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wastewater**

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law.

Consequently **JIS K 0102:2013** is replaced with this Standard.

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Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

Testing methods for industrial wastewater

1 Scope This Japanese Industrial Standard specifies the testing methods for wastewater discharged from factories (including offices, hereafter the same).

NOTES 1 For each of the test methods in this Standard which has a corresponding International Standard(s), the number of the International Standard and the symbol of degree of correspondence are shown in the respective clauses.

In the above case, where any modification has been made to the technical contents of the corresponding International Standard, the modification and its explanation are shown in the list of modifications in Annex 2.

2 Standards shown in attached table 1 contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions (including amendments) of the standards listed apply.

2 Common matters The common matters shall be as follows.

- a) **General rules** The general matters of chemical analysis shall be in accordance with **JIS K 0050**.
- b) **Definitions** For the purpose of this Standard, the terms and definitions given in **JIS K 0101**, **JIS K 0211** and **JIS K 0215** apply.
- c) **Gas chromatography** The general matters of gas chromatography shall be in accordance with **JIS K 0114**.
- d) **Absorptiometry** The general matters of absorptiometry shall be in accordance with **JIS K 0115**.
- e) **Inductively coupled plasma atomic emission spectrometry** The general matters of inductively coupled plasma atomic emission spectrometry (hereafter referred to as "ICP atomic emission spectrometry") shall be in accordance with **JIS K 0116**.
- f) **High frequency plasma mass spectrometry** The general matters of high frequency plasma mass spectrometry (hereafter referred to as "ICP mass spectrometry") shall be in accordance with **JIS K 0133**.
- g) **Infrared spectrophotometry** The general matters of infrared spectrophotometry shall be in accordance with **JIS K 0117**.
- h) **Atomic absorption spectrometry** There are a flame atomic absorption spectrometry, an electric heating type atomic absorption method (hereafter referred to as "electrothermal atomic absorption spectrometry") and other atomic absorption methods. The general matters of these methods shall be in accordance with **JIS K 0121**.

- i) **Ion-selective electrode method** The general matters of ion-selective electrode method shall be in accordance with **JIS K 0122**.
- j) **Ion chromatography** The general matters of ion chromatography shall be in accordance with **JIS K 0127**.
- k) **Flow analysis** The general matters of flow analysis shall be in accordance with **JIS K 0126**.
- l) **Determination range** The determination ranges indicated in respective test methods are expressed by the mass (mg, μg or ng) in the final solution. However, in the atomic absorption spectrometry, flame photometry, ICP atomic emission spectrometry, ICP mass spectrometry, ion chromatography, ion-selective electrode method, flow analysis, and testing methods of total organic carbon (TOC), total oxygen demand (TOD), dissolved oxygen and residual chlorine, the determination range is expressed by the concentration (mg/L or $\mu\text{g/L}$) of the final solution.

For alkylmercury (II) compounds, it shall be indicated by the concentration in sample (the concentration as mercury).

- m) **Repeatability** The repeatability shall be indicated by the approximate value of the coefficient of variation (%) obtained by performing repetitive tests using the reference solution to be used in the determination range of respective testing methods.
- n) **Water** The water to be used in this Standard shall be that of A1 to A4 specified in **JIS K 0557**. If it is otherwise specified in a particular test clause, the specification in the test clause shall be followed. Dissolved-oxygen-free water and carbon dioxide-free water shall be in accordance with the following, respectively.
 - 1) **Dissolved-oxygen-free water** (see Annex E of **JIS K 0050**) For the preparation of dissolved-oxygen-free water, use any of the methods in the following **1.1** to **1.5** or a combination of two or more thereof. Prepare this water immediately before use. When storing it, connect the flask to a gas washing bottle containing alkaline pyrogallol solution ⁽¹⁾ as shown in figure 2.1 to shield it from oxygen in air.
 - 1.1) Place water of A2 or A3 specified in **JIS K 0557** in a flask and boil it for about 5 min to expel dissolved oxygen. Connect the flask to a gas washing bottle containing alkaline pyrogallol solution ⁽¹⁾ as shown in figure 2.1, and allow it to cool while shielding oxygen in air (see NOTE 3 to clause 4 of **JIS K 0557**).
 - 1.2) Place water of A2 or A3 specified in **JIS K 0557** in a flask and expel dissolved oxygen by aerating nitrogen of Grade 2 specified in **JIS K 1107** for about 15 min (see NOTE 3 to clause 4 of **JIS K 0557**).
 - 1.3) Pass water of A2 or A3 specified in **JIS K 0557** through a gas separation pipe using an oxygen separation membrane to expel dissolved oxygen.
 - 1.4) Deaerate water of A2 or A3 specified in **JIS K 0557** using an ultrasonic vibration apparatus to expel dissolved oxygen.
 - 1.5) Take water of A2 or A3 specified in **JIS K 0557**, immediately after being refined, in an Erlenmeyer flask aerated with nitrogen of Grade 2 specified in **JIS K 1107** while taking care that water does not foam.

Note ⁽¹⁾ Dissolve 6 g of pyrogallol (1,2,3-benzenetriol) specified in **JIS K 8780** in 50 ml of water, and preserve it in a colored glass bottle. Separately, dissolve 30 g of potassium hydroxide specified in **JIS K 8574** in 50 ml of water. Mix the two solutions immediately before use. One milliliter of this solution can absorb about 12 ml (about 17 mg) of oxygen.

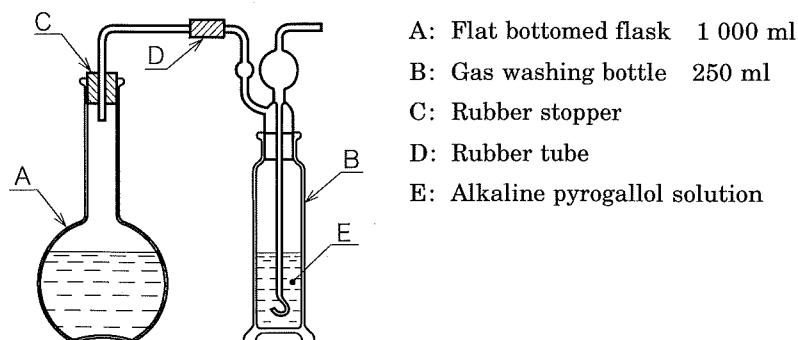


Figure 2.1 Example of cooling and preservation of dissolved-oxygen-free water

2) **Carbon dioxide-free water** (see Annex E of **JIS K 0050**) For the preparation of carbon dioxide-free water, use any of the methods in the following 2.1) to 2.4) or a combination of two or more thereof. Prepare this water immediately before use. When storing it, use the apparatus as shown in figure 2.1, and put potassium hydroxide solution (250 g/L) (which is prepared using potassium hydroxide specified in **JIS K 8574**) or soda lime for carbon dioxide absorption of No. 1 specified in **JIS K 8603** in the gas washing bottle to shield it from carbon dioxide in air.

2.1) Place water of A2 or A3 specified in **JIS K 0557** in a flask, and boil for about 5 min to expel dissolved gas and carbon dioxide. Use the apparatus as shown in figure 2.1, and put potassium hydroxide solution (250 g/L) or soda lime for carbon dioxide absorption of No. 1 specified in **JIS K 8603** in the gas washing bottle to shield it from carbon dioxide in air and allow to cool (see NOTE 4 to clause 4 of **JIS K 0557**).

2.2) Perform the procedure in 1.2) to expel carbon dioxide.

2.3) Pass water of A2 or A3 specified in **JIS K 0557** through a gas separation pipe using an carbon dioxide separation membrane to expel carbon dioxide.

2.4) Perform the procedure in 1.4) to expel carbon dioxide.

o) **Reagents**

1) The reagents used shall be those specified in Japanese Industrial Standards (hereafter referred to as “**JIS**”) and shall give no hindrance to test. When there is no specification in **JIS**, the reagents giving no hindrance to test shall be used ⁽²⁾.

For the standardization of titrants, the reference material for volumetric analysis specified in **JIS K 8005**, if any, shall be used.

Note (2) In the tests using a very small quantity of reagents such as electrothermal atomic absorption spectrometry or ICP mass spectrometry, the highest purity reagents shall be used.

- 2) For reference solutions, as well as those prepared according to the method specified in each test item, either the reference solutions with traceability ensured to meet the National Metrological Standard (Article 134 of the Measurement Act) or these solutions diluted to a definite concentration shall be used (3).

Note (3) It shall be ensured that the type and concentration of chemical compounds used for the preparation of these solutions or acids added to them would not impair the test results.

Information : Representative traceability-ensured reagents are those bearing a JCSS (Japan Calibration Service System) mark.

- 3) The concentration of the reagent solutions, unless otherwise specified, are expressed by g/L or mg/L in the case of mass concentration, and by mol/L or mmol/L in the case of mol concentration.

The mass of compound is indicated in parentheses attached after the name, using value of the mass of anhydride.

The concentration of reference solution is expressed by mass in 1 ml (mg/ml, µg/ml or ng/ml), except for the concentration of chloride reference solution used in residual chloride measurement and those of the reference solutions used in ion-selective electrode method and flame photometry, which is expressed by mass in 1 L (mg/L).

- 4) The concentration indicated in parentheses following the name of the solution of reagents, except for a reference solution, is an approximate value. For example, sodium hydroxide solution (0.1 mol/L) indicates that the sodium hydroxide solution is approximately 0.1 mol/L in concentration. Further, the concentration of the liquid reagent is indicated by [Reagent (a + b)]. This expression indicates that *a* ml of the reagent and *b* ml of water is mixed.

The concentration indicated before the name of the solution is an exact value. It is generally expressed with a whole number, and a factor is separately determined.

- 5) The water employed for the preparation of reagents shall be the water specified in **n**).
- 6) For preparing a low-concentrated reference solution by diluting a reference solution, unless otherwise specified, a transfer pipet of 10 ml or more capacity shall be used.
- 7) The designations of reagents are, as much as possible, in accordance with the nomenclature of compounds specified by the Chemical Society of Japan based on the inorganic chemicals nomenclature and organic chemicals nomenclature of the International Union of Pure and Applied Chemistry (IUPAC), and the designation of reagents specified in **JIS**.

- 8) Care shall be taken against room contamination, inhalation, adherence to human body, of reagents and wastewater. The handling of them shall follow the related laws and regulations.
- p) **Implements** Glassware, porcelain crucible, porcelain basin, platinum crucible, platinum dish and filter paper to be used in this Standard shall be as follows:
- 1) Glassware as given in **JIS R 3503** and **JIS R 3505** shall be used, unless otherwise specified. Where a special implement is needed, it is exemplified or explained in each clause where it is to be applied. If the heating procedure is involved, glassware made of borosilicate glass-1 specified in **JIS R 3503** shall be used.

The desiccant put in a desiccator, unless otherwise specified, shall be the silicagel desiccant for packaging of Type A Class 1 specified in **JIS Z 0701**.
 - 2) The porcelain crucible and porcelain basin specified in **JIS R 1301** and **JIS R 1302**, respectively, shall be used.
 - 3) The platinum crucible and platinum dish specified in **JIS H 6201** and **JIS H 6202**, respectively, shall be used.
 - 4) The filter paper for quantitative analysis specified in **JIS P 3801** shall be used. The type of filter paper to be used, however, is specified in each test clause.
- NOTE : When testing silica, boron, sodium, potassium, arsenic, zinc, and so on, sufficient care should be taken on elution of these elements from borosilicate glass.
- q) **Washing of glassware, etc.** For all of the glassware, porcelain crucibles, and porcelain basins used in this Standard, the following washing shall be carried out prior to test. If otherwise specified in a particular test clause, the specification shall be followed.
- 1) When the glassware is to be used in the test of metallic element, wash it with water of A2 and then immerse it in nitric acid (1.5 mol/L) (prepared by using the nitric acid specified in **JIS K 8541**) or hydrochloric acid (1.5 mol/L) (prepared by using the hydrochloric acid specified in **JIS K 8180**) for 1 day or longer, wash it with water of A2 again and then with water of A3.
 - 2) When the glassware is to be used in the test of other than metallic elements, wash it with water of A2 and then with water of A3.
- r) **Measurement of absorbance (absorptiometry)** Unless otherwise stated, absorption cell having a 10 mm optical path length shall be used.
- s) **Working curve [absorptiometry, atomic absorption spectrometry, flame photometry, ICP atomic emission spectrometry, ICP mass spectrometry, ion chromatography, ion-selective electrode method, total organic carbon (TOC), total oxygen demand (TOD), thermal decomposition method of total nitrogen and flow analysis]** When establishing a working curve, the determination range shown in the test method shall be divided into four steps to six steps, and reference solutions are prepared accordingly. If otherwise specified in the individual test clauses, the specification shall be followed.

The working curve covering the specified range of determination shall be prepared.

In atomic absorption spectrometry, flame photometry, ICP atomic emission spectrometry, ICP mass spectrometry, ion chromatography, ion-selective electrode method, total organic carbon (TOC), total oxygen demand (TOD), thermal decomposition method of total nitrogen and flow analysis, the working curve which has been newly prepared for the test shall be used, and when the test of the same test item is repeated successively on several samples, the indicated concentration value shall be confirmed by using a reference solution, as appropriate, during test.

In the case of absorptiometry, the working curve prepared beforehand may be used.

- t) **Note, NOTE, figure, table and formula** These are serially numbered within each test clause.
- u) **Management of quality of test results** In order to manage the quality of test results, the accuracy (trueness and precision) of measured values should be periodically evaluated using the reference materials with guaranteed traceability in each test method or the reference solutions for working curves that are prepared using such materials. When there are no reference materials with guaranteed traceability, the reference materials and reference solutions for working curves that are used in each test method shall be used. Furthermore, the accuracy of the measured value should be periodically evaluated by the addition recovery test etc. using these reference materials and reference solutions for working curves.

3 Sample

3.1 Sampling, sample container, water sampler and sampling procedure For the purpose of this Standard, sample is the water that is collected for testing. Sampling, sample container, water sampler, and sampling procedure shall be in accordance with **JIS K 0094**.

3.2 Handling of sample Determination, unless otherwise specified, shall be carried out on the whole amount contained in the sample. Therefore, when the sample contains suspended matter, it shall be agitated sufficiently until it is brought to a uniform state, and then collected for the test. When testing anion, however, unless otherwise specified, filtrated sample shall be used. Determination of the whole amount, if applicable, shall be as specified in each test clause.

Where the target component to be determined is in dissolved state, filter the sample through a filter paper of Class 5 C ⁽¹⁾ immediately after sampling, and after discarding the initial filtrate of about 50 ml, take the subsequent filtrate as a sample.

Note ⁽¹⁾ Alternatively, filter paper of Class 6 or the filter material with 1 µm or less pore diameter may be used. However, for the test of dissolved manganese and dissolved iron, the filter paper of Class 5 C shall be used. If other filtration method is indicated, the indicated method shall be followed.

3.3 Storage of sample Carry out the test, unless otherwise specified, immediately after sampling. Where this is impracticable, sample shall be preserved in accordance with clause 7 of **JIS K 0094**, and used as soon as possible. When storing in a cold place at a temperature in the vicinity of 0 °C, take care not to freeze it. If the storing procedure is specified in the particular test clause, follow the specification.

a) **Reagents** The following reagents shall be used.

- 1) **Hydrochloric acid**, specified in **JIS K 8180**.
- 2) **Hydrochloric acid (for arsenic analysis)**, specified in **JIS K 8180**.
- 3) **Nitric acid**, specified in **JIS K 8541**.
- 4) **Sulfuric acid**, specified in **JIS K 8951**.
- 5) **Phosphoric acid**, specified in **JIS K 9005**.
- 6) **L(+)-Ascorbic acid**, specified in **JIS K 9502**.
- 7) **Sodium hydroxide solution (200 g/L)** Dissolve 20 g of sodium hydroxide specified in **JIS K 8576** in water to make total 100 ml.
- 8) **Suspension of basic zinc carbonate** Dissolve 20 g of zinc sulfate heptahydrate specified in **JIS K 8953** in 100 ml of water, and mix it with the same volume of sodium carbonate solution (100 g/L) (prepared by using the sodium carbonate specified in **JIS K 8625**). Prepare this solution immediately before use.
- 9) **Copper (II) sulfate pentahydrate**, specified in **JIS K 8983**.
- 10) **Chloroform**, specified in **JIS K 8322**.

b) **Treatment for storage** Treatment of sample for storage shall be carried out as follows.

- 1) The test sample for oxygen demand by potassium permanganate at 100 °C (COD_{Mn}), oxygen demand by alkaline potassium permanganate (COD_{OH}), oxygen demand by potassium dichromate (COD_{Cr}), biochemical oxygen demand (BOD), total organic carbon (TOC), total oxygen demand (TOD), and surfactant shall be stored in a dark place at 0 °C to 10 °C.
- 2) The test sample for ammonium ion, organic nitrogen, and total nitrogen shall have its pH adjusted to 2 to 3 by addition of hydrochloric acid or sulfuric acid before it is stored in a dark place at 0 °C to 10 °C. If the storage is to be only for a short period, the said treatment for storage may be omitted.
- 3) To the test sample for nitrite ion and nitrate ion, about 5 ml of chloroform per 1 L of the sample shall be added before it is stored in a dark place at 0 °C to 10 °C. If the storage is to be only for a short period, the said treatment for storage may be omitted.
- 4) The test sample for iodide ion and bromide ion shall have its pH adjusted to about 10 by addition of sodium hydroxide solution (200 g/L) before storage. (Alternatively, it may be addition of two to four granules of sodium hydroxide per 1 L of sample).

- 5) The test sample for cyanide and sulfide ion shall have its pH adjusted to about 12 by addition of sodium hydroxide solution (200 g/L) before storage. (Alternatively, it may be addition of four to six granules of sodium hydroxide per 1 L of sample). If oxidative substance such as residual chlorine coexists in the sample for cyanide test, the pH of the sample shall be controlled to approximately 12 after being reduced with L(+)-ascorbic acid.

The test sample for sulfide ion may be treated as follows: take sample in a measuring bottle for dissolved oxygen, add about 2 ml of basic zinc carbonate suspension per 100 ml of sample, and fix the sulfide as zinc sulfide for storage (see NOTE 2 to clause 39).

- 6) The test sample for phenols shall have its pH adjusted to about 4 by addition of phosphoric acid, and after addition 1 g of copper (II) sulfate pentahydrate per 1 L of sample and shaking, shall be stored in a dark place at 0 °C to 10 °C.
- 7) To the test sample for pesticides [parathion, methyl parathion, EPN, pentachlorophenol, and ediphenphos (EDDP)], hydrochloric acid shall be added to make it weak acidic, before storage.
- 8) To the test sample used for phosphorus compound and total phosphorus, about 5 ml of chloroform shall be added per 1 L of sample before it is stored in a dark place at 0 °C to 10 °C. If the storage is to be only for a short period, the said preservation treatment may be omitted. The test sample used for dissolved phosphorus compound shall be filtered according to 3.2, and after addition of about 5 ml of chloroform per 1 L of sample, preserved in a dark place at 0 °C to 10 °C. If the storage is to be only for a short period, the said treatment for storage may be omitted.

The test sample used for total phosphorus may have its pH adjusted to about 2 by addition of sulfuric acid or nitric acid before preservation.

- 9) The test sample for metallic elements such as copper, zinc, lead, cadmium, manganese, iron, aluminium, nickel, cobalt, arsenic, antimony, tin, bismuth, chromium, mercury, selenium, molybdenum, tungsten and vanadium shall have its pH adjusted to about 1 by addition of nitric acid before it is stored.

The test sample for arsenic, antimony and selenium tests, which does not contain organic matter or a large amount of nitrate or nitrite ion, and which, therefore, is not to be pretreated with sulfuric acid and nitric acid, or nitric acid and potassium permanganate in testing, shall have its pH adjusted to about 1 by addition of hydrochloric acid (for arsenic analysis) before it is stored.

The test sample for chromium (VI) shall be stored in a dark place at 0 °C to 10 °C as it is.

The test sample for dissolved metal element shall be filtrated according to 3.2, and have its pH adjusted to about 1 by addition of nitric acid, before it is stored.

4 Flow rate The measurement of flow rate shall conform to clause 8 of JIS K 0094.

5 Pretreatment of sample The pretreatment of sample shall be as specified in respective test clauses. The pretreatment procedures for tests of metal elements, however, since they are nearly common to all metal elements irrespective of the type, shall be gathered together in the following. However, for the tests of metal elements such as sodium, potassium, calcium, magnesium, arsenic, chromium (VI), mercury, dissolved manganese and dissolved iron, the pretreatment specified in the respective test clauses shall be applied.

The pretreatment for the test of metal elements is mainly intended to decompose organic matter, suspended matter, or metal complexes which may coexist with them.

The pretreatment is generally carried out by heating the sample after adding various acids, but depending on the condition of the sample and the type of the test, other suitable method may be selected.

5.1 Boiling with hydrochloric acid or nitric acid This method is applicable to samples containing an extremely small amount of organic matter or suspended matter.

a) **Reagents** The following reagents shall be used.

- 1) **Hydrochloric acid**, specified in **JIS K 8180**.
- 2) **Nitric acid**, specified in **JIS K 8541**.

b) **Procedure** The test procedure shall be as follows.

- 1) To the sample ⁽¹⁾, add 5 ml of hydrochloric acid or 5 ml of nitric acid per 100 ml of the sample.
- 2) Heat it to gently boil for about 10 min.
- 3) After allowing to cool, if necessary, add water to obtain a specified amount.

Note ⁽¹⁾ When testing a metal element in dissolved condition, use the sample filtrated according to **3.2**.

5.2 Decomposition by hydrochloric acid or nitric acid This method is applicable to samples containing a small amount of organic matter, and suspended matter of hydroxide, oxide, sulfide, phosphate, etc.

a) **Reagents** The following reagents shall be used.

- 1) **Hydrochloric acid**, specified in **JIS K 8180**.
- 2) **Nitric acid**, specified in **JIS K 8541**.

b) **Procedure** The test procedure shall be as follows.

- 1) Shake the sample ⁽²⁾ well, immediately put it in a beaker, and add 5 ml of hydrochloric acid or 5 ml of nitric acid per 100 ml of the sample.
- 2) Heat to concentrate to the volume of about 15 ml.
- 3) When undissolved residue is found, filtrate it through filter paper of Class 5 B, and wash it sufficiently with water.
- 4) After allowing to cool, transfer the filtrate and washings into a volumetric flask of a suitable capacity, and dilute to the mark with water.

Note ⁽²⁾ In the case of testing metal element in dissolved condition, use the sample filtrated according to **3.2**, and apply the method in **5.1**.

NOTE : When the decomposition by mixed acid of hydrochloric acid and nitric acid is favorable for the sample, carry out the procedure up to **2)**, and allow to cool to room temperature. Add 5 ml of nitric acid if hydrochloric acid has been used in **1)** and add 5 ml of hydrochloric acid if nitric acid has been used in **1)**, cover with a watch glass, heat again, and when the violent reaction has subsided, remove the watch glass and heat further to expel nitrogen oxides and condense to a volume of about 5 ml. When this operation shows a shortage of acid, add suitable amount of hydrochloric acid or nitric acid, and carry out similar operations to dissolve it. When undissolved residue is found, add 15 ml of warm water, and carry out the procedures in **3)** and **4)**.

5.3 Decomposition by nitric acid and perchloric acid This method is applicable to samples containing organic matter difficult to be oxidized.

a) **Reagents** The following reagents shall be used.

- 1) **Perchloric acid**, specified in **JIS K 8223**.
- 2) **Nitric acid**, specified in **JIS K 8541**.

b) **Procedure** The test procedure shall be as follows.

- 1) Shake the sample ⁽²⁾ well, and immediately take a suitable amount of it in a beaker or a porcelain basin.
- 2) Add 5 ml to 10 ml of nitric acid, heat gently on a heating plate until condensed to the volume of about 10 ml ⁽³⁾, and allow to cool.
- 3) Add 5 ml of nitric acid, and then add 10 ml of perchloric acid ⁽⁴⁾ little by little and continue heating. When white fume of perchloric acid begins to form, cover the vessel with a watch glass, and decompose organic matter while keeping the perchloric acid flowing down the inside wall of the vessel.
- 4) When some organic matter is left undissolved, add further 5 ml of nitric acid, and repeat the procedure in **3)**.
- 5) After allowing to cool, dilute with water to make about 50 ml. If the undissolved residue is found, filtrate it through a filter paper of Class 5 B, wash it with water, transfer the filtrate and washings into a suitable volumetric flask, and dilute to the mark with water.

Notes ⁽³⁾ A Kjeldahl flask may be used for decomposition.

- ⁽⁴⁾ The thermal decomposition using perchloric acid, for some types of samples, may include a risk of explosion, and the following shall be noted.
- Oxidizable organic matter shall be decomposed sufficiently according to the procedure of **2)** prior to addition of perchloric acid.
 - Perchloric acid shall be added only after the concentrated solution is cooled.

- The thermal decomposition shall be carried out under the state where perchloric acid is coexisting with nitric acid.
- The concentrated solution shall not be made dryness.

5.4 Decomposition by nitric acid and sulfuric acid This method is applicable ⁽⁵⁾ to various types of sample.

a) **Reagents** The following reagents shall be used.

- 1) **Nitric acid**, specified in **JIS K 8541**.
- 2) **Sulfuric acid (1+1)** Take 1 volume of water in a beaker, cool it, and add gradually 1 volume of sulfuric acid specified in **JIS K 8951** while stirring.

b) **Procedure** The test procedure shall be as follows.

- 1) Shake the sample ⁽²⁾ well, immediately take a suitable amount of it in a beaker or a porcelain basin, and add 5 ml to 10 ml of nitric acid.
- 2) Heat until the liquid volume has reduced to about 10 ml ⁽³⁾. Add again 5 ml of nitric acid and 10 ml of sulfuric acid (1+1), and heat until white fumes of sulfuric acid form and organic matter is decomposed.
- 3) If decomposition of organic matter is difficult, add further 10 ml of nitric acid and repeat the procedure in 2).
- 4) After allowing to cool, dilute with water to make about 50 ml. If the undissolved residue ⁽⁶⁾ is found, filtrate it through a filter paper of Class 5 B, wash it with water, transfer the filtrate and washings into a suitable volumetric flask, and dilute to the mark with water.

Notes ⁽⁵⁾ This method is not preferable for the flame atomic absorption spectrometry, in which water solution is sprayed as it is.

- ⁽⁶⁾ In the case where undissolved residue contains lead and precipitation is generated, either the procedure in 5.3 or the following shall be performed.

After performing the procedure in 2), evaporate the solution to near dryness. Add about 30 ml of water and 15 ml of hydrochloric acid specified in **JIS K 8180**, and heat to dissolve. When undissolved matter is found, filtrate it through filter paper of Class 5 B, and wash it with warm hydrochloric acid (1+10) (prepared by using hydrochloric acid specified in **JIS K 8180**). After allowing to cool, transfer the filtrate and washings into a suitable volumetric flask, and add water up to the mark.

5.5 Pretreatment when applying flame atomic absorption spectrometry, electrothermal atomic absorption spectrometry, ICP atomic emission spectrometry or ICP mass spectrometry Pretreat the sample with the most suitable procedure chosen from among those described in 5.1 to 5.4, with careful considerations regarding such as the amount of organic matter and suspended matter in the sample, their existing condition, and the method to be applied such as atomic absorption spectrometry, ICP atomic emission spectrometry or ICP mass spectrometry ⁽⁷⁾ ⁽⁸⁾.

When carrying out the flame atomic absorption spectrometry or ICP atomic emission spectrometry in which prepared sample is directly sprayed as it is, unless otherwise specified, the sample shall be made acidic by hydrochloric acid or nitric acid ⁽⁹⁾, and when carrying out the electrothermal atomic absorption spectrometry and ICP mass spectrometry, the sample shall be made acidic by nitric acid, and then its concentration controlled to be suitable ⁽¹⁰⁾.

Notes ⁽⁷⁾ The pretreatment for solvent-extract method, which is carried out prior to flame atomic absorption spectrometry or ICP atomic emission spectrometry, unless otherwise specified, shall be as shown in each clause, and potentially interfering organic matter or other interfering substance shall be completely decomposed.

When carrying out the flame atomic absorption spectrometry or ICP atomic emission spectrometry without performing the solvent-extract method prior to spraying, the following pretreatment may be applied.

When the sample contains an extremely small amount of organic matter or suspended matter, perform the procedure in 5.1. As most typically applied procedures for the sample containing organic matter or suspended matter, perform one of the pretreatment procedures in 5.3 or 5.4. In this case, eliminate most of the sulfuric acid or perchloric acid by allowing sufficient generation of white fumes.

In the case of electrothermal atomic absorption spectrometry and ICP mass spectrometry, for some types and concentration of acid, the value of the blank test cannot be ignored. Therefore, in advance, examine the influence of the acid on the element to be measured.

Selection of the most suitable pretreatment procedure should be based on the results of a recovery test conducted by adding a specified amount of target component to the sample.

- ⁽⁸⁾ Follow Note ⁽²⁾ to clause 2. Highly purified reagents include highly purified nitric acid specified in **JIS K 9901**, highly purified hydrochloric acid specified in **JIS K 9902**, highly purified perchloric acid specified in **JIS K 9904**, highly purified sulfuric acid specified in **JIS K 9905** and so on.
- ⁽⁹⁾ In the case of ICP atomic emission spectrometry, the procedure in 5.4 should be applied only when unavoidable since in acidification by sulfuric acid, sample introduction amount may be limited, which may lead to a poor sensitivity.
- ⁽¹⁰⁾ In the case of flame atomic absorption spectrometry and electrothermal atomic absorption spectrometry, it shall be 0.1 mol/L to 1 mol/L, and in the case of ICP atomic emission spectrometry and ICP mass spectrometry, it shall be 0.1 mol/L to 0.5 mol/L except when tin or antimony is the target element. When tin or antimony is targeted, it shall be 1 mol/L to 1.5 mol/L. In any case, however, it shall be of approximately the same concentration as at the time of preparation of the working curve.

6 Expression of results When two or more test methods are applicable, all of the test methods used shall be reported.

7 Temperature The atmospheric temperature and the water temperature are both measured at the time of sampling.

7.1 Atmospheric temperature The atmospheric temperature shall be measured as follows.

a) **Implement** The following implement shall be used.

- 1) **Thermometer**, of 50 °C, which is a glass thermometer for general specified in **JIS B 7411-1**.

b) **Procedure** The test procedure shall be as follows.

- 1) In the sampling site, find a well-ventilated place without direct sunshine or any strong ambient thermal radiation, and hold the thermometer at a position 1.2 m to 1.5 m above the ground and read the scale when the temperature-sensitive liquid stops moving.

NOTE 1 To measure the maximum and minimum temperatures during measuring period, use the maximum and minimum thermometer (see figure 7.1).

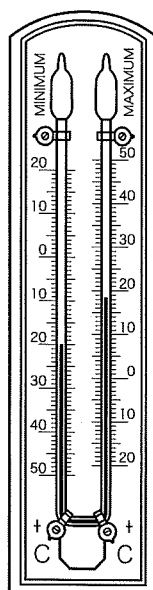


Figure 7.1 Example of maximum and minimum thermometer

7.2 Water temperature The water temperature shall be measured as follows.

a) **Implement** The following implement shall be used.

- 1) **Thermometer**, of 50 °C or 100 °C, which is a glass thermometer for general specified in **JIS B 7411-1**.

b) **Procedure** The test procedure shall be as follows.

- 1) Immerse the thermometer directly in the water at the site or in the sample⁽¹⁾ immediately after being collected, down to an approximate position of the graduation line around which the temperature sensitive liquid stops. Read the scale when the temperature sensitive liquid has stopped.

Note ⁽¹⁾ Take sufficient amount of sample to avoid the effects by the container and atmospheric temperature.

NOTES 2 When using a Pettenkofer water thermometer (see figure 7.2), throw a water thermometer into the water at the site to draw up the sample, and after replacing the sample in the metal cylinder with new draw of sample three times, fill the cylinder with the sample. Read the scale when the temperature sensitive liquid has stopped.

3 In the case of a thermistor thermometer or metal-resistance thermometer, keep the temperature detector in the water to be measured, and read the scale when the pointer of the indicator has become stable.

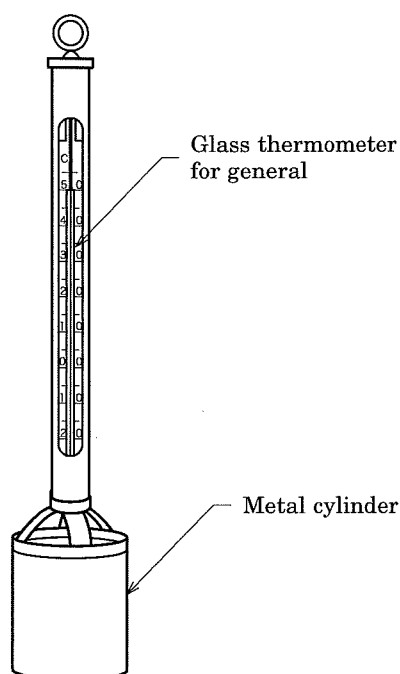


Figure 7.2 Pettenkofer water thermometer

8 Appearance The appearance of a sample is observed immediately after sampling.

a) **Implement** The following implement shall be used.

1) **Beaker**, of 300 ml to 500 ml (colorless).

b) **Procedure** The test procedure shall be as follows.

1) Place the sample in a beaker immediately after collection, and observe the sample on the following items with the naked eye.

- Type and degree of color of the whole sample
- Type and degree of color of supernatant
- Type of color and degree of quantity of floating matter, suspended matter, etc.
- State and degree of oils, tars, etc.
- Other particularities of the sample such as bubbles and odors

9 Transparency The transparency means the clarity of the sample and is measured as follows: Place the sample in a transparency meter, and observe it from above. Note the depth of water when the double cross on the mark plate placed on the bottom of the meter becomes clearly visible. Express the result in degrees, with one degree being equal to 10 mm.

The method specified in NOTE 2 is in consistency with the second edition of **ISO 7027** published in 1990.

NOTE : The corresponding International Standard relevant to this test method is as follows.

The symbols which denote the degree of correspondence in the contents between the corresponding International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

ISO 7027:1990 *Water quality—Determination of turbidity* (MOD)

Measuring range: 1 degree to 30 degrees

a) **Implement** The following implement shall be used.

- 1) **Transparency meter**, as shown in figure 9.1. This meter consists of a glass cylinder with a lower opening, of which the scale is graduated in 5 mm up to 50 mm height from the mark plate, and in 10 mm from 50 mm to 300 mm height. It shall be used with the mark plate as shown in figure 9.2 placed on its bottom.

b) **Procedure** The test procedure shall be as follows.

- 1) Fill the transparency meter with the sample which has been shaken well, observe its bottom from above while letting the sample flow out quickly from the bottom opening ⁽¹⁾ by loosening the pinch cock of the rubber tube, and read the scale at the water level just when the double cross on the mark plate becomes clearly visible.
- 2) Repeat the procedure in 1) two or three times and note the respective scale readings at the water level. Calculate the average of these readings, and record it as the degree of transparency.

Note ⁽¹⁾ Care should be exercised if the sample contains much suspended matter, since it may make sediment at the bottom of the transparency meter and cause error in measurement.

NOTE 1 The transparency is affected by the light source; using different light sources, even if they are identical in the illuminance, result in different chromas, and thus in different transparencies. The light source used for this measurement is daylight, which excludes direct sunlight.

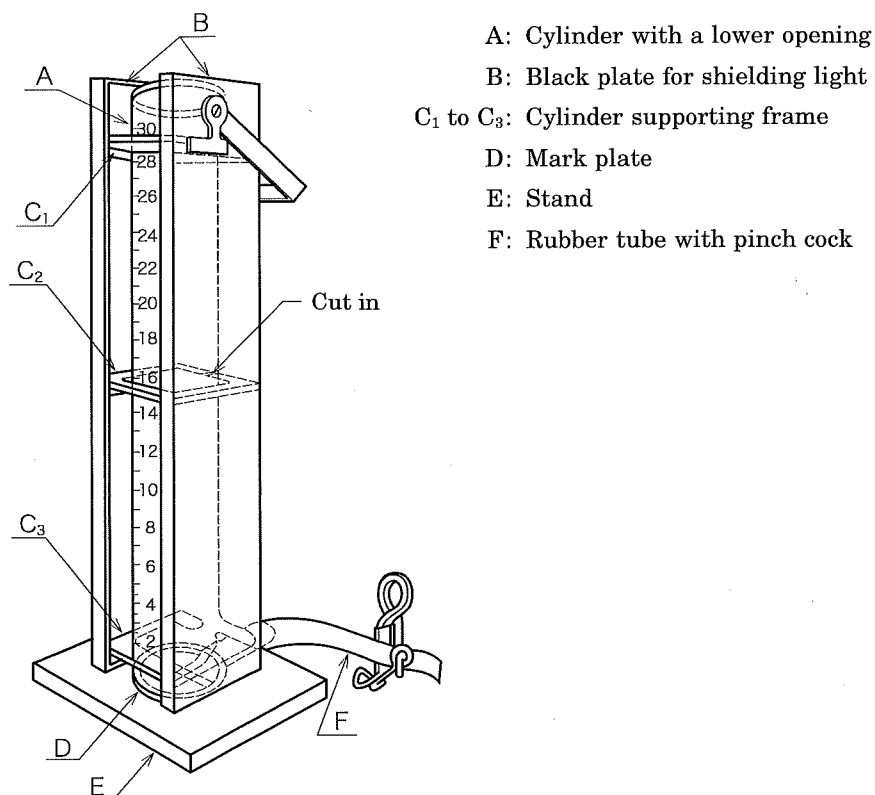


Figure 9.1 Example of transparency meter

Unit: mm

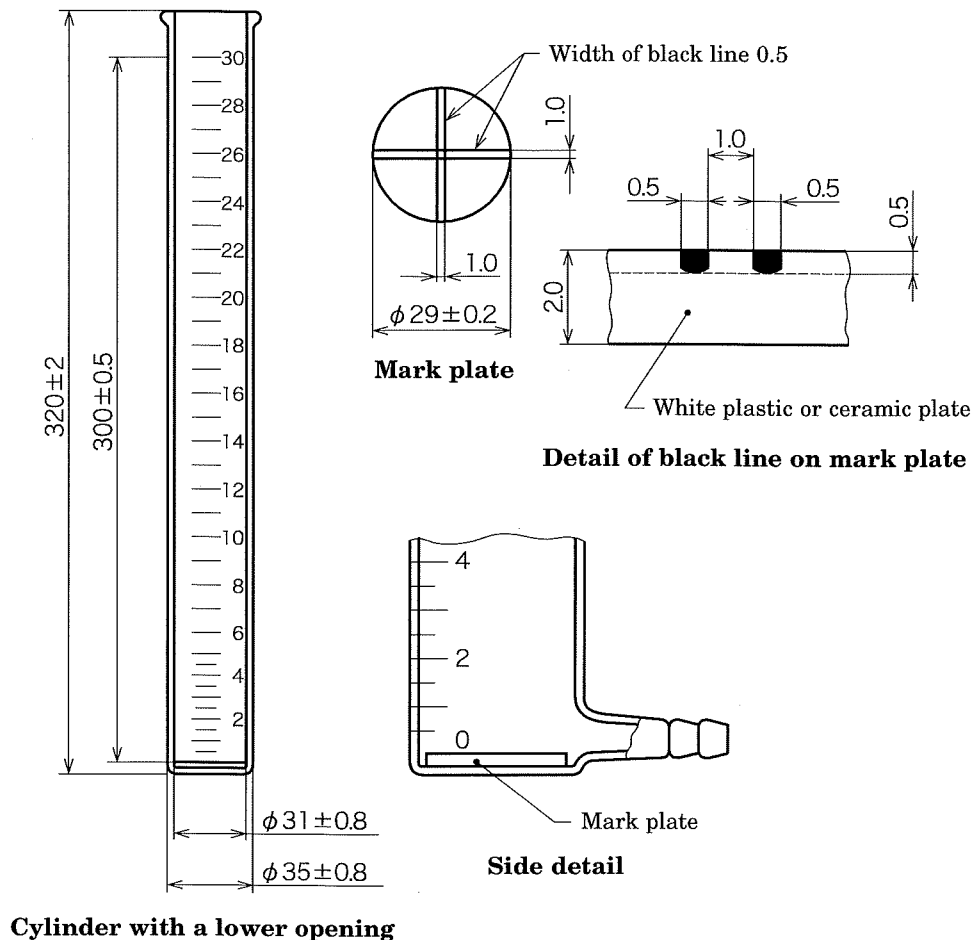


Figure 9.2 Details of transparency meter

NOTE 2 In addition to the cylinder with a lower opening as shown in figure 9.2, the cylinders 600 mm $\pm$ 10 mm in length, 25 mm $\pm$ 1 mm in inside diameter and graduated in 10 mm may be used.

Information : Cylinders made of acrylic resin or those 1 m in length are also available on the market.

10 Odor and threshold odor number (TON) The tests of odor are classified into the detection of odor and determination of the threshold odor number (TON) ⁽¹⁾.

The odors of water are caused by such as: propagation and extinction of bacteria, algae, microorganism, etc.; mixing-in of municipal sewage, cattle shed drainage, and industrial wastewater; elution of inner-treated substances of water-storage tank and piping system; and residual chlorine after chlorine treatment.

Since the test of odor is dependant on the personal sense of smell, the results can vary between individuals, and furthermore can be affected by the temperature and humidity, and the type of meal and smoking habit of the inspector.

Note ⁽¹⁾ TON stands for Threshold Odor Number, which is the dilution factor at the threshold value of odor, that is, a multiple of dilution by which the odor can be clearly sensed.

10.1 Odor The type and degree of odor shall be tested when the sample is warmed to about 40 °C.

a) **Implement** The following implement shall be used.

1) **Erlenmeyer flask with a ground stopper**, of 300 ml.

b) **Procedure** The test procedure shall be as follows.

- 1) Place 200 ml of sample in a 300-ml Erlenmeyer flask with a ground stopper, and warm to about 40 °C after loosely applying a stopper.
- 2) While swirling the flask, remove the stopper, and immediately test for the existence of odor and its type and degree.
- 3) Referring to table 10.1, the odor of sample shall be roughly identified by the type and degree of the odor.

Table 10.1 Example of classification and type of odor

Gross classification of odors	Type of odor
(1) Fragrant odor	Odors of melon, violet, garlic, cucumber, aromatics, spice, etc.
(2) Botanical odor	Odors of algae, green grass, timber, seaweed, etc.
(3) Earthy odor and moldy odor	Odors of earth, swamp, mold, etc.
(4) Fishy or shellfishy odor	Odors of fish, lever oil, clam, etc.
(5) Chemical odor in-drugstore, chemicals, etc.	Odors of phenols, tar, oil, fats, paraffin, chlorine, hydrogen sulfide, chlorophenol, in-drugstore, chemicals, etc.
(6) Metallic odor	Odors of iron, metal, etc.
(7) Putrescent odor	Odors of garbage, sewage, pigpen, putrescence, etc.
(8) Unpleasant odor	Unpleasant odors such as intensified odors of fish, pigpen, putrescence, etc.

NOTES 1 This test should be performed by more than one tester in order to minimize the error caused by the personal difference in sense of smell.

2 It is recommended to examine and record the odor of the unheated sample (odor at the time of cold) at the time of sampling.

10.2 Threshold odor number (TON) The threshold odor number (TON) is the index of the intensity of an odor, expressed by the ratio by which the odor-bearing sample has to be diluted with odor-free water at about 40 °C for the odor to be just detectable is the “threshold odor number” (dilution factor at the threshold value of odor). To minimize the error caused by personal difference in the sense of smell, one sample shall be examined by five or more, preferably ten testers.

a) **Reagent** The following reagent shall be used.

- 1) **Odor-free water** Pass water of A3 specified in **JIS K 0557** at an approximate rate of 5 L/(L-active carbon · h) through the apparatus shown in figure 10.1.

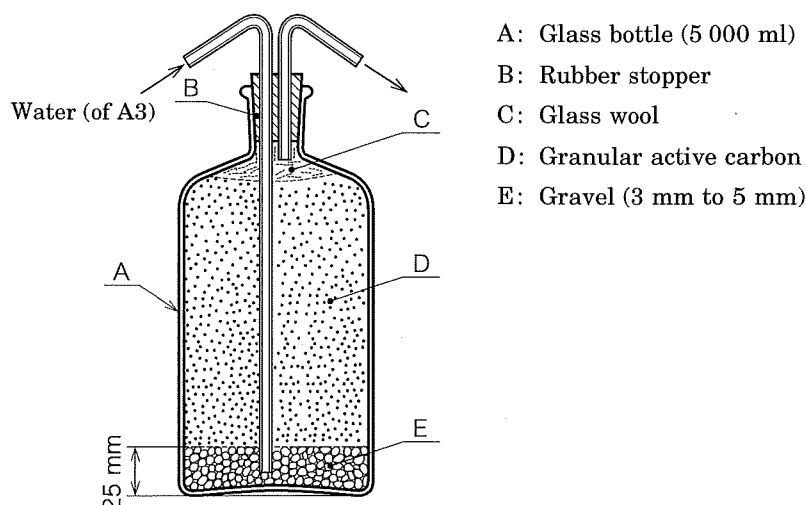


Figure 10.1 Example of method to prepare odor-free water

- b) **Implements** The following implements shall be used.
- 1) **Erlenmeyer flask with a ground stopper**, of 300 ml.
 - 2) **Buret with long stem**, of 50 ml.
 - 3) **Water bath**, equipped with a temperature controller.
- c) **Preliminary test** The preliminary test shall be carried out as follows.
- 1) Place respectively 200 ml, 40 ml, 10 ml and 4 ml of sample in 300-ml Erlenmeyer flasks with ground stoppers, and add odor-free water to each of these to make 200 ml to prepare the sample for preliminary test.
 - 2) In another 300-ml Erlenmeyer flask with a ground stopper, place 200 ml of odor-free water to use as a reference water.
 - 3) Warm the samples for preliminary test and reference water on a water bath to 40 °C to 50 °C, shake the reference water and smell the odor upon removing the stopper.
 - 4) Then, starting from the sample of the most diluted, perform procedure similar to the above and compare the odor of the sample with that of the reference water, and obtain the least amount of sample (ml) of which the odor was detected.
- d) **Procedure** The test procedure shall be as follows.
- 1) Based on the amount of sample in c) 4), determine the series of amounts of sample to be used for the test by reference to the vertical column of table 10.2.
 - 2) Put the respective amounts of sample determined in 1) into separate 300-ml Erlenmeyer flasks with ground stoppers and add odor-free water to make 200 ml to supply them as the test samples.
 - 3) Perform the procedures in c) 2) to 4) on these samples and determine the least amount of sample, in milliliters, of which the odor was detected, and calculate the threshold odor number (TON) according to the following formula:

$$TON = \frac{200}{V}$$

where, V : volume of sample used for test (ml)

Table 10.2 Volume of sample used for test

Unit: ml

Volume of sample used for the preliminary test	200	40	10	4
Volume of sample used for the test	200	40	10	4.0
	100	28.5	8.0	2.9
	67	20	6.7	2.0
	50	13.3	5.7	1.3
	40	10	4.0	1.0

- NOTES
- When the odor of sample is too strong, dilute it ten times with odor-free water prior to performing procedures of the preliminary test and the test.
 - Wash the Erlenmeyer flask with a ground stopper to be used for test sufficiently with odor-free water before using in the test.
 - Because this test is easily influenced by the ambient conditions, carry out this test in an odorless and quiet room.
 - Testers should abstain from smoking, drinking tea, having meal, and so on immediately before the test, and also make sure that their hands are free from smells of soap, lotion, perfumes, and so on.
 - After four or five successive tests, which will make the sense of smell dull, a repose of 15 min to 30 min should be taken.
 - In the case of determining the degree of odor (pO), the following formula is used:

$$pO = \frac{1}{\log 2} \times \log TON = 3.32 \times \log TON$$

11 Chromaticity For indication of the color of a sample, the method using the stimulus value and chromaticity coordinate and the method using the three wavelengths are applied.

The method using the three wavelengths is in consistency with the method given in the second edition of **ISO 7887** published in 1994.

NOTE : The corresponding International Standard relevant to this test method is as follows.

The symbols which denote the degree of correspondence in the contents between the corresponding International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

ISO 7887:1994 *Water quality—Examination and determination of colour (MOD)*

11.1 Method using stimulus value and chromaticity coordinate Using water as the contrast solution, measure the percent transmission of sample at the specified wavelength from 400 nm to 700 nm, calculate the tristimulus values (¹), X , Y , Z , and then

calculate chromaticity coordinate x , y . The color of the sample shall be expressed by chromaticity using stimulus value Y and chromaticity coordinate x , y .

Note ⁽¹⁾ The tristimulus value is based on the view that the optical nerve perceives color in three ways and the mixing ratio of the three stimuli to the optical nerve determines the color perception of the optical nerve. The tristimulus values are defined as the values obtained by totalizing percent transmissions after arranging the wavelengths giving respective stimuli into the series of X , Y and Z , at each way.

a) **Reagent** The following reagent shall be used.

- 1) **Water**, obtained by filtering the water of A3 specified in **JIS K 0557** through the filtering material with about 0.1 μm pore diameter, and then discarding the initial filtrate of about 200 ml.

b) **Apparatus** The following apparatus shall be used.

- 1) **Centrifugal separator**
- 2) **Photometer** A spectrophotometer which can use a 100-mm absorption cell and can cover the entire visible field with 10 nm or less wavelength range, or a colorimeter with performance equivalent to this.

c) **Procedure** The test procedure shall be as follows.

- 1) Remove the turbidity of the sample by either filtration through a filter paper of Class 5 C or through a filter material with pore diameter not more than 1 μm , or centrifugal separation with about 30 000 m/s^2 (approximately 3 000 g) for about 20 min.
- 2) Transfer a part of this liquid into a 100-mm absorption cell ⁽²⁾, and measure the percent transmission at each wavelength given in table 11.1 ⁽³⁾ by using water as a contrast solution.

Notes ⁽²⁾ When a 100-mm absorption cell cannot be used because of the darkness of sample, other absorption cell with a suitable optical path length shall be used.

In this case, measure the absorbance at the specified wavelength, convert this value into the absorbance given by a 100-mm absorption cell, and obtain the percent transmission from this value.

- ⁽³⁾ Table 11.1 is in accordance with attached table 5-1-1 {Weighing functions for calculating tristimulus values of X , Y , Z at wavelength interval 20 nm [400-(20)-700]} given in **JIS Z 8719**.

Table 11.1 Weighting functions, f_x, f_y, f_z for calculating tristimulus values X, Y, Z at the wavelength interval 20 nm

Wavelength λ (nm)	Standard illuminant C		
	f_x	f_y	f_z
400	0.019	-0.003	0.062
420	2.993	0.087	14.387
440	7.634	0.510	38.438
460	6.642	1.382	38.130
480	2.360	3.206	19.545
500	0.068	6.907	5.746
520	1.196	12.876	1.444
540	5.590	18.261	0.356
560	11.751	19.592	0.073
580	16.795	15.991	0.026
600	17.897	10.694	0.013
620	14.021	6.261	0.002
640	7.453	2.901	0.000
660	2.731	1.003	0.000
680	0.756	0.273	0.000
700	0.166	0.059	0.000
Total	98.072	100.000	118.225
Chromaticity coordinates	$x=0.310\ 1$	$x=0.316\ 2$	$z=0.373\ 7$

- 3) **Methods of obtaining tristimulus values and chromaticity coordinates x, y** Using the values of f_x, f_y, f_z , corresponding to the percent transmission at the specified wavelengths given in table 11.1, calculate the tristimulus values X, Y, Z and chromaticity coordinates x, y according to the following formulas:

$$X = \frac{1}{K} \sum_{400}^{700} f_x(\lambda) \cdot \tau(\lambda)$$

$$Y = \frac{1}{K} \sum_{400}^{700} f_y(\lambda) \cdot \tau(\lambda)$$

$$Z = \frac{1}{K} \sum_{400}^{700} f_z(\lambda) \cdot \tau(\lambda)$$

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

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

where, X : stimulus value X
 Y : stimulus value Y
 Z : stimulus value Z
 K : 100.000
 $f_X(\lambda)$: f_X at the wavelength λ
 $f_Y(\lambda)$: f_Y at the wavelength λ
 $f_Z(\lambda)$: f_Z at the wavelength λ
 $\tau(\lambda)$: percent transmission at the wavelength λ

- 4) **Method of obtaining stimulus value Y** Stimulus value Y , as it is, shall be used as the stimulus value.

NOTE 1 Methods of obtaining dominant wavelength and complementary wavelength The point C in chromaticity diagram (figure 11.1) is the colorless chromaticity coordinate, and $x = 0.310\ 1$, and $y = 0.316\ 2$.

When the chromaticity coordinate is the color expressed by the point S_1 which is in the area surrounded by straight lines RC , VC , and spectrum locus, the wavelength corresponding to S_1' , intersection point between extension of straight line CS_1 and the spectrum locus, is obtained on figure 11.3. This wavelength is called the dominant wavelength of that color, and expressed by the symbol λ_d . Furthermore, when the chromaticity coordinate is the color expressed by the point S_2 in the triangle CRV , the wavelength corresponding to S_2'' , intersection point between extension of straight line CS_2 and spectrum locus, is obtained on figure 11.3. This wavelength is called complementary wavelength of that color, and expressed by the symbol λ_c .

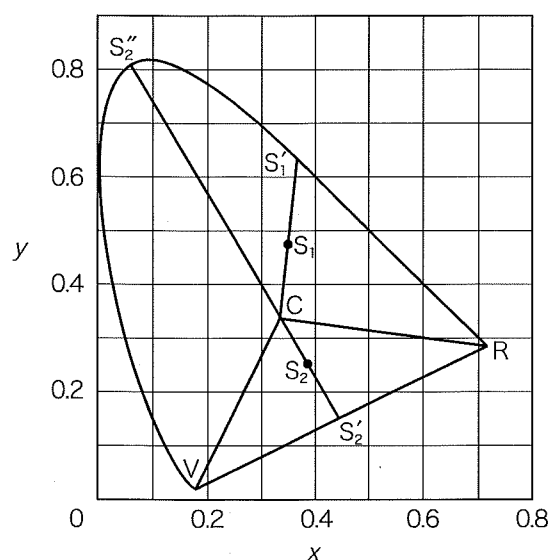


Figure 11.1 Chromaticity diagram

NOTE 2 Method of obtaining excitation purity When the chromaticity coordinate is the color indicated by the point S_1 in figure 11.1, the excitation purity P_e is obtained from the following formula, and % attached to the value:

$$P_e = \frac{x - x_c}{x_\lambda - x_c} \times 100 \quad \dots\dots\dots (1)$$

or

$$P_e = \frac{y - y_c}{y_\lambda - y_c} \times 100 \quad \dots\dots\dots (2)$$

where, x, y : coordinate of point S_1

x_c, y_c : coordinate of point C

x_λ, y_λ : coordinate of point S_1'

Furthermore, when the chromaticity coordinate is the color indicated by the point S_2 , the excitation purity P_e is obtained from the following formula, and % attached to the value:

$$P_e = \frac{x - x_c}{x_p - x_c} \times 100 \quad \dots\dots\dots (3)$$

or

$$P_e = \frac{y - y_c}{y_p - y_c} \times 100 \quad \dots\dots\dots (4)$$

where, x, y : coordinate of point S_2

x_c, y_c : coordinate of point C

x_p, y_p : coordinate of point S_2' (intersection between the extension of straight line CS_2 and the locus of pure purple)

The value P_e is obtained by the formula in which the absolute value of denominator or numerator is larger.

Example of method to obtain excitation purity and dominant wavelength If the tristimulus value obtained by measuring the sample gives 40.14 to X, 76.50 to Y, and 34.25 to Z, x of chromaticity coordinate becomes 0.266 and y of that becomes 0.507 and stimulus value Y becomes 76.50. Obtain the chromaticity coordinate as a point (S_1) on figure 11.2 and then the colorless point as C ($x = 0.310$ 1, $y = 0.316$ 2). Connect C and S_1 with a straight line, and obtain the intersection between extended straight line and spectrum locus as S_1' . The point S_1' is located at 534 nm on the spectrum locus, i.e. the dominant wavelength λ_d is 534 nm. Figure 11.2 says that coordinate x_λ of S_1' is 0.200 and y_λ is 0.785, therefore the excitation purity P_e is calculated as follows according to formula (2):

$$\frac{0.507 - 0.316}{0.785 - 0.316} \times 100 = 40.70 \%$$

Therefore, the color of the sample is indicated as dominant wavelength $\lambda_d = 534 \text{ nm}$, excitation purity P_e is 40.70 %, and stimulus value Y is 76.50 %.

When the color of the sample is faint, figure 11.4, and when dark, figure 11.5 is convenient to obtain the excitation purity.

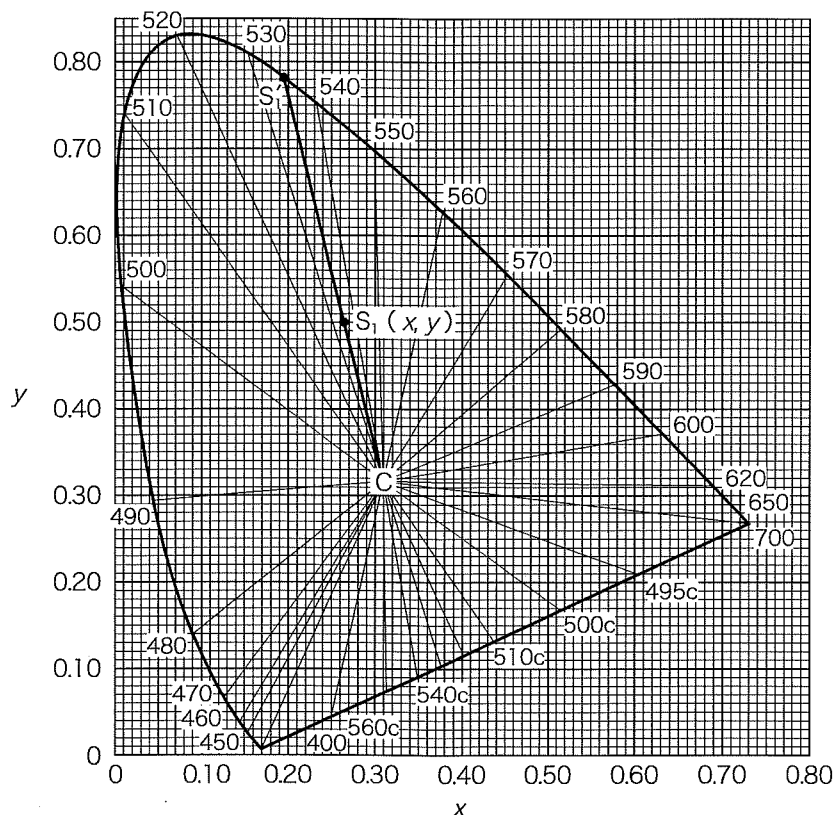


Figure 11.2 Relation diagram between chromaticity diagram and dominant wavelength according to 2 degree visual field XYZ system

NOTE 3 Dominant wavelength and hue The relation between the dominant wavelength and the hue is shown in table 11.2 and figure 11.3.

The curve plotted with wavelength scale is the spectrum locus, and line connecting both ends of the locus is the locus of pure purple. The point C indicates the chromaticity coordinate of standard illuminant C ($x = 0.3101$, $y = 0.3162$).

Table 11.2 Dominant wavelength and name of hue

Dominant wavelength nm	Name of hue	Abbrevia- tion	Dominant wavelength nm	Name of hue	Abbrevia- tion
498c to 700 to 618	Red	R	498 to 482	Blue green	BG
618 to 586	Orange	O	482 to 435	Blue	B
586 to 571	Yellow	Y	435 to 400 to 578c	Violet	V
571 to 531	Yellow green	YG	578c to 528c	Purple	P
531 to 498	Green	G	528c to 498c	Red purple	RP

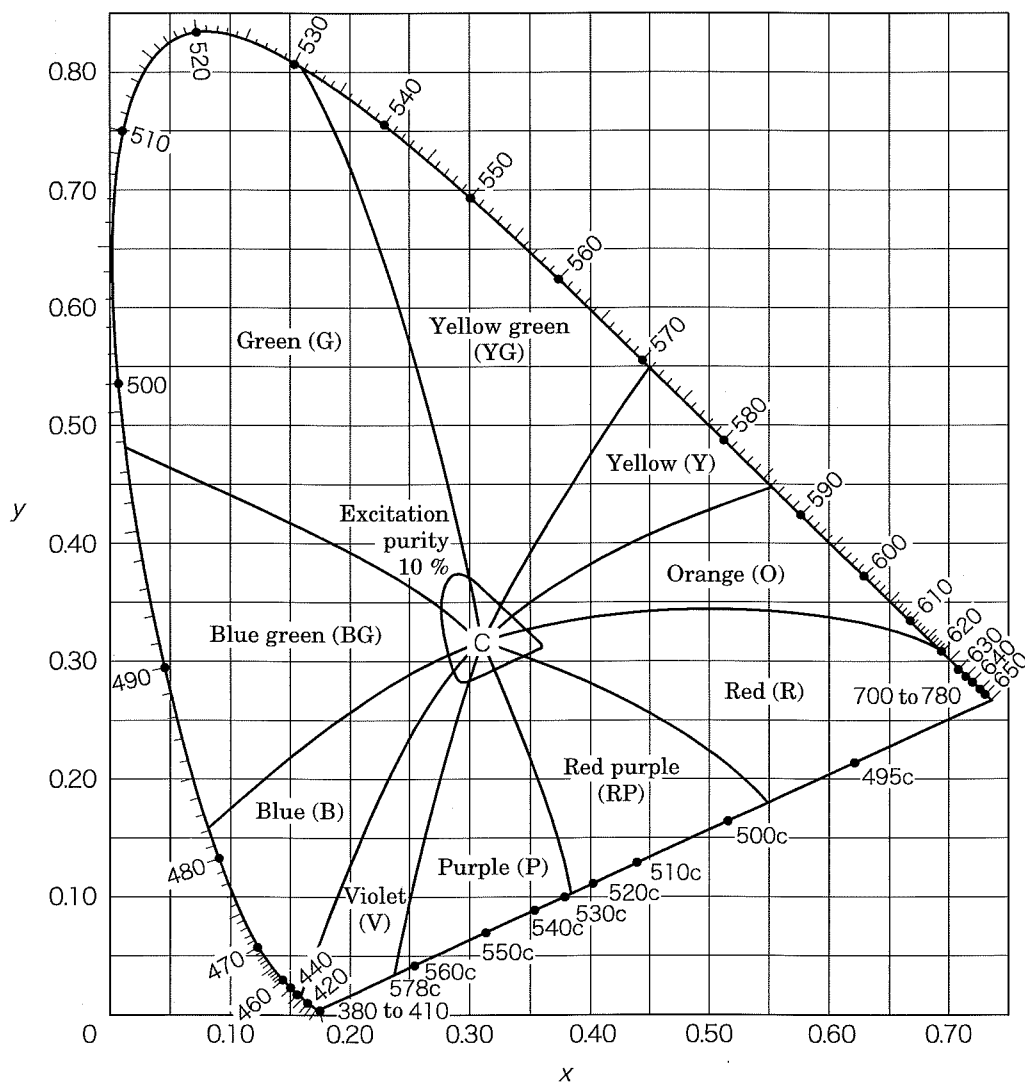


Figure 11.3 Chromaticity diagram according to 2 degree visual field XYZ system (Dominant wavelength and name of hue)

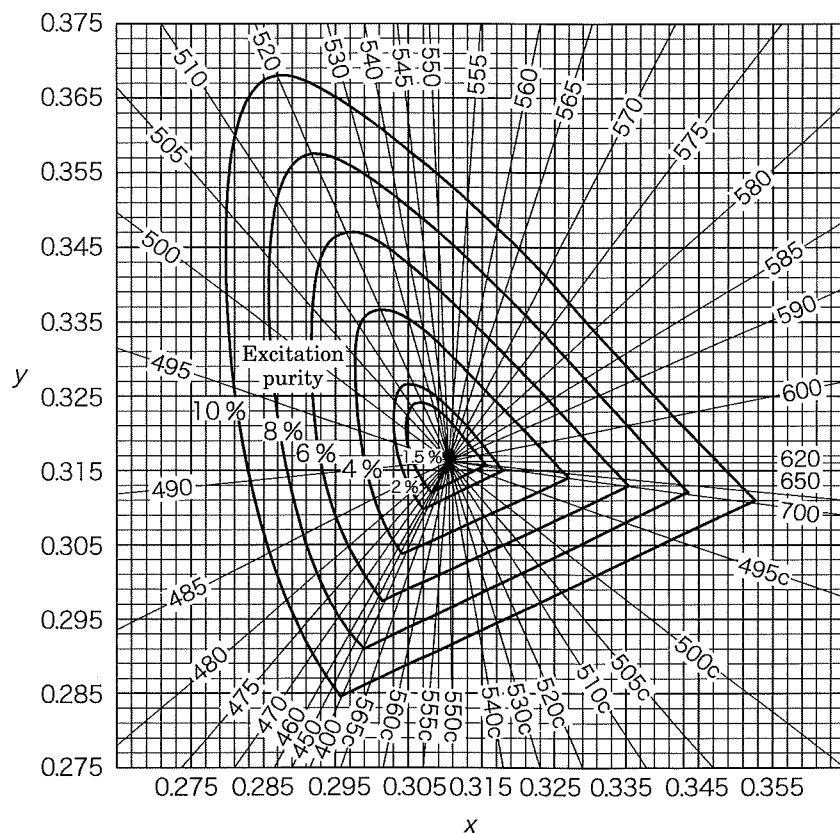


Figure 11.4 Excitation purity (10 % marking) (when color of sample is faint)

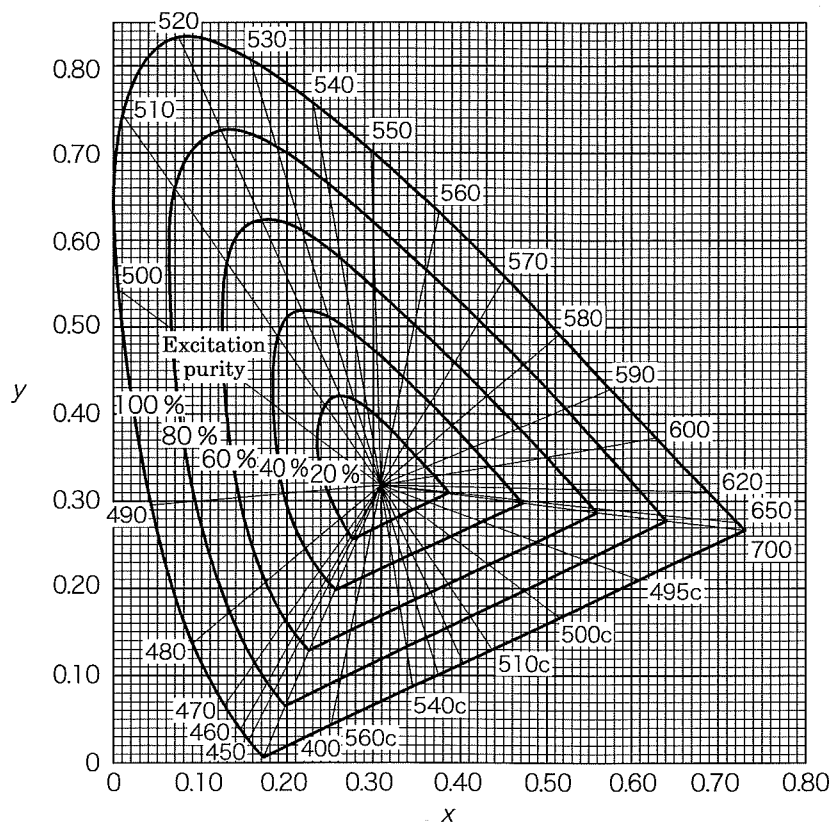


Figure 11.5 Excitation purity (100 % marking) (when color of sample is dark)

11.2 Method using three wavelengths In this method, after sample is filtered by membrane filter, the absorbance is measured at the wavelengths of 436 nm, 525 nm and 620 nm and the respective absorption coefficients are calculated. The obtained absorption coefficients are used to indicate the colors.

a) **Reagent** The following reagent shall be used.

1) **Water**, as specified in 11.1 a) 1).

b) **Apparatuses** The following apparatuses shall be used.

1) **Photometer**, in accordance with 11.1 b) 2).

2) **pH-meter**, of Type II specified in JIS Z 8802.

3) **Thermometer**, in accordance with 7.2 a) 1).

c) **Procedure** The test procedure shall be as follows.

- 1) Filter the sample with the membrane filter of 0.45 µm in pore diameter, and measure the pH and temperature ⁽⁵⁾ of the filtered sample in parallel to the measurement of color ⁽⁴⁾.
- 2) Transfer a part of the above to an absorption cell ⁽⁶⁾ and measure the absorbance at the wavelengths of 436 nm, 525 nm and 620 nm, using water as a contrast solution.
- 3) Calculate the absorption coefficients $\alpha(\lambda)$ (absorbance per meter in optical path length) at the respective wavelengths from the obtained absorbance according to the following formula:

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

where, $\alpha(\lambda)$: absorbance per meter in optical path length (m^{-1})

A : absorbance of the sample after filtered, at wavelength λ

d : optical path length of absorption cell (mm)

f : coefficient to convert to the absorbance per meter in optical path length ($f = 1\,000$)

Notes ⁽⁴⁾ In the case of dark color, the filtered sample is diluted with a definite volume of water. In such a case, for the calculation of $\alpha(\lambda)$ value, the dilution shall be considered.

⁽⁵⁾ The pH and temperature shall be both reported in the test result for reference.

⁽⁶⁾ When the absorption coefficient is smaller than 10 m^{-1} , the optical path length of the absorption cell used shall be 10 mm or longer.

12 pH The pH is measured by the glass-electrode method in **JIS Z 8802**.

Since the pH of a sample is quickly changed by chemical, physical, biochemical action and so on, it shall be measured immediately after sampling.

This test method is in consistency with the first edition of **ISO 10523** published in 1994.

NOTE : The corresponding International Standard relevant to this test method is as follows.

The symbols which denote the degree of correspondence in the contents between the corresponding International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

ISO 10523:1994 *Water quality—Determination of pH* (MOD)

12.1 Glass-electrode method The pH is measured using a pH meter equipped with glass electrodes.

a) **Reagents** The following reagents shall be used.

- 1) **Water**, of A2 or A3 specified in **JIS K 0557**. For preparing borate pH reference solution or carbonate pH reference solution, the carbon dioxide-free water as specified in 2 n) 2) shall be used.
- 2) **Potassium trihydrogen dioxalate dihydrate**, specified in **JIS K 8474**.
- 3) **Potassium hydrogen phthalate**, for pH reference solution, specified in **JIS K 8809**.
- 4) **Potassium dihydrogen phosphate**, for pH reference solution, specified in **JIS K 9007**.
- 5) **Disodium hydrogenphosphate**, for pH reference solution, specified in **JIS K 9020**.
- 6) **Sodium tetraborate**, for pH reference solution, specified in **JIS K 8866**.
- 7) **Sodium hydrogen carbonate**, for pH reference solution, specified in **JIS K 8622**.
- 8) **Sodium carbonate**, for pH reference solution, specified in **JIS K 8625**.

b) **pH reference solutions** ⁽¹⁾ The pH reference solutions shall be either 1) or 2) in the following.

- 1) **Prepared pH reference solutions**, prepared in accordance with 7.3.2 of **JIS Z 8802**.
- 2) **Certified pH reference solutions**, traceable to National Metrological Standard, of Class 2.

Note ⁽¹⁾ The pH value of pH reference solutions at each temperature shall be in accordance with table 12.1 and table 12.2.

- NOTES 1 Obtain the pH value at the temperature not shown in table 12.1 and table 12.2 by interpolating.
- 2 The pH reference solutions which have been preserved for a long period should not be used because the pH value can have changed during preservation. This should be especially noted for borate and carbonate pH reference solutions, whose pH value can easily be reduced due to absorption of the carbon dioxide in the atmosphere.
- 3 The pH reference solutions which have been used once or left exposed to the atmosphere should not be used.

Table 12.1 Typical pH value of prepared pH reference solution at each temperature

Temperature	pH value				
°C	Oxalate	Phthalate	Neutral phosphate	Borate	Carbonate*
0	1.67	4.01	6.98	9.46	10.32
5	1.67	4.01	6.95	9.39	(10.25)
10	1.67	4.00	6.92	9.33	10.18
15	1.67	4.00	6.90	9.27	(10.12)
20	1.68	4.00	6.88	9.22	(10.07)
25	1.68	4.01	6.86	9.18	10.02
30	1.69	4.01	6.85	9.14	(9.97)
35	1.69	4.02	6.84	9.10	(9.93)
38	—	—	—	—	9.91
40	1.70	4.03	6.84	9.07	—
45	1.70	4.04	6.83	9.04	—
50	1.71	4.06	6.83	9.01	—
55	1.72	4.08	6.84	8.99	—
60	1.73	4.10	6.84	8.96	—
70	1.74	4.12	6.85	8.93	—
80	1.77	4.16	6.86	8.89	—
90	1.80	4.20	6.88	8.85	—
95	1.81	4.23	6.89	8.83	—

Note * The values in parentheses are the secondary interpolated values. The value of pH at each temperature shall be in accordance with **JIS Z 8802**.

**Table 12.2 Typical pH value of certified pH reference solutions*
(informative reference)**

Temperature °C	pH value					
	Oxalate	Phthalate	Neutral phosphate	Phosphate	Borate	Carbonate
	2nd grade	2nd grade	2nd grade	2nd grade	2nd grade	2nd grade
0	1.67	4.00	6.98	7.53	9.46	10.32
5	1.67	4.00	6.95	7.50	9.40	10.24
10	1.67	4.00	6.92	7.47	9.33	10.18
15	1.67	4.00	6.90	7.45	9.28	10.12
20	1.68	4.00	6.88	7.43	9.22	10.06
25	1.68	4.01	6.86	7.41	9.18	10.01
30	1.68	4.02	6.85	7.40	9.14	9.97
35	1.69	4.02	6.84	7.39	9.10	9.92
38	1.69	4.03	6.84	7.38	9.08	—
40	1.69	4.04	6.84	7.38	9.07	9.89
45	1.70	4.05	6.83	7.37	9.04	9.86
50	1.71	4.06	6.83	7.37	9.01	9.83
55	1.72	4.08	6.83	—	8.98	—
60	1.72	4.09	6.84	—	8.96	—
70	1.74	4.13	6.84	—	8.92	—
80	1.77	4.16	6.86	—	8.88	—
90	1.79	4.20	6.88	—	8.85	—
95	1.81	4.23	6.89	—	8.83	—

Note * The indicated values are obtained by rounding the values stated in OIML recommendation (R054-e81) to two decimal places. See **JIS Z 8802**.

c) **Implement and apparatus** The following implement and apparatus shall be used.

- 1) **pH meter**, of Type II specified in **JIS Z 8802** ⁽²⁾.
- 2) **Thermometer**, of 50 °C or 100 °C, which is a glass thermometer for general specified in **JIS B 7411-1** ⁽³⁾.

Notes ⁽²⁾ Other types of pH meter may be selected depending on the purpose of test.

In **JIS Z 8802**, pH meters of four types from 0 to III are specified, and the repeatability of readings obtained by respective types, measured using one type of pH reference solution, are specified as ± 0.005 for Type 0, ± 0.02 for Type I, ± 0.05 for Type II, and ± 0.1 for Type III.

⁽³⁾ The glass thermometer for general specified in **JIS B 7411-1** with tolerance on scale interval ± 1 °C.

d) **Calibration of pH meter** The calibration of pH meter shall be carried out as follows.

- 1) Assemble a detector [such as a glass electrode ⁽⁴⁾ ⁽⁵⁾ and reference electrode ⁽⁶⁾, thermometer, etc.], and run the power source of a pH meter.
- 2) Wash the detector three times or more with water, and wipe it with clean soft paper.
- 3) Place the neutral phosphate pH reference solution in a beaker, and dip the detector in it. Adjust the temperature compensation dial or, if equipped with digital switch, adjust the scaled value on the switch to match the temperature of neutral phosphate pH reference solution ⁽⁷⁾ ⁽⁸⁾.
- 4) Adjust the pH to the value corresponding to the temperature of neutral phosphate pH reference solution (table 12.1 or table 12.2).
- 5) Wash the detector three times or more with water, and wipe it with a clean soft paper or the like.
- 6) When the pH value of sample is 7 or lower, dip the detector in either phthalate pH reference solution or oxalate pH reference solution taken in a beaker.

Adjust the pH to the value corresponding to the temperature of the employed pH reference solution (table 12.1 or table 12.2) ⁽⁸⁾. When the pH value of sample is over 7 ⁽⁹⁾, use the phosphate pH reference solution, the borate pH reference solution or the carbonate pH reference solution, and adjust, similarly to above, to the pH value corresponding to the temperature of pH reference solution ⁽⁸⁾.

- 7) Repeat the procedures from 2) to 6) until the indicated pH value agrees with the pH value corresponding to the temperature of the pH reference solution within the tolerance of ± 0.05 .

Notes ⁽⁴⁾ A glass electrode which has been under dried condition for a long period shall be dipped in water prior to use until reaching equilibrium.

⁽⁵⁾ If the glass electrode is not clean, as necessary, wash it with detergent or hydrochloric acid (1+20) [prepared using the hydrochloric acid (guaranteed reagent) specified in **JIS K 8180**] for a short period, and rinse it sufficiently with running water. Maintenance of the electrode should be in accordance with NOTE 4.

⁽⁶⁾ The reference electrode, if contaminated, shall be cleaned by the same procedure as the glass electrode, and exchange of its inner liquid (potassium chloride solution) shall be as stated in the instruction manual. For avoiding the contamination of the liquid junction part, the electrolysis solution requires a hydrostatic pressure equivalent to that obtained by the water level difference of 2 cm or more.

⁽⁷⁾ The temperature of pH reference solution shall conform to that of the sample as nearly as possible.

⁽⁸⁾ During calibration, keep the temperature fluctuation of each pH reference solution within ± 2 °C.

⁽⁹⁾ When the pH value of sample is 11 or greater, measure it according to NOTE 5.

NOTES 4 The maintenance of the electrode is as follows.

When it is found that, after many measurements, the reading of the pH of the pH reference solution takes a long while before reaching equilibrium, the contamination of the electrode system (measurement cell) needs to be removed by carrying out the following operation.

- 1) Clean the electrode by wiping it well with a soft paper periodically (once each day or each week). If it is contaminated by organic matter, wash it with ethanol [volume fraction 70 %] [prepared by using ethanol (95) specified in **JIS K 8102**], acetone (specified in **JIS K 8034**), warmed detergent solution and so on.
- 2) The organic solvent takes away moisture from the glass film surface to cause the reduction of sensitivity, therefore the use of it should be restricted to a short time. When the organic solvent is used, after the use, the electrode should be immersed in water for at least several hours for recovery. In this case, a recalibration will be necessary.
- 3) In the case of adhesion of calcium carbonate, dissolve it by diluted hydrochloric acid.
- 4) It is recommended that the reference electrode and complex electrode be immersed in the electrolysis solution for reference electrode and the glass electrode be immersed in water.
- 5) When a sample shows 11 or more pH value and especially gives a high concentration of alkaline metal, alkaline error easily takes place. For avoiding this, an electrode with a small alkaline error should be used and the pH meter should be calibrated with 0.1 mol/L sodium hydroxide solution [specified in **16.1 a) 1)**] containing no carbonate or calcium hydroxide solution (saturated at 25 °C).

The 0.1 mol/L sodium hydroxide solution or calcium hydroxide solution (saturated at 25 °C), of which the pH value can easily be reduced by absorbing carbon dioxide in the air, should be prepared immediately before use.

Table 12.3 shows the pH value of 0.1 mol/L sodium hydroxide solution and calcium hydroxide solution (saturated at 25 °C) given at each temperature.

Table 12.3 pH value of 0.1 mol/L sodium hydroxide solution and calcium hydroxide solution saturated at 25 °C given at each temperature

Temperature °C	0.1 mol/L sodium hydroxide solution	Calcium hydroxide solution saturated at 25 °C	Temperature °C	0.1 mol/L sodium hydroxide solution	Calcium hydroxide solution saturated at 25 °C
0	13.8	13.43	35	12.6	12.14
5	13.6	13.21	40	12.4	11.99
10	13.4	13.00	45	12.3	11.84
15	13.2	12.81	50	12.2	11.70
20	13.1	12.63	55	12.0	11.58
25	12.9	12.45	60	11.9	11.45
30	12.7	12.30			

e) **Procedure** The test procedure shall be as follows.

- 1) Wash the calibrated detector of the pH meter three times or more with water, and wipe it with a clean soft paper or the like.
- 2) Place the sample in a beaker, and immerse the detector in it. Adjust the indicated value of the temperature compensation dial or, a digital switch, if provided, to the temperature ⁽¹⁰⁾ of the sample, and measure the value of pH.
- 3) Take out the detector, wash three times or more with water, and wipe it with a clean soft paper or the like.
- 4) Place some sample again in a beaker, immerse the detector in it, and measure the pH value ⁽¹⁰⁾.
- 5) Repeat the procedures in 3) and 4) and average the three measured values which have agreed within the limit of ± 0.1 ⁽¹¹⁾ to calculate the pH value of the sample.

Notes ⁽¹⁰⁾ Because pH value varies with the temperature of sample, the temperature fluctuation of the sample shall be within ± 2 °C.

⁽¹¹⁾ With a sample with low buffer property, since its pH value can easily change, it can be difficult to achieve the repeatability of ± 0.1 . In this case, average the pH values which have agreed within the limit of ± 0.2 to calculate the pH value. Where pH value easily fluctuates owing to carbon dioxide in air, it is advisable to use a flow-through type electrode.

NOTES 6 For the pH measurement of water of low ionic strength (not more than 5 mS/m in electrical conductivity) or water of low buffering property, the special attention is required.

- 7 When the pH value of the sample is 11 or higher, an electrode having a glass film of low solubility, that is, a high alkali electrode should be used. Use of such an electrode is recommended for all measurements of water. The reference electrode should be a ground sleeve type and potassium chloride solution (1 mol/L) (prepared by using the potassium chloride specified in **JIS K 8121**) should be used for the electrolysis

solution. For avoiding the influence of potassium chloride on the glass electrode, the solution is gently agitated. For avoiding the influence of air, sample is poured in a measurement container. For restricting the electrostatic effect, the measurement container part is electromagnetically screened, a metallic electrode is inserted in the test solution and the earthing is carried out.

NOTE 8 Interferences The temperature, a certain type of gas and organic compound interfere with the measurement of pH. Suspended matter can cause a comparatively large error (suspension effect). In such a case, an electrode is inserted in supernatant part after waiting for the settlement to have resulted or the ultrafiltration method is applied. Some samples may have a higher possibility to cause adhesion of oils and fats, and other contaminants to the electrode, and contamination of diaphragm.

This contamination can be prevented in the liquid junction part of the reference electrode ⁽⁶⁾. When the precipitation, for example, silver sulfide or protein flock is generated in diaphragm, the use of salt bridge of potassium nitrate (1 mol/L) (prepared by using potassium nitrate specified in **JIS K 8548**) between the sample and the reference electrode is required.

13 Electrical conductivity Electrical conductivity is the inverse number of electric resistivity ($\Omega \cdot \text{m}$) of solution, expressed in the unit of (S/m). Electric conductance is the inverse number of electric resistance (Ω) of solution, expressed in the unit of (S).

In water test, the measurement at 25 °C is expressed by the unit of (mS/m)⁽¹⁾ or (mS), which are one-thousandth of (S/m) and (S), respectively⁽²⁾.

This test shall be carried out immediately after sampling. When this is not possible, the sample shall be placed in a sample container completely filled and stored at a dark place at 0 °C to 10 °C with the container tightly sealed and shall be tested as soon as possible.

This test method is in consistency with the first edition of **ISO 7888** published in 1985.

Notes⁽¹⁾ The unit of mS/m reads “millisiemens per meter”.

⁽²⁾ 1 $\mu\text{S}/\text{cm}$, expressed by the traditional unit, corresponds to 0.1 mS/m ($1 \mu\text{S}/\text{cm} = 1 \times 10^{-6} \text{ S}/10^{-2} \text{ m} = 1 \times 10^{-4} \text{ S}/\text{m} = 0.1 \text{ mS}/\text{m}$) in SI units.

NOTE 1 The corresponding International Standard relevant to this test method is as follows.

The symbols which denote the degree of correspondence in the contents between the corresponding International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

ISO 7888:1985 *Water quality—Determination of electrical conductivity* (MOD)

NOTE 2 For water test, (μS) and ($\mu\text{S}/\text{cm}$) has been conventionally used for the unit of electric conductance and electrical conductivity respectively, and (cm^{-1}) has been used for a cell constant.

For electric conductance, the value expressed by (μS) is 1 000 times the value expressed by (mS).

For electrical conductivity, the value expressed by ($\mu\text{S}/\text{cm}$) is 10 times the value expressed by (mS/m).

For cell constant, the value expressed by cm^{-1} is 0.01 times the value expressed by m^{-1} .

a) **Reagents** The following reagents shall be used.

- 1) **Water**, of A2 or A3 specified in **JIS K 0557**, not more than 0.2 mS/m (2 $\mu\text{S}/\text{cm}$) (25 °C) in electrical conductivity. Condition to 20 °C $\pm$ 2 °C when preparing.
- 2) **Potassium chloride** Grind potassium chloride (for electrical conductivity measurement) specified in **JIS K 8121** with an agate mortar, heat it at 500 °C for about 4 h, and allow it to cool in a desiccator.
- 3) **1 mol/kg potassium chloride reference solution**, as specified in 7.1 of **JIS K 0130**.
- 4) **0.1 mol/kg potassium chloride reference solution**, as specified in 7.1 of **JIS K 0130**.

- 5) **0.01 mol/kg potassium chloride reference solution**, as specified in 7.1 of **JIS K 0130**.
- 6) **0.001 mol/kg potassium chloride reference solution**, as specified in 7.1 of **JIS K 0130**.

Preserve these potassium chloride reference solutions in polyethylene bottles or in borosilicate glass bottles with the bottles tightly stoppered. The electrical conductivity of these potassium chloride reference solutions is shown in table 13.1 and table 13.2.

The potassium chloride reference solutions commercially available may be used.

- 7) **Hydrochloric acid (1+1)** Use the hydrochloric acid (guaranteed reagent) specified in **JIS K 8180**.
- 8) **Sulfuric acid (1+360)** Place 360 volumes of water in a beaker and add gradually 1 volume of sulfuric acid specified in **JIS K 8951** while stirring.
- 9) **Electrolyte** Weigh 30 g of hydrogen hexachloroplatinate (IV) hexahydrate specified in **JIS K 8153** and 0.25 g of lead (II) acetate trihydrate specified in **JIS K 8374**, and prepare electrolyte to make total 1 L using water of A2, A3 or A4 specified in **JIS K 0557**. This solution is used, when necessary.

Table 13.1 Electrical conductivity of potassium chloride reference solutions ⁽³⁾

Unit: mS/m

Temperature °C	Value of electrical conductivity and its uncertainty						
	0.01 mol/kg potassium chloride reference solution		0.1 mol/kg potassium chloride reference solution		1 mol/kg potassium chloride reference solution		CO ₂ saturated water
	Electrical conductivity	2u _c	Electrical conductivity	2u _c	Electrical conductivity	2u _c	Electrical conductivity
0	77.292	0.023	711.685	0.285	6 348.8	2.5	0.058
5	89.096	0.027	818.370	0.327	7 203.0	2.9	0.068
10	101.395	0.030	929.172	0.372	8 084.4	3.2	0.079
15	114.145	0.034	1 043.71	0.42	8 990.0	3.6	0.089
18	121.993	0.037	1 114.06	0.45	—	—	0.095
20	127.303	0.038	1 161.59	0.46	9 917.0	4.0	0.099
25	140.823	0.042	1 282.46	0.51	10 862.0	4.3	0.110
30	154.663	0.046	1 405.92	0.56	11 824.0	4.7	0.120
35	168.779	0.051	1 531.60	0.61	12 797.0	5.1	0.130
40	183.127	0.055	1 659.10	0.66	13 781.0	5.5	0.140
45	197.662	0.059	1 788.06	0.72	14 772.0	5.9	0.151
50	212.343	0.064	1 918.09	0.77	15 767.0	6.3	0.161

Note ⁽³⁾ Data of National Institute of Standards and Technology (NIST) [*Pure Appl. Chem.*, vol.73, pp.1783 (2001); 2u_c is the expanded uncertainty.]

Table 13.2 Electrical conductivity of 0.001 mol/kg potassium chloride reference solution ⁽⁴⁾

Concentration of potassium chloride reference solution mol/kg	Temperature °C	Electrical conductivity mS/m
0.001 mol/kg	25	14.65

Note ⁽⁴⁾ It is calculated from the data of Shedlovsky and the density data, and expressed in four digits [*J.Am.Chem.Soc.*, 54, 1411 (1932)].

b) **Implements and apparatus** The following implements and apparatus shall be used.

- 1) **Conductance meter**, composed of a detector and an indicator. The detector shall consist of a cell having a built-in platinum electrode coated with platinum black, and having the cell constant shown in table 13.3. The indicator shall be incorporated with a Wheatstone bridge circuit or the like. The cell shall be stored in water ⁽⁵⁾.
- 2) **Thermometer**, of 50 °C, which is a glass thermometer for general specified in **JIS B 7411-1**.
- 3) **Thermostatic bath**, capable of maintaining the temperature at 25 °C ± 0.5 °C.

Note ⁽⁵⁾ The cell constant shall be periodically checked according to the method shown in c) 2).

c) **Procedure** The test procedure shall be as follows.

- 1) **Electrical conductivity measurement of sample** The electrical conductivity of the sample shall be measured as follows.

- 1.1) In advance, run the conductance meter. Use the cell having the cell constant corresponding to the electrical conductivity of the sample shown in table 13.3, and wash the cell two or three times with water. When the contamination is serious, immerse it in hydrochloric acid (1+100) [prepared using hydrochloric acid (guaranteed reagent) specified in **JIS K 8180**], wash it sufficiently with running water, and finally wash two or three times with water.
- 1.2) Wash this cell two or three times with sample, fill it with the sample, and measure its electric conductance ⁽⁷⁾ ⁽⁸⁾ while keeping it at 25 °C ± 0.5 °C ⁽⁶⁾.

Repeat the measurements by changing the sample each time, until the meter readings agree within ± 3 % ⁽⁹⁾, and obtain the electric conductance as the mean of three measurements.

- 1.3) From the obtained electric conductance, calculate the electrical conductivity (mS/m) (25 °C) of the sample according to the following formula:

$$L = J \times L_x$$

where, L : electrical conductivity of the sample (mS/m) (25 °C)

J : cell constant (m⁻¹)

L_x : measured electric conductance (mS)

Note (6) When the accuracy is not specially required, the conductance meter incorporating a temperature compensating circuit or the temperature conversion formula [formula (1)] may be used. Electrical conductivity varies according to the temperature, and increases about 2 % per 1 °C increment in temperature. When the electrical conductivity is 1 mS/m (10 µS/cm) or less, however, since the influence of hydrogen ion and hydroxide ion which have resulted from the dissociation of water will become larger, this conversion formula cannot be applied.

$$\kappa_{25} = \frac{\kappa_{\theta}}{1 + (\alpha/100)(\theta - 25)} \quad \dots\dots\dots (1)$$

where, κ_{25} : electrical conductivity at 25 °C (mS/m)
 κ_{θ} : electrical conductivity at measurement temperature θ (mS/m)
 α : temperature coefficient of electrical conductivity (%)
 θ : temperature of sample at the time of measurement (°C)

The value of temperature coefficient of electrical conductivity (change rate of electrical conductivity per 1 °C), α , can be obtained from the following formula (2) according to an experimental measurement:

$$\alpha_{\theta,25} = \frac{1}{\kappa_{25}} \times \left(\frac{\kappa_{\theta} - \kappa_{25}}{\theta - 25} \right) \times 100 \quad \dots\dots\dots (2)$$

where, $\alpha_{\theta,25}$: temperature coefficient of electrical conductivity for converting κ_{θ} to κ_{25} (%)
 κ_{25} : electrical conductivity at 25 °C (mS/m)
 κ_{θ} : electrical conductivity at measurement temperature θ (mS/m)
 θ : temperature of sample at the time of measurement (°C)

Notes (7) If the indication of a conductance meter gives electric resistance (Ω), electrical conductivity (mS/m) shall be calculated according to the following formula (3):

$$\kappa = \frac{J}{R_x} \times 10^3 \quad \dots\dots\dots (3)$$

where, κ : electrical conductivity of the sample (mS/m) (25 °C)
 J : cell constant (m^{-1}). Where electric resistivity ($\Omega \cdot \text{m}$) is directly indicated, it shall be 1.
 R_x : measured electric resistance (Ω)

(8) If the indication of a conductance meter gives electric conductance (μS), electrical conductivity (mS/m) shall be calculated according to the following formula (4):

$$\kappa = J' \times L_x' \times 0.1 \quad \dots\dots\dots (4)$$

where, κ : electrical conductivity of the sample (mS/m) (25 °C)

J' : cell constant (cm⁻¹)

L_x' : measured electric conductance (μS)

Note (9) When the electrical conductivity of the sample is less than 1 mS/m (25 °C), sometimes they cannot agree within ± 3 %. In this case, either try the test according to **JIS K 0552** or use a flow-through type cell.

Table 13.3 Cell constant and measuring range

Unit: mS/m

Division	Cell constant m ⁻¹	Measuring range
		Material of detection part (platinum black)
AC two-terminal system	0.1 to 1	0.005 to 100
	1 to 10	0.005 to 1 000
	10 to 100	0 to 10 000
	100 to 1 000	0 to 100 000
	1 000 to 5 000	0 to 500 000

2) **Measurement or inspection of cell constant** The measurement or inspection of cell constant shall be carried out periodically, if not every time the sample is tested, by using the potassium chloride reference solutions given in table 13.1 according to the following procedure.

2.1) Wash the cell with water two or three times, and then with potassium chloride reference solution (use potassium chloride reference solution corresponding to the measuring range for the relevant cell constant, stated in table 13.3) two or three times, and fill it with the potassium chloride reference solution. Measure the electric conductance while keeping this cell at 25 °C ± 0.5 °C. Repeat the measurements by each time changing the potassium chloride reference solution until the measurements agree within ± 3 % [Where the measurements do not agree within ± 3 %, further plating of platinum black shall be performed on the platinum-black-plated electrode in accordance with 3)].

2.2) Calculate the cell constant from the average of the three measured values, according to the following formula:

$$J = \frac{\kappa_{KCl} + \kappa_{H_2O}}{L_{XO}}$$

where, J : cell constant (m⁻¹)

L_{XO} : measured electric conductance (mS). When the electric conductance indication is in μS, use the value of $\mu S \times \frac{1}{1000}$.

κ_{KCl} : electrical conductivity of employed potassium chloride reference solution at this temperature (mS/m)