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Hydrochloric acid (Reagent)

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Reagent Association (JRA)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS K 8180** : 2015), which has been technically revised.

However, **JIS K 8180** : 2015 may be applied in the **JIS** mark certification based on the relevant provisions of Article 30, paragraph (1), etc. of the Industrial Standardization Act until 21 August 2021.

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Hydrochloric acid (Reagent)

HCl FW : 36.46

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 6353-2** : 1983, Edition 1, with some modifications of the technical contents.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the requirements for hydrochloric acid intended for use as a reagent.

WARNING 1 Hydrochloric acid is a deleterious substance. Its contact with eyes, mucous membrane or skin should be prevented with utmost care. It generates harmful gases. Pay attention to the exhaust ventilation.

WARNING 2 Persons carrying out tests based on this Standard should be familiar with normal laboratory practice. This Standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this Standard to establish appropriate safety and health practices, by reference to SDS (safety data sheets), etc.

NOTE The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 6353-2 : 1983 *Reagents for chemical analysis — Part 2 : Specifications — First series R 13 Hydrochloric acid* (MOD)

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

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS K 0050 *General rules for chemical analysis*

JIS K 0071-1 *Test methods for colour of chemical products — Part 1 : Estimation of colour in Hazen units (platinum-cobalt colour scale)*

JIS K 0113 *General rules for methods of potentiometric, amperometric, coulometric, and Karl Fischer titrations*

JIS K 0115 *General rules for molecular absorptiometric analysis*

JIS K 0121 *General rules for atomic absorption spectrometry*

JIS K 0133 *General rules for high frequency plasma mass spectrometry*

JIS K 0970 *Piston pipettes*

JIS K 8001 *General rules for test methods of reagents*

JIS K 8012 *Zinc (Reagent)*

JIS K 8034 *Acetone (Reagent)*

JIS K 8051 *3-Methyl-1-butanol (Reagent)*

JIS K 8102 *Ethanol (95) (Reagent)*

JIS K 8107 *Disodium dihydrogen ethylenediamine tetraacetic acid dihydrate (Reagent)*

JIS K 8136 *Tin(II) chloride dihydrate (Reagent)*

JIS K 8150 *Sodium chloride (Reagent)*

JIS K 8155 *Barium chloride dihydrate (Reagent)*

JIS K 8355 *Acetic acid (Reagent)*

JIS K 8374 *Lead (II) acetate trihydrate (Reagent)*

JIS K 8541 *Nitric acid (Reagent)*

JIS K 8576 *Sodium hydroxide (Reagent)*

JIS K 8580 *Tin (Reagent)*

JIS K 8625 *Sodium carbonate (Reagent)*

JIS K 8637 *Sodium thiosulfate pentahydrate (Reagent)*

JIS K 8659 *Starch, soluble (Reagent)*

JIS K 8732 *Carbon disulfide (Reagent)*

JIS K 8777 *Pyridine (Reagent)*

JIS K 8798 *Phenol (Reagent)*

JIS K 8842 *Bromothymol blue (Reagent)*

JIS K 8913 *Potassium iodide (Reagent)*

JIS K 8920 *Iodine (Reagent)*

JIS K 8951 *Sulfuric acid (Reagent)*

JIS K 9512 *Silver N,N-diethyldithiocarbamate (Reagent)*

JIS K 9905 *Highly purified sulfuric acid*

JIS R 1302 *Porcelain basins for chemical analysis*

JIS R 3503 *Glass apparatus for chemical analysis*

JIS Z 0701 *Silicagel desiccants for packaging*

3 Classification

Hydrochloric acid specified in this Standard is classified into guaranteed reagent, analytical grade reagent for arsenic and analytical grade reagent for trace metal.

4 Properties

4.1 Characteristics

Hydrochloric acid is a colourless and transparent liquid having a pungent odour, which forms white fumes upon contact with atmosphere. Its density is about 1.18 g/ml.

4.2 Qualitative test method

The qualitative test method shall be as follows.

- a) When 10 ml of water and 2 ml of silver nitrate solution (20 g/L) are added to 1 ml of the sample, white precipitation is produced.
- b) When a glass rod moistened with aqueous ammonia is brought close to the sample, white fumes are produced.

5 Quality

When the sample is tested in accordance with Clause 6, the results shall conform to the requirements given in Table 1.

Table 1 Quality

Item	Specification				Test methods	
		Guaranteed reagent	Analytical grade reagent for arsenic	Analytical grade reagent for trace metal	Guaranteed reagent and analytical grade reagent for arsenic	Analytical grade reagent for trace metal
Concentration (HCl)	Mass fraction %	35.0 to 37.0	35.0 to 37.0	35.0 to 37.0	6.2	6.2
Appearance	—	Conforming to test	Conforming to test	—	6.3	—
Evaporation residue	Mass fraction %	0.001 max.	0.001 max.	—	6.4	—
Ignition residue (sulfate)	Mass fraction ppm	5 max.	5 max.	—	6.5	—
Sulfate (SO ₄)	Mass fraction ppm	1 max.	1 max.	—	6.6	—
Free chlorine ^{a)}	—	Conforming to test	Conforming to test	—	6.7	—
Iodine reducing substance ^{b)}	—	Conforming to test	Conforming to test	—	6.8	—
Sodium (Na)	Mass fraction ppm	—	—	0.1 max.	—	6.12
Copper (Cu)	Mass fraction ppm	0.1 max.	0.1 max.	0.005 max.	6.9	6.12
Silver (Ag)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Magnesium (Mg)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Calcium (Ca)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Zinc (Zn)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Cadmium (Cd)	Mass fraction ppm	—	—	0.000 5 max.	—	6.12
Mercury (Hg)	Mass fraction ppm	—	—	0.000 5 max.	—	6.13
Aluminium (Al)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Tin (Sn)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Lead (Pb)	Mass fraction ppm	0.2 max.	0.2 max.	0.000 5 max.	6.9	6.12
Vanadium (V)	Mass fraction ppm	—	—	0.01 max.	—	6.12
Arsenic (As)	Mass fraction ppm	0.01 max.	0.005 max.	0.002 max.	6.10	6.12
Antimony (Sb)	Mass fraction ppm	—	—	0.002 max.	—	6.12
Bismuth (Bi)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Chromium (Cr)	Mass fraction ppm	—	—	0.000 5 max.	—	6.12
Molybdenum (Mo)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Tungsten (W)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Selenium (Se)	Mass fraction ppm	—	—	0.002 max.	—	6.12
Manganese (Mn)	Mass fraction ppm	—	—	0.002 max.	—	6.12
Iron (Fe)	Mass fraction ppm	0.2 max.	0.2 max.	0.01 max.	6.9	6.12
Cobalt (Co)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Nickel (Ni)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Gallium (Ga)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Yttrium (Y)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Indium (In)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Thallium (Tl)	Mass fraction ppm	—	—	0.005 max.	—	6.12
Ammonium (NH ₄)	Mass fraction ppm	3 max.	3 max.	—	6.11	—
Notes ^{a)} Corresponds to about 0.1 ppm or under in mass fraction as chloride (Cl). ^{b)} Corresponds to about 1 ppm or under in mass fraction as sulfite (SO ₃).						

6 Test methods

6.1 General matters

General matters of test methods shall be in accordance with **JIS K 0050** and **JIS K 8001**.

6.2 Concentration (HCl)

The test method for concentration (HCl) shall be as follows.

a) **Solutions for testing** The following solutions shall be used for testing.

- 1) **Carbon dioxide-free water**, in accordance with **5.8 c)** of **JIS K 8001**.
- 2) **Bromothymol blue solution**, prepared by dissolving 0.10 g of bromothymol blue specified in **JIS K 8842** in 50 ml of ethanol (95) specified in **JIS K 8102** and adding water to make 100 ml. Preserve it in a brown glass bottle.
- 3) **1 mol/L sodium hydroxide solution** (NaOH : 40.00 g/L), prepared, standardized and calculated in accordance with **JA.6.4 r) 1)** of **JIS K 8001** (1 mol/L sodium hydroxide solution) using sodium hydroxide specified in **JIS K 8576**. Preserve it in a bottle made of resin such as polyethylene.

b) **Apparatus**, mainly used in testing shall be as follows.

- **Automatic titrator**, having the potentiometric titration function, of which the minimum discharge amount is 0.01 ml or under

c) **Operation** As follows.

- 1) Take 20 ml of water in a 100 ml Erlenmeyer flask with interchangeable ground joint or the like, and weigh the mass to the nearest 0.1 mg (m_1 g). Take about 2.5 ml of the sample in the Erlenmeyer flask and weigh the mass again to the nearest 0.1 mg (m_2 g).
- 2) The titration shall be carried out by either of the following.
 - 2.1) Add 20 ml of carbon dioxide-free water and two or three drops of bromothymol blue solution to this Erlenmeyer flask, and titrate with 1 mol/L sodium hydroxide solution. Take the point when the yellow colour of the solution turns bluish green as the endpoint.
 - 2.2) In accordance with Clause 5 of **JIS K 0113**, without using an indicator, carry out the titration using 1 mol/L sodium hydroxide solution, in which a platinum electrode or silver electrode is used as the indicator electrode while a silver-silver chloride electrode is used as the reference electrode, or the composite electrode that is the combination of the indicator electrode and the reference electrode is used. Take the inflection point as the endpoint.

The sample solution may be transferred into a beaker or the like of an appropriate size to immerse the electrodes by adding water.

d) **Calculation** Obtain the concentration (HCl) according to the following formula.

$$A = \frac{0.036\,461 \times V_1 \times f_1}{(m_2 - m_1)} \times 100$$

- where,
- A : concentration (HCl) (mass fraction %)
 - V_1 : volume of 1 mol/L sodium hydroxide solution required for titration (ml)
 - f_1 : factor of 1 mol/L sodium hydroxide solution
 - m_1 : mass of Erlenmeyer flask with interchangeable ground joint containing 20 ml of carbon dioxide-free water (g)
 - m_2 : mass of Erlenmeyer flask with interchangeable ground joint containing sample and 20 ml of carbon dioxide-free water (g)
 - 0.036 461 : conversion factor for indication of mass of HCl corresponding to 1 ml of 1 mol/L sodium hydroxide solution (g/ml)

6.3 Appearance

The test method for appearance shall be in accordance with **JIS K 0071-1**, except that the Hazen units No. 10 shall be used.

6.4 Evaporation residue

The test method for evaporation residue shall be as follows.

a) **Instruments and apparatus** mainly used in testing shall be as follows.

- 1) **Evaporating dish** Porcelain basins specified in **JIS R 1302** or a similarly shaped quartz evaporating dish
- 2) **Desiccator**, containing silica gel (Type A, Class 1) specified in **JIS Z 0701** as drying material
- 3) **Water bath or hot plate**, capable of adjusting the temperature to about 100 °C.
- 4) **Dry oven**, capable of adjusting the temperature to 105 °C ± 2 °C.

b) **Operation** As follows.

Harmful hydrogen chloride gas, etc. generates. Pay attention to exhaust ventilation.

- 1) Weigh out 100 g (about 84.7 ml) of the sample into an evaporating dish (W_1 g) that has attained the constant mass (W_2 g). The mass of sample m_3 g corresponds to ($W_2 - W_1$) g.

The operation in which the sample is weighed separately (m_3 g) and transferred into the evaporating dish is permissible. Also, if the capacity of evaporating dish is small, the operation in which the sample is added again after the subsequent concentration operation and the operation is returned to 2) is permissible.

- 2) Evaporate the sample contained in the evaporating dish to dryness in the boiled water bath or on the hot plate capable of heating to 100 °C.
- 3) Put the evaporating dish in the dry oven, and heat and dry for 2 h at 105 °C.
- 4) Quickly transfer the evaporating dish taken from the dry oven into a desiccator.

After cooling as it is, take it out from the desiccator, and weigh the mass to the nearest 0.1 mg (W_3 g).

- 5) Repeat 3) and 4) to attain the constant mass. The heat and dry time in this case shall be about 1 h.

- c) **Calculation** Obtain the evaporation residue according to the following formula.

$$B = \frac{W_3 - W_1}{m_3} \times 100$$

where, B : evaporation residue (mass fraction %)
 W_1 : mass of evaporation dish that has attained the constant mass (g)
 W_3 : mass of evaporation dish after evaporation procedure (g)
 m_3 : mass of sample weighed out (g)

6.5 Ignition residue (sulfate)

The test method for ignition residue (sulfate) shall be as follows.

- a) **Reagents** As follows.

- **Sulfuric acid**, specified in **JIS K 8951**.

- b) **Instruments and apparatuses**, mainly used in testing shall be as follows.

- 1) **Evaporating dish**, in accordance with 6.4 a) 1).
- 2) **Desiccator**, in accordance with 6.4 a) 2).
- 3) **Water bath or hot plate**, in accordance with 6.4 a) 3).
- 4) **Electric furnace or wet ashing device**, capable of adjusting the temperature to $500\text{ }^{\circ}\text{C} \pm 50\text{ }^{\circ}\text{C}$.

- c) **Operation** As follows.

Harmful hydrogen chloride gas, etc. generates. Pay attention to exhaust ventilation.

- 1) Weigh out 200 g (about 169.5 ml) of the sample into an evaporating dish (W_4 g) that has attained the constant mass (W_5 g) to the nearest 0.1 g. In this case, the mass of sample m_4 g corresponds to ($W_5 - W_4$) g.

The operation in which the sample is weighed separately (m_4 g) and transferred into the evaporating dish is permissible. Also, if the capacity of evaporating dish is small, the operation in which the sample is added again after the subsequent concentration operation and the operation is returned to 3) is permissible.

- 2) Add 0.2 ml of sulfuric acid gradually.
- 3) Concentrate the sample contained in the evaporating dish to about 1 ml at about $100\text{ }^{\circ}\text{C}$ in the boiled water bath or on the hot plate capable of heating to $100\text{ }^{\circ}\text{C}$.
- 4) Raise the temperature of hot plate to heat the sample until white mist of sulfuric acid does not generate any more.