
Safety of toys —

Part 10:

**Experimental sets for chemistry and
related activities**

Sécurité des jouets —

Partie 10: Coffrets d'expériences chimiques et activités connexes

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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.

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

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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

This document was prepared by Technical Committee ISO/TC 181, *Safety of toys*.

This second edition cancels and replaces the first edition (ISO 8124-10:2019), which has been technically revised. The main changes are given in [Annex C](#).

A list of all parts in the ISO 8124 series can be found on the ISO website.

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

Introduction

This document is largely based upon an existing standard in the European Union (EN 71-4).

Conformity with the requirements of this document will reduce the risks and health hazards to children when experimental sets involving chemical experiments are used as intended or in a foreseeable way, bearing in mind the behaviour of children.

During use of these experimental sets, hazards should be kept to a minimum by the provision of appropriate information to make the experiments safe and controllable. Therefore, this document specifies warning phrases and instructions for use with experimental sets.

As a general rule, experimental sets are designed and manufactured for particular ages of children. Their characteristics are related to the age and stage of development of the children, and their use presupposes certain aptitudes. Age requirements are therefore given.

The requirements of this document do not release parents or carers from their responsibility of watching over a child while he or she is carrying out experiments. On the contrary, the use of these sets requires close supervision by adults.

Products covered by this document can be subject to legal requirements specific to the jurisdiction in which they are sold and conformity with the requirements in this document cannot be relied on to ensure compliance with those requirements.

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Safety of toys —

Part 10: Experimental sets for chemistry and related activities

1 Scope

This document specifies requirements for the maximum amount and, in some cases, the maximum concentration of certain substances and mixtures used in experimental sets for chemistry and related activities.

These substances and mixtures are:

- those classified as dangerous by the *Globally Harmonized System of Classification and Labelling of Chemicals* (GHS);^[3]
- substances and mixtures which in excessive amounts could harm the health of the children using them and which are not classified as dangerous by the GHS;
- any other chemical substance(s) and mixture(s) delivered with the experimental set.

This document applies to experimental sets for chemistry and related activities, including chemistry sets, crystal-growing sets, carbon-dioxide-generating experimental sets and supplementary sets.

This document also specifies requirements for marking, a contents list, instructions for use, eye protection and the equipment intended for carrying out the experiments.

This document does not apply to combined sets, for example a combination of a chemistry set and a crystal-growing set.

Requirements for certain other chemical toys are given in ISO 8124-11.

See [Clause A.1](#).

2 Normative references

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

ISO 48-5, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 5: Indentation hardness by IRHD pocket meter method*

ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 8124-1, *Safety of toys — Part 1: Safety aspects related to mechanical and physical properties*

ISO 8124-11, *Safety of toys — Part 11: Chemical toys (sets) other than experimental sets*

ISO 8317, *Child-resistant packaging — Requirements and testing procedures for reclosable packages*

EN 862, *Packaging — Child-resistant packaging — Requirements and testing procedures for non-reclosable packages for non-pharmaceutical products*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1
chemical toy
toy intended for the direct handling of chemical substances and mixtures and which is used in a manner appropriate to a given age group and under the supervision of an adult

[SOURCE: ISO 8124-2:2014, 3.1]

3.2
experimental set
chemical toy (3.1) in which the experimental and explorative character in playing with single chemical substances and mixtures is guided by strict instructions that dominate over the creative ideas of the user

3.3
chemistry set
experimental set (3.2) consisting of one or more chemical substances and/or mixtures, with or without equipment, intended for carrying out chemical experiments

Note 1 to entry: The definition also covers experimental sets for chemical experiments within the fields of mineralogy, biology, physics, microscopy and environmental sciences whenever they contain one or more chemical substances and/or mixtures which are classified as hazardous according to the GHS, excluding *crystal-growing sets* (3.4) and *carbon-dioxide-generating experimental sets* (3.5).

3.4
crystal-growing set
experimental set (3.2) consisting of one or more chemical substances for growing crystals without any reaction between the supplied substances

Note 1 to entry: A crystal-growing set is used to grow crystals of different substances in aqueous solutions. The crystals can be grown on different materials (e.g. stones or gypsum) and can be coloured in different ways (e.g. with food colours). The expanding nature of the growing crystal is not subject to requirements within ISO 8124-1 for expanding materials, as the expansion is not related to the absorption of water in the crystal and the expansion usually takes place over a long period of time (several days or weeks).

3.5
carbon-dioxide-generating experimental set
experimental set (3.2) consisting mainly of a carbon-dioxide-donor substance or mixture and a carbon-dioxide-liberating substance or mixture which, after combination, generate carbon dioxide in the presence of water in an open system without any gas-tight restriction or confinement

Note 1 to entry: The set is used to carry out and observe chemical reactions where there is no intention to generate carbon dioxide in order to demonstrate speed, velocity or noise.

3.6
supplementary set
incomplete *experimental set* (3.2) which is intended to be used with a complete *experimental set* (3.2)

4 Chemical substances in experimental sets (see [Clause A.2](#))

4.1 Chemistry sets

4.1.1 Inclusion in the chemistry set

The chemical substances, mixtures and indicators given in [Table 1](#) and [Table 2](#) may be supplied in chemistry sets or in a supplementary set for a chemistry set up to the amounts and concentrations specified in those tables.

The quality of the chemicals used should be appropriate for the experiments described. In particular, the chemicals should not contain impurities or substances that allow undefined or dangerous reactions to occur.

NOTE 1 Information on the quality of chemicals can be obtained from manufacturers.

Furthermore, colourants and colouring materials which are not specified in [Table 2](#) may only be supplied in chemistry sets if they do not react with the substances and mixtures of the set and if they do not fulfil the criteria of any of the following hazard classes:

- “acute toxicity” (hazard class 3.1);
- “skin corrosion/irritation” (hazard class 3.2);
- “serious eye damage/eye irritation” (hazard class 3.3);
- “respiratory or skin sensitisation” (hazard class 3.4);
- “germ cell mutagenicity” (hazard class 3.5);
- “carcinogenicity” (hazard class 3.6);
- “reproductive toxicity” (hazard class 3.7);
- “specific target organ toxicity — single exposure” (hazard class 3.8);
- “specific target organ toxicity — repeated exposure” (hazard class 3.9);
- “aspiration hazard” (hazard class 3.10).

Colourants which are permitted for use in food or cosmetics may be provided.

NOTE 2 The classification is detailed in the GHS (Part 3: Health Hazards).^[3]

Besides the chemical substances, mixtures and indicators given in [Table 1](#) and [Table 2](#) and colourants and colouring materials, only foodstuffs and additives permitted for use in food and their mixtures may be supplied in chemistry sets, if pure additives permitted for use in food are not classified as hazardous substances or mixtures are not classified as hazardous mixtures.

NOTE 3 Samples of rocks, stones and minerals on which to perform experiments in order to distinguish their composition are sometimes supplied with the set.

4.1.2 Inclusion for experiments (as mentioned in the instructions but not supplied in the chemistry set)

See [Clause A.3](#).

The use of reagents listed in [Table 3](#) may be suggested in the instructions at concentrations not exceeding those specified. The substances specified in [Table 3](#) shall not be supplied in a chemistry set.

Apart from its presence in tincture of iodine, denatured alcohol (ethanol) shall not be supplied in a chemistry set. However, where experiments contained in the instructions of a chemistry set require it, the use of denatured alcohol may be suggested in the instructions.

The instructions for use may suggest the use of other substances that are not classified as hazardous substances or mixtures that are not classified as hazardous mixtures (e.g. sucrose, table sugar, starch, flour).^[3]

4.1.3 Requirements for packaging in containers

The substances and mixtures in [Tables 1](#) and [2](#) in a chemistry set or in a supplementary set of a chemistry set shall be supplied in containers (see [5.2.3](#)) which are provided with closures (see [5.2.4.1](#)).

Table 1 — Maximum amounts of chemical substances and mixtures for chemistry sets and labelling

Chemical substance or mixture	Maximum amount per set	GHS pictograms (see Figure 1)	Signal word	CAS Registry Number ^{®e}	EINECS number	INDEX number
Aluminium potassium sulfate	10 g	—	—	10043-67-1	233-141-3	—
Ammonium carbonate	5 g	GHS07	Warning	10361-29-2	233-786-0	—
Ammonium chloride	30 g	GHS07	Warning	12125-02-9	235-186-4	017-014-00-8
Ammonium iron (III) sulfate	5 g	GHS05	Danger	10138-04-2	233-382-4	—
Ammonium sodium hydrogen phosphate	5 g	—	—	13011-54-6	235-860-8	—
Calcium carbonate	100 g	—	—	471-34-1	207-439-9	—
Calcium chloride	10 g	GHS07	Warning	10043-52-4	233-140-8	017-013-00-2
Calcium hydroxide ^a	20 g	GHS05, GHS07	Danger	1305-62-0	215-137-3	—
Calcium nitrate	5 g	GHS03, GHS05, GHS07	Danger	10124-37-5	233-332-1	—
Calcium oxide ^a	10 g	GHS05, GHS07	Danger	1305-78-8	215-138-9	—
Calcium sulfate	100 g	—	—	7778-18-9	231-900-3	—
Charcoal ^b	100 g	—	—	7440-44-0	231-153-3	—
Citric acid	20 g	GHS07	Warning	77-92-9	201-069-1	—
Copper sheet	100 g	—	—	7440-50-8	231-159-6	—
Copper (II) oxide	10 g	GHS07, GHS09	Warning	1317-38-0	215-269-1	029-016-00-6
Copper (II) sulfate	15 g	GHS05, GHS07, GHS09	Danger	7758-98-7	231-847-6	029-004-00-0
Disodium disulfite	10 g	GHS05, GHS07	Danger	7681-57-4	231-673-0	016-063-00-2

^a Only one of these substances shall be provided in each set.

^b Generally, IUPAC chemical nomenclature is used with the exception of these substances.

^c Only to be provided in chemistry sets intended for children over 12 years of age.

^d Denatured alcohol (ethanol).

^e Chemical Abstracts Service (CAS) Registry Number[®] is a trademark of the American Chemical Society (ACS). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.

Table 1 (continued)

Chemical substance or mixture	Maximum amount per set	GHS pictograms (see Figure 1)	Signal word	CAS Registry Number ^{®e}	EINECS number	INDEX number
Glycerol (containing at least 15 % water)	25 g	—	—	56-81-5	200-289-5	—
Hexamethylene-tetramine ^b (solid fuel)	10 g	GHS02, GHS07	Warning	100-97-0	202-905-8	612-101-00-2
Iron filings ^b	100 g	GHS02	Warning	7439-89-6	231-096-4	—
Iron powder ^b	100 g	GHS02	Danger	7439-89-6	231-096-4	—
Iron (III) chloride	10 g	GHS05, GHS07	Danger	7705-08-0	231-729-4	—
Iron (II) sulfate	10 g	GHS07	Warning	7720-78-7	231-753-5	026-003-00-7
Lactose	100 g	—	—	63-42-3	200-559-2	—
Lead-free solder	100 g	—	—	—	—	—
Magnesium strip	3 g	GHS02	Warning	7439-95-4	231-104-6	012-001-00-3
Magnesium sulfate	25 g	—	—	7487-88-9	231-298-2	—
Manganese (IV) dioxide	5 g	GHS07, GHS08	Danger	1313-13-9	215-202-6	025-001-00-3
Manganese (II) sulfate	15 g	GHS05, GHS08, GHS09	Danger	7785-87-7	232-089-9	025-003-00-4
Ninhydrin	1 g	GHS07	Warning	485-47-2	207-618-1	—
Pepsin A	10 g	GHS07, GHS08	Danger	9001-75-6	232-629-3	647-008-00-6
Potassium bromide	15 g	GHS07	Warning	7758-02-3	231-830-3	—
Potassium hexacyanoferrate (III) ^b	10 g	GHS07	Warning	13746-66-2	237-323-3	—
Potassium hexacyanoferrate (II) ^b	10 g	—	—	13943-58-3	237-722-2	—
Potassium iodide	10 g	GHS08	Danger	7681-11-0	231-659-4	—
Potassium permanganate ^c	15 g	GHS03, GHS07, GHS08, GHS09	Danger	7722-64-7	231-760-3	025-002-00-9
Potassium permanganate: sodium sulfate mixture (1:2) (mass fraction)	10 g	GHS03, GHS07, GHS08, GHS09	Danger	—	—	—
Silver nitrate (0,01 g/ml mass concentration aqueous solution)	10 ml	GHS05, GHS07, GHS09	Warning	7761-88-8	231-853-9	047-001-00-2
Sodium acetate	20 g	—	—	127-09-3	204-823-8	—
Sodium carbonate	50 g	GHS07	Warning	497-19-8	207-838-8	011-005-00-2
Sodium chloride	100 g	—	—	7647-14-5	231-598-3	—

^a Only one of these substances shall be provided in each set.

^b Generally, IUPAC chemical nomenclature is used with the exception of these substances.

^c Only to be provided in chemistry sets intended for children over 12 years of age.

^d Denatured alcohol (ethanol).

^e Chemical Abstracts Service (CAS) Registry Number[®] is a trademark of the American Chemical Society (ACS). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.

Table 1 (continued)

Chemical substance or mixture	Maximum amount per set	GHS pictograms (see Figure 1)	Signal word	CAS Registry Number ^{®e}	EINECS number	INDEX number
Sodium hydrogen carbonate	50 g	—	—	144-55-8	205-633-8	—
Sodium hydrogen sulfate	30 g	GHS05	Danger	7681-38-1	231-665-7	016-046-00-X
Sodium silicate solution (SiO ₂ :Na ₂ O > 2)	100 ml	GHS05	Danger	1344-09-8	215-687-4	—
Sodium sulfate	100 g	—	—	7757-82-6	231-820-9	—
Sodium thiosulfate	50 g	—	—	7772-98-7	231-867-5	—
Sulfur	15 g	GHS07	Warning	7704-34-9	231-722-6	016-094-00-1
Tannin	15 g	—	—	1401-55-4	215-753-2	—
Tartaric acid	20 g	GHS05	Danger	87-69-4	201-766-0	—
Tin (II) chloride	15 g	GHS05, GHS07, GHS08, GHS09	Danger	7772-99-8	231-868-0	—
Tincture of iodine ^b (0,025 g/ml mass concentration ethanolic solution) ^d	10 ml	GHS02, GHS07, GHS08	Danger	7553-56-2	231-442-4	053-001-003
Urea ^b	10 g	—	—	57-13-6	200-315-5	—
Zinc powder (stabilized) or zinc pellets	20 g	GHS09	Warning	7440-66-6	231-175-3	030-001-01-9
Zinc sulfate (heptahydrate)	20 g	GHS05, GHS07, GHS09	Danger	7446-20-0	231-793-3	030-006-00-9
<p>^a Only one of these substances shall be provided in each set.</p> <p>^b Generally, IUPAC chemical nomenclature is used with the exception of these substances.</p> <p>^c Only to be provided in chemistry sets intended for children over 12 years of age.</p> <p>^d Denatured alcohol (ethanol).</p> <p>^e Chemical Abstracts Service (CAS) Registry Number[®] is a trademark of the American Chemical Society (ACS). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.</p>						

If indicators are supplied in solution, their solid contents shall not exceed the amounts and concentrations specified in [Table 2](#).

Non-bleeding indicators in books, pads or rolls are not of toxicological concern and are sometimes supplied without any quantity limitations for the relevant indicator(s).

Table 2 — Maximum amounts and concentrations of indicators for chemistry sets and labelling

Chemical substance or mixture	Maximum amount per set	GHS pictograms (see Figure 1)	Signal word	CAS Registry Number	EINECS number	INDEX number
Eosin	1 g	GHS07	Warning	17372-87-1	241-409-6	—
Iodine [0,025 g/ml mass concentration in an aqueous solution (0,025 g/ml mass concentration) of potassium iodide]	10 ml	GHS08	Warning	7553-56-2	231-442-4	053-001-00-3
Litmus blue	1 g	—	—	1393-92-6	215-739-6	—
Litmus red	1 g	—	—	1393-92-6	215-739-6	—
Luminol [5 % (mass fraction) mixture with sodium sulfate]	3 g	—	—	521-31-3	208-309-4	—
Methyl orange [15 % (mass fraction) mixture with sodium sulfate]	3 g	GHS07	Warning	547-58-0	208-925-3	—
Methylene blue	1 g	GHS07	Warning	61-73-4	200-515-2	—
Phenol red	1 g	GHS07	Warning	143-74-8	205-609-7	—
Thymol blue	1 g	—	—	76-61-9	200-973-3	—
Bleeding universal indicator paper	1 pad	—	—	—	—	—

If not mentioned otherwise, the maximum amounts of the solid substances in [Table 1](#) and [Table 2](#) refer to the anhydrous chemicals. Equivalent amounts of the hydrated chemicals may replace the anhydrous substances.

Table 3 — Maximum concentration of reagents not supplied with the chemistry set and labelling

Reagent	Maximum concentration mol/l	GHS pictograms (see Figure 1)	Signal word	CAS Registry Number	EINECS number	INDEX number
Ammonia solution	2	GHS05	Danger	1336-21-6	215-647-6	007-001-01-2
Hydrochloric acid	2	GHS05	Warning	7647-01-0	231-595-7	017-002-01-X
Hydrogen peroxide ^a	1	—	—	7722-84-1	231-765-0	008-003-00-9
Sodium hydroxide solution	1	GHS05	Danger	1310-73-2	215-185-5	011-002-00-6

Additional units (e.g. percentage) may also be used, for example, on the packaging or the instructions for use.

^a The concentration of hydrogen peroxide is equivalent to a 3 % (volume fraction) solution.



a) GHS02



b) GHS03



c) GHS05



d) GHS07



e) GHS08



f) GHS09

The use of these pictograms shall comply with the requirements in the GHS.

SOURCE: GHS.^[3]

Figure 1 — GHS pictograms

4.2 Crystal-growing sets

See [Clause A.4](#).

The chemical substances given in [Table 4](#) may be supplied in crystal-growing sets or in a supplementary set for a crystal-growing set up to the amounts specified.

A crystal-growing set shall only contain substances which cannot react with each other.

The quality of the chemicals used in crystal-growing sets should be appropriate for the experiments described; in particular, the chemicals should not contain impurities or substances which allow undefined or dangerous reactions to occur.

Besides the chemical substances given in [Table 4](#), only colourants and colouring materials which do not fulfil the criteria of any of the following hazard classes shall be supplied in crystal-growing sets:

- “acute toxicity” (hazard class 3.1);
- “skin corrosion/irritation” (hazard class 3.2);
- “serious eye damage/eye irritation” (hazard class 3.3);
- “respiratory or skin sensitisation” (hazard class 3.4);
- “germ cell mutagenicity” (hazard class 3.5);
- “carcinogenicity” (hazard class 3.6);
- “reproductive toxicity” (hazard class 3.7);
- “specific target organ toxicity — single exposure” (hazard class 3.8);
- “specific target organ toxicity — repeated exposure” (hazard class 3.9);
- “aspiration hazard” (hazard class 3.10).

NOTE The classification is detailed in the GHS (Part 3: Health Hazards).^[3]

If substances are supplied as mixtures or if substances or mixtures are supplied in solution, their solid contents shall not exceed the amounts specified in [Table 4](#).

Samples of materials on which to grow the crystals may be supplied with the set [e.g. plaster of Paris (gypsum), different stones, different minerals] without limits to their quantities. For gypsum, applicable requirements shall be as specified in ISO 8124-11 (e.g. labelling).

Colourants which are permitted for use in food or cosmetics may be provided.

The substances and mixtures in [Table 4](#) in a crystal-growing set or in a supplementary set for a crystal-growing set shall be supplied in child-resistant packaging (see [5.2.4.2](#)).

Table 4 — Maximum amounts of chemical substances for crystal-growing sets and labelling

Chemical substance	Maximum amount per set g	GHS pictograms (see Figure 1)	Signal word	CAS Registry Number	EINECS number	INDEX number
Ammonium chloride ^a	30	GHS07	Warning	12125-02-9	235-186-4	017-014-00-8
Ammonium dihydrogen orthophosphate (ammonium biphosphate)	600	—	—	7722-76-1	231-764-5	—
Aluminium potassium sulfate	600	—	—	7784-24-9	233-141-3	—
Citric acid ^b	50	GHS07	Warning	77-92-9	201-069-1	—
Copper (II) sulfate	50	GHS05, GHS07, GHS09	Danger	7758-98-7	231-847-6	029-004-00-0
Iron (II) sulfate	50	GHS07	Warning	7782-63-0	231-753-5	026-003-00-7
Magnesium sulfate	100	—	—	10034-99-8	231-298-2	—
Potassium dihydrogen phosphate	600	—	—	7778-77-0	231-913-4	—
Potassium hexacyanoferrate (III)	100	GHS07	Warning	13746-66-2	237-323-3	—
Potassium sodium tartrate	600	—	—	6381-59-5	205-698-2	—
Sodium acetate	100	—	—	127-09-3	204-823-8	—
Sodium hydrogen carbonate	600	—	—	144-55-8	205-633-8	—
Sodium silicate ^b (SiO ₂ :Na ₂ O > 2)	50	GHS05, GHS07	Danger	1344-09-8	215-687-4	—
Sodium sulfate	100	—	—	7757-82-6	231-820-9	—
Sodium thiosulfate	600	—	—	7772-98-7	231-867-5	—
Strontium aluminate	5	GHS 07	Warning	e.g. 12004-37-4 ^d	e.g. 234-455-3 ^d	—
Tartaric acid ^b	50	GHS05	Danger	87-69-4	201-766-0	—

The maximum amounts specified refer to anhydrous chemicals. Equivalent amounts of the hydrated chemicals may replace the anhydrous substances.

^a Shall be supplied as an aqueous solution.

^b Shall not be supplied in a set with sodium hydrogen carbonate.

^c Shall not be supplied in a set with any acid, for example citric acid.

^d If different to the given number, the CAS or EINECS number of the chemical supplier should be given.

Table 4 (continued)

Chemical substance	Maximum amount per set g	GHS pictograms (see Figure 1)	Signal word	CAS Registry Number	EINECS number	INDEX number
Trisodium citrate	600	—	—	6132-04-3	200-675-3	—
Zinc sulfide ^c	5	—	—	e.g. 1314-98-3 ^d	e.g. 215-251-3 ^d	—

The maximum amounts specified refer to anhydrous chemicals. Equivalent amounts of the hydrated chemicals may replace the anhydrous substances.

^a Shall be supplied as an aqueous solution.

^b Shall not be supplied in a set with sodium hydrogen carbonate.

^c Shall not be supplied in a set with any acid, for example citric acid.

^d If different to the given number, the CAS or EINECS number of the chemical supplier should be given.

4.3 Carbon-dioxide-generating experimental sets

See [Clause A.5](#).

The chemical substances given in [Table 5](#) may be supplied in carbon-dioxide-generating experimental sets whose function relies on the generation of carbon dioxide. The amounts supplied in a single set shall not exceed those specified in [Table 5](#). If mixtures of these substances are supplied in solid form, the single mixture shall consist of stoichiometric equivalent amounts of acidic and carbon-dioxide-generating substances.

The quality of the chemicals used in carbon-dioxide-generating experimental sets should be appropriate for the experiments described; in particular, the chemicals should not contain impurities or substances which allow undefined or dangerous reactions to occur.

Besides the chemical substances given in [Table 5](#), carbon-dioxide-generating experimental sets may only contain gypsum or colourants. For gypsum, applicable requirements are specified in ISO 8124-11 (e.g. labelling). Only colourants and colouring materials which do not fulfil the criteria of any of the following hazard classes shall be supplied in carbon-dioxide-generating experimental sets:

- “acute toxicity” (hazard class 3.1);
- “skin corrosion/irritation” (hazard class 3.2);
- “serious eye damage/eye irritation” (hazard class 3.3);
- “respiratory or skin sensitisation” (hazard class 3.4);
- “germ cell mutagenicity” (hazard class 3.5);
- “carcinogenicity” (hazard class 3.6);
- “reproductive toxicity” (hazard class 3.7);
- “specific target organ toxicity — single exposure” (hazard class 3.8);
- “specific target organ toxicity — repeated exposure” (hazard class 3.9);
- “aspiration hazard” (hazard class 3.10).

Colourants that are permitted for use in food or cosmetics may be provided.

NOTE The classification is detailed in the GHS (Part 3: Health Hazards).^[3]

If substances are supplied as mixtures or if substances or mixtures are supplied in solution, their solid contents shall not exceed the amounts specified in [Table 5](#).

The substances in [Table 5](#) in a carbon-dioxide-generating experimental set shall be supplied in child-resistant packaging (see [5.2.4.3](#)).

Table 5 — Maximum amounts of chemical substances for carbon-dioxide-generating experimental sets and labelling

Chemical substance	Maximum amount per set g	GHS pictograms (see Figure 1)	Signal word	CAS Registry Number	EINECS number	INDEX number
Citric acid ^a	100	GHS07	Warning	77-92-9	201-069-1	—
Disodium hydrogen phosphate	20	—	—	7558-79-4	231-448-7	—
Malic acid ^a	60	GHS07	Warning	6915-15-7	230-022-8	—
Potassium hydrogen carbonate	50	—	—	298-14-6	206-059-0	—
Potassium dihydrogen phosphate	100	—	—	7778-77-0	231-913-4	—
Sodium dihydrogen phosphate	70	—	—	7558-80-7	231-449-2	—
Sodium hydrogen carbonate	100	—	—	144-55-8	205-633-8	—
Tartaric acid ^a	60	GHS05	Danger	87-69-4	201-766-0	—

The maximum amounts specified refer to anhydrous chemicals. Equivalent amounts of the hydrated chemicals may replace the anhydrous substances.

^a Only one of these substances shall be provided in each set.

5 Equipment

5.1 General requirements

Experimental sets, excluding supplementary sets, shall be supplied with instructions for use (see [Clause 8](#)); a contents list with warnings and first aid information (see [Clause 7](#)); the equipment necessary for carrying out the experiments described in the instructions for use; and, if required, eye protection (see [5.5](#)) and/or a test tube stand (see [5.4](#)).

Supplementary sets shall be supplied with instructions for use (see [Clause 8](#)) and a contents list with warnings and first aid information, as specified in [Clause 7](#).

All the experiments described in the instructions for use shall be evaluated by the manufacturer. In particular, it shall not be possible for substances to be formed in amounts that are injurious to health.

Any known hazards arising from the use of the set, especially during the experiments, should be detailed (e.g. handling of chemicals, handling of glassware, retarded boiling point, back flow of barrier water into overheated glassware, evolution of gases and handling of burners and other heating sources).

5.2 Containers and glassware

5.2.1 Test tubes

5.2.1.1 Sets in which test tubes are heated

In experimental sets where the instructions for use include chemical experiments in which test tubes are heated, all test tubes shall be made of borosilicate glass in order to be heat-resistant.

Glass test tubes which are intended to be heated shall have dimensions greater than 110 mm in length and greater than 15 mm in internal diameter.

Glass test tubes which are not intended to be heated, for example those used as containers, shall have dimensions not greater than 90 mm in length and not greater than 12 mm in internal diameter unless they are made of borosilicate glass.

When necessary, borosilicate glass shall be identified by the test method described in [5.2.6](#).

5.2.1.2 Sets in which test tubes are not heated

In experimental sets where the instructions for use do not include chemical experiments in which glass test tubes are heated, any glass tubes not made of borosilicate glass shall be labelled in accordance with [6.2](#).

5.2.2 Other glassware

In experimental sets where the instructions for use include experiments in which laboratory glassware is heated, all glassware intended to be heated shall be made of borosilicate glass in order to be heat-resistant. This requirement does not apply to glass tubing intended to be heated for the purpose of bending.

Unless made of borosilicate glass, glassware which is not intended to be heated, but which by its appearance or shape could be construed as being suitable for heating, shall be labelled in accordance with [6.2](#).

When necessary, borosilicate glass shall be identified by the test method described in [5.2.6](#).

5.2.3 Containers for reagents, substances and mixtures

Containers for reagents shall differ in size and shape from laboratory glassware to avoid them being mistaken as glassware for use in experiments.

All containers for reagents, substances and mixtures shall be shock-resistant. They shall not break or crack when subjected to the drop test specified in ISO 8124-1.

5.2.4 Packaging and closures

5.2.4.1 Chemistry sets

All substances and mixtures in [Tables 1](#) and [2](#) shall be supplied in child-resistant containers. Closures for child-resistant containers shall conform with ISO 8317.

Closures for child-resistant containers intended to be used for liquids shall not break, crack or leak when tested in according to the following procedure:

- Fill the container with water. The filling volume shall be three-quarters of the container volume.
- Attach the closure.

- Drop the filled container, including its closure, with its closure facing downwards, five times from a height of (850 ± 50) mm on to a 4-mm-thick steel plate which has a 2-mm-thick coating of shore A hardness (75 ± 5) as measured according to ISO 868 or ISO 48-5 and which is placed on a non-flexible horizontal surface.
- Check visually for any breaks, cracks or leakages of the closure.

NOTE Conformity with these requirements is intended to prevent younger children accessing materials contained in such containers.

5.2.4.2 Crystal-growing sets

The following crystal-growing substances in [Table 4](#) shall be supplied in packaging that conforms with [5.2.4.1](#):

- ammonium chloride;
- citric acid;
- copper (II) sulfate;
- iron (II) sulfate;
- potassium hexacyanoferrate (III);
- sodium silicate;
- strontium aluminate;
- tartaric acid.

All other crystal-growing substances in [Table 4](#) shall be supplied either:

- a) in containers which are provided with closures that conform with [5.2.4.1](#); or
- b) in non-reclosable, child-resistant packaging, as specified in EN 862.

The containers and/or packaging in which the substances are supplied shall not contain more than 200 g.

5.2.4.3 Carbon-dioxide-generating experimental sets

The following carbon-dioxide-generating substances in [Table 5](#) shall be supplied in packaging that conforms with [5.2.4.1](#):

- citric acid;
- tartaric acid;
- malic acid.

All other carbon-dioxide-generating substances in [Table 5](#) shall be supplied either:

- a) in containers which are provided with closures that conform with [5.2.4.1](#); or
- b) in non-reclosable, child-resistant packaging, as specified in EN 862.

5.2.5 Empty containers

Empty containers intended for storage of reagents in [Table 3](#) shall have a maximum volume in accordance with [Table 6](#) and shall be provided with closures (see [5.2.4.1](#)).

Table 6 — Maximum volume of the empty containers for reagents (see Table 3)

Reagent	Maximum volume of the empty container
	ml
Ammonia solution	50
Hydrochloric acid	100
Hydrogen peroxide	100
Sodium hydroxide solution	100

5.2.6 Test method for borosilicate glass

5.2.6.1 General

Several methods exist to distinguish borosilicate glass, for example determination of density and refractive index. A density method is given in this subclause.

5.2.6.2 Apparatus

5.2.6.2.1 25-ml pycnometer.

5.2.6.2.2 Water bath, capable of maintaining a temperature of (20 ± 1) °C.

5.2.6.2.3 Deionised water.

5.2.6.2.4 Analytical balance, accuracy 0,1 mg.

5.2.6.3 Procedure

- a) Weigh the pycnometer (m_0).
- b) Make sure that the fraction from the glass sample is clean. Place it in the pycnometer and re-weigh the pycnometer (m_2).
- c) Fill up the pycnometer with water and place it in a water bath until the contents equilibrate at 20 °C. Top up the pycnometer with water. Remove the pycnometer from the water bath, dry the exterior and weigh (m_3).
- d) Empty the pycnometer. Fill up the pycnometer with water and place in the water bath until the contents equilibrate at 20 °C. Top up the pycnometer with water, dry and weigh. Record the mass (m_1).
- e) Calculate the density of the glass using the following formula:

$$\rho_G = \frac{(m_2 - m_0)}{(m_1 - m_3 + m_2 - m_0)} \cdot \rho_W$$

where

- ρ_G is the density of the glass sample in g/cm³;
- ρ_W is the density of water at 20 °C ($\rho_W = 0,988 2$ g/cm³);
- m_0 is the mass of the empty pycnometer, in g;
- m_1 is the mass of the pycnometer filled with water, in g;

m_2 is the mass of the pycnometer with the glass sample, in g;

m_3 is the mass of the pycnometer with glass sample and water, in g.

NOTE Reference densities for certain types of glass are:

- $(2,40 \pm 0,05)$ g/cm³ for sheet window glass;
- $(2,48 \pm 0,05)$ g/cm³ for soft soda glass;
- $(2,25 \pm 0,05)$ g/cm³ for borosilicate glass;
- $(2,21 \pm 0,05)$ g/cm³ for fused silica glass.

5.3 Equipment for the transfer of liquid

Mouth-actuated pipettes shall not be supplied. Where the transfer of liquid is required, a mechanical means which does not allow any aspiration by the mouth shall be provided (e.g. dropper with a permanently fitted teat).

5.4 Test tube stand and test tube holder

See [5.1](#).

The test tube stand shall not overturn when a test tube positioned in an outermost hole is filled with 5 ml of water and the stand is tilted to an angle of 15° from horizontal.

Experimental sets shall contain a functional test tube holder if the described experiments require the heating of test tubes.

5.5 Eye protection

See [5.1](#).

Eye protection shall be provided with:

- chemistry sets;
- crystal-growing sets containing substances which are required to be marked with the GHS pictogram GHS05 according to [Table 4](#) [see [6.2 b](#)];
- carbon-dioxide-generating experimental sets containing substances which are required to be marked with the GHS pictogram GHS05 according to [Table 5](#) [see [6.2 b](#)].

If eye protection is required to be provided and the set does not contain eye protection for the supervising adult, the primary packaging shall be marked in accordance with [6.3.1](#).

6 Marking (see [Clause A.6](#))

6.1 General requirements

Markings shall be clearly visible, easily legible, understandable, accurate, indelible and in the national language(s) of the country of sale.

Only for the marking according to [6.3.1](#) and, if required, [6.3.2](#), the upper-case letter size is specified as follows:

- a) Letters of a minimum height of 7 mm shall be used for the term “Warning(s)”.

- b) Letters of a minimum height of 3 mm shall be used for the “Warning” phrases. The “Warning” phrases shall be clearly legible.

6.2 Marking of individual containers, packaging and glassware

Individual containers and packaging shall be marked with the following information:

- a) the name and product identifier (INDEX number, if available, otherwise EINECS or CAS Registry Number) of the chemical substance or the chemical substances contained in the mixture as specified in [Table 1](#), [Table 2](#), [Table 3](#), [Table 4](#) or [Table 5](#) and the name and telephone number of the manufacturer, authorized representative or importer;

NOTE 1 In addition, the containers can be labelled with the common names of the chemical substances and mixtures that they contain.

- b) if specified in [Table 1](#), [Table 2](#), [Table 3](#), [Table 4](#) or [Table 5](#), the GHS pictogram(s) and signal word appropriate to the chemical substance, mixture or reagent.

NOTE 2 For more information regarding marking of containers, see the GHS.^[3]

Unless made of borosilicate glass, glassware not intended for heating shall be marked:

“Not to be heated”

6.3 Marking of the primary packaging

6.3.1 Warnings for experimental sets and supplementary sets

6.3.1.1 Suitable age

The manufacturer, authorized representative or importer shall determine the suitable age for the experimental set. The suitable age shall not be less than 8 years in any case. For chemistry sets containing potassium permanganate, the suitable age shall not be less than 12 years.

6.3.1.2 Warnings

The primary packaging shall bear the following warnings:

- Warning. Not suitable for children under X years. For use under adult supervision.

Where X is the age in accordance with [6.3.1.1](#).

- Contains some chemicals which present a hazard to health.
- Read the instructions before use, follow them and keep them for reference.
- Do not allow chemicals to come into contact with any part of the body, particularly the mouth and eyes.
- Keep small children and animals away from experiments.
- Keep the experimental set out of reach of children under X years old.

Where X is the age in accordance with [6.3.1.1](#)

In addition, the following warning shall be used, where appropriate (see [5.5](#)):

Eye protection for supervising adults is not included.

The words “some chemicals” and “chemicals” may be adjusted if only one substance, mixture or solution is included in the set.

6.3.2 Warnings for supplementary sets

Supplementary sets shall additionally be marked with the following warning on the primary packaging:

“Warning. This supplementary set does not contain all the equipment and chemicals necessary for performing tests. For carrying out experiments a complete experimental set is required.”

The word “chemicals” may be adjusted if only one substance, mixture or solution is included in the set.

7 Contents list with warnings and first aid information

See [5.1](#).

The contents list shall contain the following information:

- a) a list of the chemicals supplied;
- b) the H- and P-phrases specified in the GHS as required for each particular substance or mixture;
- c) a space for the telephone number of the local poison centre (central office for first aid information) or hospital and an instruction for this to be added and used in case of intake by accident of dangerous substances;
- d) general first aid information as follows:
 - In case of eye contact: Wash out eye with plenty of water, holding eye open if necessary. Seek immediate medical advice.
 - If swallowed: Wash out mouth with water, drink some fresh water. Do not induce vomiting. Seek immediate medical advice.
 - In case of inhalation: Remove person to fresh air.
 - In case of skin contact and burns: Wash affected area with plenty of water for at least 10 min.
 - In case of doubt, seek medical advice without delay. Take the chemical and its container with you.
 - In case of injury always seek medical advice.
- e) specific first-aid information when appropriate.

8 Instructions for use (see [5.1](#))

8.1 General instructions

The instructions for use shall be given in the national language(s) of the country of sale.

The warnings for experimental sets as specified in [6.3.1](#) or for supplementary sets as specified in [6.3.1](#) and [6.3.2](#) shall be repeated on the outer page of the front cover of the instructions for use.

The first page(s) of the instructions for use shall contain a list of its contents. This list shall refer to the information required in [8.2](#) and [8.3](#).

Detailed information on how to perform each experiment shall be given.

When appropriate, GHS pictograms and the H- and P-phrases specified in the GHS and information on first aid in the event of foreseeable accidents shall be given with the description of the experiment.

Information on disposal of used chemicals, including substances and mixtures not supplied with the toy but needed for the described experiments, shall be given. The necessity of disposing of, for example,

foodstuffs used for experimenting shall be underlined. Further information on environmental aspects is given in [Annex B](#).

The instructions for disposal of substances shall take account of national regulations for the disposal of such chemicals.

The opening pages of the instructions for use shall provide the following information:

- a) advice for supervising adults (see [8.2](#));
- b) the information required in [Clause 7](#);
- c) safety rules (see [8.3](#)).

8.2 Advice for supervising adults

The advice for adults shall contain the following information:

- a) Read and follow these instructions, the safety rules and the first-aid information and keep them for reference.
- b) The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments which are listed in the instructions.
- c) This experimental set is for use only by children over X years.

Where X is the age in accordance with [6.3.1.1](#).

- d) Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which experiments are suitable and safe for them. The instructions should enable supervisors to assess any experiment to establish its suitability for a particular child.
- e) The supervising adult should discuss the warnings and safety information with the child or children before commencing the experiments. Particular attention should be paid to the safe handling of acids, alkalis and flammable liquids.

If the experimental set does not contain acids, alkalis and/or flammable liquids, the second sentence in [8.2 e](#)) shall be omitted or adjusted accordingly.

- f) The area surrounding the experiment should be kept clear of any obstructions and away from the storage of food. It should be well lit and ventilated and close to a water supply. A solid table with a heat-resistant top should be provided.

For carbon-dioxide generating experimental sets, the third sentence in [8.2 f](#)) may be omitted.

- g) Instructions for the use of the burner, if provided.

If the experimental set contains packaging of chemical substances from [Table 4](#) or [Table 5](#) which conform with EN 864, the following advice shall be given:

Substances in non-reclosable packaging should be used up (completely) during the course of one experiment, i.e. after opening the package.

8.3 Safety rules

8.3.1 Chemistry sets

The following safety rules shall be given for chemistry sets:

- Read these instructions before use, follow them and keep them for reference.

- Keep young children, animals and those not wearing eye protection away from the experimental area.
- Always wear eye protection.
- Store this experimental set out of reach of children under X years of age.
Where X is the age in accordance with [6.3.1.1](#).
- Clean all equipment after use.
- Make sure that all containers are fully closed and properly stored after use.
- Ensure that all empty containers are disposed of properly.
- Wash hands after carrying out experiments.
- Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
- Do not eat or drink in the experimental area.
- Do not allow chemicals to come into contact with the eyes or mouth.

If foodstuffs are required by any experiment or in the instructions for use, the following safety rule shall be given:

- Do not replace foodstuffs in original container. Dispose of immediately.

8.3.2 Crystal-growing sets

The following safety rules shall be given for crystal-growing sets:

- Read these instructions before use, follow them and keep them for reference.
- Keep young children and animals away from the experimental area.
- Store this experimental set and the final crystal(s) out of reach of children under X years of age.
Where X is the age in accordance with [6.3.1.1](#).
- Clean all equipment after use.
- Ensure that all empty containers and/or non-reclosable packaging are disposed of properly.
- Wash hands after carrying out experiments.
- Do not eat or drink in the experimental area.
- Do not allow chemicals to come into contact with the eyes or mouth.
- Do not apply any substances or solutions to the body.
- Do not grow crystals where food or drink is handled or in bedrooms.
- Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
- Take care while handling with hot water and hot solutions.
- Ensure that during growing of the crystal the container with the liquid is out of reach of children under X years of age.

Where X is the age in accordance with [6.3.1.1](#).