

DRAFT TANZANIA STANDARD

Hydrochloric acid — Specification

TANZANIA BUREAU OF STANDARDS

Foreword

This Draft Tanzania Standard was prepared by the Technical Committee on Industrial and laboratory chemicals under supervision of Chemicals Divisional Standards Committee and it is in accordance with the procedures of the Tanzania Bureau of Standards.

This second edition cancels and replaces the first edition, TZS 505: 1995 *Specification for hydrochloric acid* which technically revised by deleting pure grade and remaining with two grades i.e. technical and analytical grades.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value observed or calculated expressing the result(s) of a test or analysis shall, be rounded off in accordance with TZS 4 *Rounding off numerical values*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft for Stakeholders comments only

Hydrochloric acid — Specification

1. Scope

This Draft Tanzania Standard specifies requirements and methods of test and sampling of hydrochloric acid.

2. Normative references

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

TZS 4 *Rounding off numerical values*

TZS 59/ISO: 3696 *Water for analytical laboratory use – Specification and test method*

3. Terms and definitions

<<<<<<<Not applicable>>>>>>>

4. Requirements

4.1. General requirements

4.1.1 Grades

There shall be two grades of hydrochloric acid, namely; technical grade and analytical/reagent grade.

4.1.2 Description

4.1.2.1 Technical grade -The material shall be clear, yellow coloured liquid free from dirt and other visible impurities.

4.1.2.2 Analytical reagent grade - The material shall be clear, colourless liquid, free from dirt and other visible impurities.

4.2. Specific requirements

Hydrochloric acid shall also comply with the following specific requirements given in Table 1, when tested according to the methods prescribed in the Annex A.

Table 1 – Specific requirements for Hydrochloric acid

SN	Characteristic	Requirements		Test method
		Technical Grade	Analytical/Reagent Grade	
i.	Specific gravity at 300 K (26.85 °C, <i>min</i>	1.145	1.155	A.2
ii.	Hydrochloric acid (HCl) percent by mass, <i>min.</i>	30.0	32.0	A.3
iii.	Residue on ignition, percent by mass, <i>max.</i>	0.1	0.0005 (5 ppm)	A.4
iv.	Sulphates (as H ₂ SO ₄), percent by mass, <i>max.</i>	0.1	0.0003 (3 ppm)	A.5
v.	Iron (Fe), percent by mass, <i>max.</i>	0.005	0.0001 (1 ppm)	A.6
vi.	Free chlorine and bromine (as Cl), percent mass, <i>max.</i>	0.02	0.0002 (2 ppm)	A.7
vii.	Heavy metals (as Pb), percent by mass, <i>max.</i>	0.001 (10 ppm)	0.0002 (2 ppm)	A.8
viii.	Sulphites (as SO ₂), percent by mass, <i>max.</i>	0.05	0.0003 (3 ppm)	A.9

5. Packing and labelling

5.1 Packing

Hydrochloric acid shall be packed in a suitable container that prevents it from deterioration of its quality during storage, transportation and handling.

5.2 Labelling

Each container shall legibly and indelibly label with the information below either in English or Kiswahili or in combination as agreed between the manufacturer and/or the supplier. Any other additional language is optional.

- Name and grade of the material;
- Name and address of the manufacturer;
- Trade mark, if any;
- Lot or batch number;
- Net content;
- Date of manufacture;
- Shall prominently display the words 'CORROSSIVE, HANDLE WITH CARE'.
- Pictograms warning signs showing respective hazardous

5.2.2 Manufacturer is required to provide the material safety data sheet for the Hydrochloric acid.

5.2.3 In case of analytical reagent grade, the actual analysis of the hydrochloric acid with respect to required characteristics shall also appear on the label.

5.2.4 The packages shall be labelled with visible pictorial markings in red colour indicating hazards associated with hydrochloric acid such as corrosiveness.

6. Sampling

The method of drawing representative test samples of the material and the criteria for conformity shall be as prescribed in Annex B.

Annex A

(Normative)

Analysis of hydrochloric acid

A. 1 Quality of reagents

Unless specified otherwise, analytical chemical reagents and distilled water shall be used in the test procedures.

A.2 Determination of specific gravity

A. 2.1 Apparatus

Squibb specific gravity bottle. The specific gravity bottle is of 100 mL capacity, having a ground-in graduated capillary tube and glass stopper.

A.2.2 Procedure - Clean and thoroughly dry the specific gravity bottle and weigh it. Fill it up to the mark with freshly boiled and cooled water which has been maintained at a temperature of 300 ± 1 K, and weigh. Remove the water, dry the bottle again and fill it with the material maintained at the same temperature. Weigh the bottle again.

A.2.3 Calculation

A.2.3.1 Specify the temperature of testing.

A.2.3.2 Calculate as follows:

Specific gravity at 300/300 K (26.85/26.85 °C) = $\frac{C-A}{B-A}$

Where

A = weight in g of the empty specific gravity bottle,

B = weight in g of the specific gravity bottle with water and

C = weight in g of the specific gravity bottle with the material, specific gravity bottle, and

A.3 Determination of hydrochloric acid

A.3.1 Reagents

A.3.1.1 Standard sodium hydroxide solution - 1 M

A.3.1.2 Methyl orange indicator solution - dissolve 0.05 g or methyl orange in 100 mL of water.

A.3.2 Procedure - Weigh about 3 g of the material to the nearest milligram in a weighed stoppered weighing bottle containing about 10 mL of water. Transfer the contents completely into a clean, dry 250 mL flask and dilute it with about 100 mL of water. Titrate against standard sodium hydroxide solution, using methyl orange as indicator.

A.3.3 Calculation

Hydrochloric acid (HCl) percent by weight = $3.65 \frac{V}{W}$

Where,

V= volume in mL of standard sodium hydroxide solution used, and

W= weight in g of the material taken for the test.

A.4 Determination of residue on ignition

A.4.1 Procedure - Transfer about 25 g of the material, accurately weighed to 0.01 g into a weighed porcelain dish. Evaporate to dryness on a sand-bath in a fume cupboard. Transfer the dish to a muffle furnace and raise the temperature till it reaches 973 K to 1 023 K. Cool in a desiccator and weigh.

A.4.2 Calculation

Residue on ignition, percent by weight = $100 \frac{W_1}{W_2}$

where

W_1 = weight in g of the residue, and

W_2 = weight in g of the material taken for the test.

A.5 Test for sulphates

A.5.1 For technical grade

A.5.1.1 Reagent

A.5.1.1.1 Sodium chloride

A.5.1.1.2 Barium chloride solution – approximately 10 percent (w/v).

A.5.1.2 Procedure – Weigh, to the nearest 0.01 g, 10 g of the material into porcelain dish, add 0.5 of sodium chloride and evaporate to dryness. Moisten the residue with 1.000 g of the material, add 200 mL of boiling water and filter if necessary. Bring the contents to boil over a low flame and, add slowly and with stirring, 5 mL of hot barium chloride solution. Boil the contents for two minutes and allow the precipitate to settle for four hours. Filter the supernatant liquid through a tared sintered glass crucible (G No.4) or a tared Gooch crucible and transfer the precipitate carefully into the crucible. Wash thoroughly with hot water till free from chlorides. Heat the crucible at 105° to 110°C to constant weight.

A.5.1.3 Calculation

Sulphates (as H_2SO_4), percent by weight = $\frac{42.02 W}{11}$

Where

W = weight in g of the precipitate

A.5.2 For analytical reagent grade

A.5.2.1 Reagents

A.5.2.1.1 Sodium chloride

A.5.2.1.2 Hydrochloric acid – approximately 1 M, sulphate-free.

A.5.2.1.3 Barium chloride solution – same as in B. 5.1.1.2.

A.5.2.1.4 Standard sulphate solution – Dissolve 0.178 g of potassium sulphate in water and make up the volume to 100 mL. Dilute 100 mL of the solution in a graduated flask to 1000 mL. One millilitre of the diluted solution contains 0.01 mg of sulphate (as H_2SO_4).

A.5.2.2 Procedure – To 20.00 g of the material add 20 mg of sodium chloride and evaporate to dryness. Take up the residue with 5 mL of water and 0.5 mL of hydrochloric acid. Filter, wash with water to make up to 10 mL and add 1 mL of barium chloride solution. Carry out a control test in the same manner using 6 mL of standard sulphate solution in place of the material. Stir the two solutions and compare the turbidity produced.

The requirement prescribed in table 1 shall be taken as not having been exceeded if the turbidity produced with the material is not greater than that produced in the control test.

A.6 Test for Iron

A.6.1 Apparatus

Nessler tubes – 50 mL capacity.

A.6.2 Reagents

A.6.2.1 Ammonium persulphate

A.6.2.2 Butanolic potassium thiocyanate solution – Dissolve 10 g of potassium thiocyanate in 10 mL of water. Add sufficient n-butanol to make up to 100 mL and shake vigorously until the solution is clear.

A.6.2.3 Standard iron solution – Dissolve 0.702 g of iron (II) ammonium sulphate ($\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$) in about 50 mL of water containing about 10 mL of dilute sulphuric acid (10 percent v/v) and dilute to 1000 mL. Immediately before use, dilute 50 mL of the solution to 1 000 mL. One millilitre of the dilute solution contains 0.005 mg of iron (as Fe).

A.6.3 Procedure

A.6.3.1 For technical grade – Dilute 1.000 g of the material to 100 mL with water. Transfer 10 mL of this solution to a Nessler tube, add about 30 mg of ammonium persulphate and 15 mL of butanolic potassium thiocyanate solution. Shake vigorously for about 30 seconds and allow the layers to separate. Carry out a control test in another Nessler tube using the same reagents and in the same total volume, with 4 mL of standard iron solution in place of the material.

A.6.3.2 For analytical reagent grades – Weigh 50.0 g of the material and evaporate it to 10 mL. Dilute it to 30 mL; add about 30 mg of ammonium persulphate and 15 mL of butanolic potassium thiocyanate solution. Carry out the test as prescribed under B.6.3.1 using 10 mL of standard iron solution in the control test.

A.6.3.3 The requirement prescribed in table 1 shall be taken as not having been exceeded if the intensity of colour produced with the material is not greater than that produced in the respective control test.

A.7 Test for free chlorine and bromine**A.7.1 Reagents**

A.7.1.1 Potassium iodide solution – 2 percent (w/v).

A.7.1.2 Starch indicator solution – see annex C for its preparation

A.7.1.3 Standard sodium thiosulphate solution – 0.01 M, freshly standardized.

A.7.2 Procedure – Take 5.00 g of the material for technical grade or 25.0 g of the material analytical reagent grade, in a 100 mL gas-washing bottle and dilute to 50 mL with water. Connect this bottle to another gas-washing bottle containing 10 mL of potassium iodide solution diluted with 50 mL of water and containing 5 mL of starch solution. Aspirate a current of air through the first bottle for 15 minutes and then transfer the contents of the second bubbler into a conical flask. Titrate the solution against standard sodium thiosulphate solution till the blue colour disappears.

The relevant requirement prescribed in table 1 shall be taken as not having been exceeded if the volume of standard sodium thiosulphate solution required for the titration does not exceed:

- a) 2.8 mL in the case of technical grade,
- b) 0.15 mL in the case of analytical reagent grade.

A.8 Test for lead**A.8.1 Apparatus**

Nessler tubes – 50 mL capacity.

A.8.2 Reagents

A.8.2.1 *Ammonium hydroxide* – approximately 6 M.

A.8.2.2 *Acetic acid* – 33 percent (w/w).

A.8.2.3 Sodium sulphide solution – Dissolve 10 g sodium sulphide in sufficient quantity of water to produce 100 mL of solution. Filter and preserve in a dark bottle.

A.8.2.4 Standard lead solution – Dissolve 1.60 g of lead nitrate, in water, add 1 mL of concentrated nitric acid and dilute to 1 000 mL. Pipette out 10 mL of this solution and dilute again to 1 000 mL. 1 mL of the diluted solution contains 0.01 mg of lead (as Pb). This solution should be freshly prepared.

A.8.3 Procedure

A.8.3.1 For analytical reagent grade– Transfer 20 g of the material into a beaker and dilute to 25 mL with water. Neutralize with ammonium hydroxide. Acidify with 1 mL of acetic acid and transfer quantitatively to a Nessler tube. Add 10 drops of sodium sulphide solution and dilute the contents to mark. Carry out a control test in another Nessler tube using 4 mL of standard lead solution in place of the material. Compare the intensity of colour produced in the two tubes.

A.8.3.2 The requirements prescribed in table 1 shall be taken as not having been exceeded if the intensity of colour produced with the material is not greater than that produced in the control test.

A.9 Determination of sulphites**A.9.1 Reagents**

A.9.1.1 *Standard iodine solution* - 0.05 M, freshly standardized.

A.9.1.2 *Standard sodium thiosulphate solution* - 0.1 M, freshly standardized.

A.9.2 Procedure - introduce successively into a 500 mL glass-stoppered conical flask 100 mL of freshly boiled water and 10 mL of standard iodine solution. Add while cooling about 50 g of the material weighed to ± 0.01 g. Stopper the flask, mix and after 2 minutes, titrate the excess iodine with standard sodium thiosulphate solution, adding 5 mL of starch solution towards the end of the titration.

A.9.3 Calculation

Sulphites (as SO₂), percent by weight = $\frac{0.3203 (10-V)}{W}$

Where

V = volume in mL of standard sodium thiosulphate solution used in the titration, and

W = weight in g of the material taken for the test.

Annex B

(Normative)

Sampling of hydrochloric acid and conformity criteria**B.1 General requirements of sampling:**

In drawing, preparing and storing test samples, the followings precautions and directions shall be observed:

B.1.1 Samples shall not be taken in an exposed place.

B.1.2 The sampling instrument shall be clean and dry when used.

B.1.3 Precautions shall be taken to protect the samples the material being sampled, the sampling instrument and the containers for the samples from adventitious contamination.

B.1.4 To draw a representative sample, the contents of each container selected for sampling shall be mixed thoroughly by rolling, shaking or stirring by suitable means and with necessary caution.

B.1.5 The samples shall be placed in suitable clean, dry and air-tight glass containers.

B.1.6 Each sample container shall be sealed air-tight after filling and shall be marked with full details of sampling, the date of sampling and the year of manufacture of the material.

B.2 Scale of sampling

B.2.1 *Lot* – All containers in a single consignment of the material drawn from a single batch of manufacture shall constitute a lot. If a consignment is declared to consist of different batches of manufacture, the batches shall be marked separately, and the groups of each batch shall constitute separate lots.

B.2.2 Samples shall be tested from each lot separately for judging the conformity of the material to the requirements of the specification. For this purpose, five containers shall be selected at random from each lot.

NOTE – If the number of containers in the lot is eight or less, the number of containers to be selected and the criteria for conformity of the lot to the specification requirements shall be as agreed to between the purchaser and the vendor.

B.2.3 The containers shall be selected at random and to ensure randomness of selection, the following procedure is recommended for use:

Starting from any container in the lot, count them as 1, 2up to r and so on,

where r is the integral part of $N/5$ (N being the number of containers in the lot). Every r th container thus counted shall be withdrawn to constitute a sample till the required number of five containers is obtained.

B.3 Preparation of test samples

B.3.1 *Sampling tube* – The sampling tube shall be made of glass and shall be 20 mm to 40 mm in diameter and 350 mm to 750 mm in length. The upper and lower ends are conical and reach 6 to 12 diameters at the narrow ends. Handling is facilitated by two rings at the upper end.

For drawing sample, the apparatus is first closed at the top with the thumb or a stopper and lowered till a desired depth is reached. It is then opened for a short time to admit the material and finally closed and withdrawn.

Note: For small containers, the size of the sampling tube may be altered suitably.

B.3.2 From each of the containers selected according to A.2.3, a small representative portion of the material, about 200 mL shall be taken out with the help of the sampling tube after thoroughly stirring the acid with the help of a glass rod.

B.3.3 Out of these portions, a small but equal quantity of the material shall be taken out and thoroughly mixed to form a composite sample not less than 600 mL. The composite sample shall be divided into three equal parts, one for the purchaser, one for the vendor and the third to be used as a referee sample.

B.3.4 The remaining portion of the material from each container shall be divided into three equal parts, each forming an individual sample. One set of individual samples representing the five containers sampled shall be marked for the purchaser, another for the vendor and the third to be used as a referee sample.

B.3.5 All the individual and composite samples shall be transferred to separate bottles. These bottles shall be sealed and labeled with full identification particulars.

B.3.6 The referee samples consisting of composite sample and a set of five individual samples shall bear the seals of the purchaser and the vendor. They shall be kept at a place agreed to between the purchaser and the vendor, to be used in the case of a dispute between the two.

B.4 Number of tests

B.4.1 Tests for the determination of specific gravity and hydrochloric acid shall be performed on each of the five individual samples.

B.4.2 Tests for the determination of all other characteristics listed in table 1 shall be performed on the composite sample only.

B.5 Criteria for conformity

B.5.1 For individual samples – From each set of five test results for specific gravity and hydrochloric acid percentage by mass, the mean (\bar{x}) and range (R) ($\bar{x} - 0.6 R$) as calculated from the relevant test results is greater than or equal to the minimum value specified in columns 3, 4 and 5 of table 1 (depending of the grade of hydrochloric acid under consideration).

B.5.2 For composite sample – From declaring the conformity of the lot to the requirements of all other characteristics tested on the composite sample, the test result for each of the characteristics shall satisfy the relevant requirement specified in table 1.

Annex C

(Normative)

Preparation of Starch Solution**C. 1 Introduction**

This procedure contains two recipes for preparing starch solution—the traditional method and the spray starch method. With the traditional method, soluble starch is added to boiling water. The spray starch method simply requires spraying spray starch into a container of water.

C.2 Materials**C.2.1 Traditional Method**

Soluble starch, 1 g

Water, distilled or deionized, 100 mL Water, 100 mL

Balance mL

Beaker, 250-mL mL

Graduated cylinder, 100-mL Stirring rod

Hot plate

C.2.2 Spray Starch Method

Spray starch (the type used for ironing)

Water, 100 mL

Beaker, 250-mL

Graduated cylinder, 100-mL

Stirring rod

Note: Safety Precautions

This activity requires the use of hazardous components and/or has the potential for hazardous reactions. Avoid spraying starch onto the floor as this may cause the floor to become slippery. Avoid spraying starch in the direction of anyone's face or eyes. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

C.3 Procedure**C.3.1 Traditional Method for preparing 100 mL of a 1% starch solution.**

1. Place 100 mL of distilled or deionized water in a 250-mL beaker and bring to boiling on a hot plate.
2. Make a smooth paste with 1 g of soluble starch and a small volume (several milliliters or so) of distilled or deionized water.

3. Once the water is boiling, carefully remove the beaker containing the boiling water from the hot plate. Pour the starch paste into the boiling water and stir until all of the starch is dissolved. The resulting solution may be somewhat cloudy.

4. Allow the starch solution to cool to room temperature before use. *Note:* This is especially important if the starch solution is to be used in a kinetics experiment where temperature is a factor.

C.3.2 Spray Starch Method for preparing 100 mL of a starch solution.

1. Pour 100 mL of distilled or deionized water into a 250-mL beaker.

2. Generously spray the spray starch into the water. Spray until the solution appears slightly blue in colour (at least 10 sec).

3. Stir the solution to mix and allow the foam to settle. This may take up to 10 minutes.

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