INTERNATIONAL STANDARD

ISO 424

Second edition
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Photography — Processing chemicals — Specifications for anhydrous sodium carbonate and sodium carbonate monohydrate

Photographie — Produits chimiques de traitement — Spécifications pour le carbonate de sodium anhydre et monohydraté

Reference number
ISO 424:1994(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 424 was prepared by Technical Committee ISO/TC 42, *Photography*.

This second edition cancels and replaces the first edition (ISO 424:1976) and ISO 3942:1976.

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Introduction

0.1 This International Standard is one of a series that establishes criteria of purity for chemicals used in processing photographic materials. General test methods and procedures cited in this International Standard are compiled in parts 1, 5, 6 and 9 of ISO 10349.

This International Standard is intended for use by individuals with a working knowledge of analytical techniques, which may not always be the case. Some of the procedures utilize caustic, toxic or otherwise hazardous chemicals. Safe laboratory practice for the handling of chemicals requires the use of safety glasses or goggles, rubber gloves and other protective apparel such as face masks or aprons where appropriate. Normal precautions required in the performance of any chemical procedure are to be exercised at all times but care has been taken to provide warnings for hazardous materials. Hazard warnings designated by a letter enclosed in angle brackets, < >, are used as a reminder in those steps detailing handling operations and are defined in ISO 10349-1. More detailed information regarding hazards, handling and use of these chemicals may be available from the manufacturer.

0.2 This International Standard provides chemical and physical requirements for the suitability of a photographic-grade chemical. The tests correlate with undesirable photographic effects. Purity requirements are set as low as possible consistent with these photographic effects. These criteria are considered the minimum requirements necessary to assure sufficient purity for use in photographic processing solutions, except that if the purity of a commonly available grade of chemical exceeds photographic processing requirements and if there is no economic penalty in its use, the purity requirements have been set to take advantage of the availability of the higher-quality material. Every effort has been made to keep the number of requirements to a minimum. Inert impurities are limited to amounts which will not unduly reduce the assay. All tests are performed on samples "as received" to reflect the condition of materials furnished for use. Although the ultimate criterion for suitability of such a chemical is its successful performance in an appropriate use test, the shorter, more economical test methods described in this International Standard are generally adequate.

Assay procedures have been included in all cases where a satisfactory method is available. An effective assay requirement serves not only as a safeguard of chemical purity but also as a valuable complement to the identity test. Identity tests have been included whenever a possibility exists that another chemical or mixture of chemicals could pass the other tests.

All requirements listed in clause 4 are mandatory. The physical appearance of the material and any footnotes are for general information only and are not part of the requirements.

0.3 Efforts have been made to employ tests which are capable of being run in any normally equipped laboratory and, wherever possible, to avoid tests which require highly specialized equipment or techniques. Instrumental methods have been specified only as alternative methods or alone in those cases where no other satisfactory method is available.

Over the past few years, great improvements have been made in instrumentation for various analyses. Where such techniques have equivalent or greater precision, they may be used in place of the tests described in this International Standard. Correlation of such alternative procedures with the given method is the responsibility of the user. In case of disagreement in results, the method called for in the specification shall prevail. Where a requirement states "to pass test", however, alternative methods shall not be used.

Photography — Processing chemicals — Specifications for anhydrous sodium carbonate and sodium carbonate monohydrate

1 Scope

This International Standard establishes criteria for the purity of photographic-grade anhydrous sodium carbonate and sodium carbonate monohydrate and specifies the test methods to be used to determine the purity.

2 Normative references

The following International Standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 10349-1:1992, *Photography — Photographic-grade chemicals — Test methods — Part 1: General.*

ISO 10349-5:1992, *Photography — Photographic-grade chemicals — Test methods — Part 5: Determination of heavy metals and iron content.*

ISO 10349-6:1992, *Photography — Photographic-grade chemicals — Test methods — Part 6: Determination of halide content.*

ISO 10349-9:1992, *Photography — Photographic-grade chemicals — Test methods — Part 9: Reaction to ammoniacal silver nitrate.*

3 General

3.1 Physical properties

Anhydrous sodium carbonate, Na_2CO_3, exists in the form of white granules or powder. It has a relative molecular mass of 105,99.

Sodium carbonate monohydrate, $Na_2CO_3 \cdot H_2O$, exists in the form of white crystalline granules. It has a relative molecular mass of 124,00.

3.2 Hazardous properties

Sodium carbonate is not hazardous when handled with normal precautions.

3.3 Handling and storage

Sodium carbonate shall be stored in a closed container at room temperature.

4 Requirements

A summary of the requirements is shown in table 1.

5 Reagents and glassware

All reagents, materials and glassware shall conform to the requirements specified in ISO 10349-1 unless otherwise noted. The hazard warning symbols used as a reminder in those steps detailing handling operations are defined in ISO 10349-1. These symbols are used to provide information to the user and are not meant to provide conformance with hazardous labelling requirements, as these vary from country to country.

6 Sampling

See ISO 10349-1.

7 Test methods

7.1 Assay

7.1.1. Specifications

Content of anhydrous sodium carbonate, Na_2CO_3, shall be 98,0 % (*m/m*) min.

Content of sodium carbonate monohydrate, $Na_2CO_3 \cdot H_2O$, shall be 98,5 % (*m/m*) min.

Table 1 — Summary of requirements

Test	Limit	Subclause	International Standard in which test method is given
Assay			
anhydrous	98,0 % (*m*/*m*) min.	7.1	ISO 424
monohydrate	98,5 % (*m*/*m*) min.	7.1	ISO 424
Heavy metals (as Pb)	0,001 % (*m*/*m*) max.	7.2	ISO 10349-5
Iron (Fe)	0,002 % (*m*/*m*) max.	7.3	ISO 10349-5
Halides (as Cl)			
anhydrous	0,35 % (*m*/*m*) max.	7.4	ISO 10349-6
monohydrate	0,30 % (*m*/*m*) max.	7.4	ISO 10349-6
Reaction to ammoniacal siver nitrate	To pass test	7.5	ISO 10349-9
Free alkali (as NaOH)			
anhydrous	0,20 % (*m*/*m*) max.	7.6	ISO 424
monohydrate	0,17 % (*m*/*m*) max.	7.6	ISO 424
Bicarbonate (as $NaHCO_3$)			
anhydrous	0,7 % (*m*/*m*) max.	7.7	ISO 424
monohydrate	0,6 % (*m*/*m*) max.	7.7	ISO 424
Appearance of solution	Clear and free from insoluble matter except for a slight flocculence	7.8	ISO 424

NOTE – *m*/*m* = mass/mass

7.1.2 Reagents

7.1.2.1 Hydrochloric acid, HCl, standard volumetric solution of 1,00 mol/l (36,5 g/l)[1) 2) 3)].

7.1.2.2 Methyl orange indicator solution, 0,4 g/l.

7.1.3 Apparatus

7.1.3.1 Burette, of 50 ml capacity.

7.1.4 Procedure

Weigh, to the nearest 0,001 g, a test portion of about 2,0 g of the sample and dissolve it in 50 ml of water. Add 2 drops of the methyl orange indicator solution (7.1.2.2) and titrate with the hydrochloric acid (7.1.2.1) to the colour change from yellow to red.

7.1.5 Expression of results

The assay, expressed as a percentage by mass, for anhydrous sodium carbonate (Na_2CO_3), is given by

$$5{,}30\ cV/m$$

The assay, expressed as a percentage by mass, for sodium carbonate monohydrate ($Na_2CO_3 \cdot H_2O$), is given by

$$6{,}20\ cV/m$$

where

c is the actual concentration, expressed in moles per litre, of the hydrochloric acid (7.1.2.1);

V is the volume, in millilitres, of the hydrochloric acid (7.1.2.1) used to reach the titration endpoint;

m is the mass, in grams, of the test portion;

5,30 is a conversion factor obtained from the mass of anhydrous sodium carbonate equivalent to 1 mole of hydrochloric acid (i.e. 53,0) × the conversion factor for millilitres to litres (i.e. 0,001) × 100 (for percentage);

1) Hazard warning codes are defined in ISO 10349-1.

2) Commercially available analysed reagents are recommended. If solutions are to be prepared, see any quantitative analytical chemistry text.

3) This can be prepared from hydrochloric acid, $\rho \approx 1{,}18$ g/l (DANGER:<C><B>).

6,20 is a conversion factor obtained from the mass of sodium carbonate monohydrate equivalent to 1 mole of hydrochloric acid solution (i.e. 62,0) × the conversion factor for millilitres to litres (i.e. 0,001) × 100 (for percentage).

7.2 Heavy metals content

7.2.1 Specification

Maximum content of heavy metals shall be 0,001 % (*m/m*).

7.2.2 Procedure

NOTE 1 The standard for the iron test (7.3) is prepared in the same way as the heavy metals standard.

Determine the percentage of heavy metals in accordance with ISO 10349-5. Use a test portion of 4,90 g to 5,10 g of the sample prepared in accordance with ISO 10349-5:1992, 7.3. Use 5 ml of the heavy metals standard prepared in accordance with ISO 10349-5:1992, 8.1.2.

7.3 Iron content

7.3.1 Specification

Maximum content of iron shall be 0,002 % (*m/m*).

7.3.2 Procedure

Determine the percentage of iron in accordance with ISO 10349-5. Use a test portion of 4,90 g to 5,10 g of the sample prepared in accordance with ISO 10349-5:1992, 7.3. Use 10 ml of the iron standard prepared in accordance with ISO 10349-5:1992, 8.1.2.

7.4 Halide content (as Cl)

7.4.1 Specifications

Maximum halide content in anhydrous sodium carbonate, Na_2CO_3, shall be 0,35 % (*m/m*).

Maximum halide content in sodium carbonate monohydrate, $Na_2CO_3 \cdot H_2O$, shall be 0,30 % (*m/m*).

7.4.2 Procedure

Determine the percentage of halides (expressed as Cl) in accordance with ISO 10349-6. Use 35 ml of the halide standard solution A for anhydrous sodium carbonate and 30 ml for sodium carbonate monohydrate.

7.5 Reaction to ammoniacal silver nitrate

7.5.1 Specification

To pass test.

7.5.2 Procedure

Determine the reaction to ammoniacal silver nitrate in accordance with ISO 10349-9.

7.6 Free alkali content (as NaOH)

7.6.1 Specifications

Maximum free alkali content in anhydrous sodium carbonate, Na_2CO_3, shall be 0,20 % (*m/m*).

Maximum free alkali content in sodium carbonate monohydrate, $Na_2CO_3 \cdot H_2O$, shall be 0,17 % (*m/m*).

7.6.2 Reagents

7.6.2.1 Barium chloride, $BaCl_2$, neutral solution, 1 mol/l.

Dissolve 244 g of barium chloride dihydrate ($BaCl_2 \cdot 2H_2O$) (DANGER:<S>)[1] in 1 litre of carbon-dioxide-free water. Check that it is neutral to phenolphthalein indicator solution (7.6.2.6) and, if not, adjust with a few drops of sodium hydroxide solution (7.6.2.3).

7.6.2.2 Hydrochloric acid, HCl, 0,100 mol/l (3,65 g/l)[2) 3)].

7.6.2.3 Sodium hydroxide, NaOH, 0,100 mol/l (4,0 g/l)[2) 4)].

7.6.2.4 Ethanol, C_2H_5OH, 95 % (denatured).

7.6.2.5 Phenolphthalein indicator, ethanol/water solution, 5 g/l.

Dissolve 0,5 g of phenolphthalein in 50 ml of ethanol (7.6.2.4) and add 50 ml of water with constant stirring. Filter if necessary.

7.6.3 Apparatus

7.6.3.1 Pipette, of 25 ml capacity.

7.6.3.2 Burette, of 50 ml capacity.

7.6.4 Procedure

Weigh, to the nearest 0,1 g, a test portion of about 2 g and dissolve it in 30 ml of freshly boiled water in a 125 ml stoppered conical flask. Using the pipette

4) This can be prepared from sodium hydroxide (DANGER:<<C>>).

(7.6.3.1), add 25 ml of the neutral barium chloride solution (7.6.2.1) followed by 10 drops of the phenolphthalein indicator (7.6.2.5) and mix well. If the solution has a pink colour, titrate with the hydrochloric acid (7.6.2.2) until the colour is discharged. (If no pink colour is produced, proceed to 7.7, using the same solution.)

7.6.5 Expression of results

The free alkali content, expressed as a percentage by mass, as NaOH, is given by

$$4{,}0\ cV/m$$

where

c is the actual concentration, expressed in moles per litre, of the hydrochloric acid (7.6.2.2);

V is the volume, in millilitres, of hydrochloric acid used for the titration;

m is the mass, in grams, of the test portion;

4,0 is a conversion factor obtained from the mass of sodium hydroxide equivalent to 1 mole of hydrochloric acid (i.e. 40,0) × the conversion factor for millilitres to litres (i.e. 0,001) × 100 (for percentage).

A maximum free alkali content (as NaOH) of 0,20 % for anhydrous sodium carbonate is equivalent to no more than 1,0 ml of the hydrochloric acid (7.6.2.2) used to discharge the pink colour.

A maximum free alkali content (as NaOH) of 0,17 % sodium carbonate monohydrate is equivalent to no more than 0,85 ml of the hydrochloric acid (7.6.2.2) used to discharge the pink colour.

7.7 Bicarbonate content

7.7.1 Specifications

Maximum bicarbonate content, as $NaHCO_3$, in anhydrous sodium carbonate, Na_2CO_3, shall be 0,7 % (*m*/*m*).

Maximum bicarbonate as $NaHCO_3$, in sodium carbonate monohydrate, $Na_2CO_3 \cdot H_2O$, shall be 0,6 % (*m*/*m*).

7.7.2 Reagents

As specified in 7.6.2.

7.7.3 Apparatus

As specified in 7.6.3.

7.7.4 Procedure

If the solution from 7.6.4 is not pink, then titrate with the sodium hydroxide (7.6.2.3) until a faint pink colour, which persists for 30 s, is obtained.

7.7.5 Expression of results

The bicarbonate content, expressed as a percentage by mass, as $NaHCO_3$, is given by

$$8{,}4\ cV/m$$

where

c is the actual concentration, expressed in moles per litre, of the sodium hydroxide (7.6.2.3);

V is the volume, in millilitres, of the sodium hydroxide used for the titration;

m is the mass, in grams, of the test portion;

8,4 is a conversion factor obtained from the mass of sodium bicarbonate equivalent to 1 mole of hydrochloric acid (i.e. 84,0) × the conversion factor for millilitres to litres (i.e. 0,001) × 100 (for percentage).

A maximum bicarbonate content (as $NaHCO_3$) of 0,7 % for anhydrous sodium carbonate is equivalent to no more than 1,7 ml of the sodium hydroxide (7.6.2.3) used to produce a faint pink colour persisting for 30 s.

A maximum bicarbonate content (as $NaHCO_3$) of 0,6 % for sodium carbonate monohydrate is equivalent to no more than 1,5 ml of the sodium hydroxide (7.6.2.3) used to produce a faint pink colour persisting for 30 s.

7.8 Appearance of solution

7.8.1 Specification

The solution shall be clear and free from insoluble matter except for a slight flocculence.

7.8.2 Procedure

For anhydrous sodium carbonate, dissolve 200 g of the sample in 1 litre of water and examine for colour and clarity.

For sodium carbonate monohydrate, dissolve 235 g of the sample in 1 litre of water and examine for colour and clarity.

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