuring tape, with centimetre (cm) scale **or rope** with marks every 10 cm (metres and half metres can be identified by different coloured markers) or with winch depth indicator (normally of at least 10 m length, in oligotrophic waters longer).

Regularly check the accuracy of the indication length of the rope or tape measure. Compare this to a standard with a traceable length such as a tape measure or folding rule.

5.2.1.3 Pole, optional, for running waters or waters with water currents.

5.2.1.4 Weight, optional, for running waters or waters with water currents, fixed in the middle of the bottom side of the disc facilitating its insertion into the water column or allowing it to stabilize more easily in running waters or with currents.

5.2.1.5 Optional devices for suppression of reflections, for example view scopes (examples of view scopes are given in Annex A, Figure A.3).

5.2.2 Procedure

The transparency depth can be recorded most easily and reliably by looking from a small distance above the water surface into the water. It is highly recommended to use the shaded side of the boat, dock or footbridge to avoid direct sunlight reflections from the water surface. It is essential that no direct sunlight is present. The period for best results is between 10 am and 2 pm. Allow sufficient time when looking at the disc near its extinction point for the eyes to adapt completely to the prevailing luminance level.

Lower the disc (5.2.1.1) into the water and let it sink slowly. Determine the point at which the surface of the disc is just visible. If necessary, slowly move the disc several times up and down, to determine the mean of disappearance and reappearance. Ensure that the visual line is perpendicular to the water surface.

NOTE Slow movement of the disc prevents sediment from whirling.

Read the depth from the disc to the water surface from the measuring tape or rope (5.2.1.2).

If the procedure is repeated, the mean from all replicates shall be calculated and reported as the transparency depth.

The water depth should be if possible at least 50 % greater than the Secchi depth so that the disc is viewed against the water background, not bottom-reflected light (see Reference [3]).

In running waters or water bodies with water currents, an extra weight (5.2.1.4) or a pole (5.2.1.3) may be required to eliminate sway and to facilitate the measurement.

To minimize interferences arising from reflection at the water surface, a sight glass (for example view scope, see A.2) may help. With a view scope, the sunny side of the boat can be used (see Reference [3]). The user of this document shall validate and demonstrate whether the view scope enhances the analysis or not.

It should be noted that a considerable amount of light is absorbed when polarization glasses are used. This can interfere with the determination of the transparency depth.

The transparency depth depends on the following factors (see Reference [6]):

a) the attenuating material between water surface and disc;

b) the optical state of the water surface;

