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**Soft soldering fluxes — Test methods — Part 6: Determination and detection of halide
(excluding fluoride) content**

***Flux de brasage tendre — Méthodes d'essai — Partie 6: Dosage et détection des halogénures (à
l'exception des fluorures)***

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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 documents 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).

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This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 12, *Soldering materials*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 9455-6:1995), of which ~~has been technically revised.~~

it constitutes a minor revision. The ~~main~~ changes are as follows:

- Clause 2 has been updated;
- new Clause 3, Terms and definitions, has been inserted;
- the coding of the fluxes has been updated in accordance with ISO 9454-1:2016;
- 4.2, 5.2, 6.2 and A.3 restructured;
- notes changed to body text in 4.4, 5.4, 5.6, 6.4 and 7.4.1.4;
- title added to Table 1;
- formulae numbered;

— minor editorial changes.

A list of all parts in the ISO 9455 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. Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: <https://committee.iso.org/sites/tc44/home/interpretation.html>.

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Soft soldering fluxes — Test methods — Part 6: Determination and detection of halide (excluding fluoride) content

1 Scope

This document specifies three quantitative methods for the determination of the ionic halide (excluding fluoride) content of soldering fluxes. Halides are calculated as chlorides. A useful qualitative test method for the detection of ionic halides is also described.

Method A is a potentiometric titration method for the determination of halide (excluding fluoride) content and is applicable to flux classes 1 and 2, defined in ISO 9454-1. This method, which is ~~to be~~ considered the reference method for these fluxes, is suitable for halide contents generally within the range of 0,05 % ~~(m/m) mass fraction~~ to 2 % ~~(m/m) mass fraction~~ in the non-volatile matter of the flux.

Method B is a titration method for the determination of the total halide (excluding fluoride) content of water-soluble fluxes. It is applicable to flux classes 2122 to 2124, 3112 to 3114 and 3212 to 3214, as defined in ISO 9454-1.

Method C is a titration method for the determination of the halide (excluding fluoride) content of water-soluble fluxes containing phosphates and is applicable to flux class 331, as defined in ISO 9454-1.

Method D is a qualitative test, using silver chromate test paper, for the presence of ionic halides. The technique ~~may~~ be used for all classes of flux.

2 Normative references

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There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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/>

4 Method A: Potentiometric method (Reference method)

4.1 Principle

A prepared, weighed sample of the flux is dissolved in a suitable solvent. The resulting solution is titrated with standard silver nitrate solution, using a silver electrode, the mV readings being recorded simultaneously. From the graph of volume of titrant readings against mV readings, the point of inflexion is determined and the percentage halide content, expressed as chloride, is calculated. The method is not suitable for the determination of fluoride.

This method is applicable to flux classes 1 and 2, as defined in ISO 9454-1.

4.2 Reagents

4.2.1 General

Only reagents of recognized analytical quality and distilled or deionized water with a conductivity less than 10 $\mu\text{S}/\text{cm}$ are to be used.

4.2.2 Propan-2-ol.

4.2.3 Silver nitrate solution (0,02 mol/l).

3,4 g of silver nitrate (AgNO_3) are dissolved in water (see Note 1) then transferred to a 1-l volumetric flask and diluted to the mark with water. It is mixed thoroughly. The silver nitrate (AgNO_3) should be dried at $(110 \pm 5)^\circ\text{C}$ for 16 h and cooled in a desiccator before weighing.

Alternatively, a commercially available concentrate is used to prepare 0,02 mol/l standard silver nitrate solution.

~~The Standardize the~~ silver nitrate solution ~~is standardized~~ using the method given in Annex A, to derive the correlation factor f_1 . This is stored in an amber glass bottle.

~~NOTE 1 The silver nitrate (AgNO_3) should be dried at $(110 \pm 5)^\circ\text{C}$ for 16 h and cooled in a desiccator before weighing.~~

~~NOTE 2~~ 1 ml of silver nitrate solution (4.2.2) is equivalent to $0,000\ 709 \times f_1$ g of chloride ion.

4.3 Apparatus

~~Ordinary~~ The usual laboratory apparatus and, in particular, the following shall be used:

4.3.1 Millivolt meter.

4.3.2 Silver electrode.

4.3.3 Mercury/mercurous sulfate 1 mol/l sodium sulfate electrode, or a reversible hydrogen electrode.

4.3.4 Magnetic or mechanical stirrer, with variable speed drive, the stirrer bar to be PTFE-coated.

4.4 Procedure

Carry out the following procedure, in triplicate, on the flux sample.

Weigh, to the nearest 0,001 g, approximately 0,5 g of the solid flux sample or 2 g of the liquid flux sample, avoiding loss of volatile matter during the weighing, and transfer it to a 250-ml low-form beaker.

~~NOTE 1~~ This procedure is suitable for halide ion concentrations generally within the range of 0,1 % (m/m) mass fraction to 1 % (m/m) mass fraction in the non-volatile content of the solution to be titrated. For flux samples having halide ion concentrations outside this range, the sample mass taken should be adjusted, as follows:

~~for flux samples having a)~~ for flux samples having a halide ion concentration in the range of 0,05 % (m/m) mass fraction to 0,1 % (m/m) mass fraction, the mass of sample taken should be double; and

b) for flux samples having a halide ion concentration in the range of 1 % (m/m) mass fraction to 2 % (m/m) mass fraction, the mass of sample taken should be halved.

Add 100 ml of propan-2-ol (4.2.1), or water, according to the solubility characteristics of the flux ~~(see Note 2)~~. Cover with a watch glass and allow to dissolve with gentle agitation.

NOTE 2 For fluxes of class 12, as defined in ISO 9454-1, the choice of solvent should be agreed between the flux manufacturer and the user.

Place the beaker on the stand of the titration assembly with the electrodes, stirrer and burette in position. Adjust the speed of the stirrer to give vigorous stirring without splashing. Titrate with the silver nitrate solution (4.2.2), adding 1-ml portions and recording the mV meter readings after each addition. As the end -point is approached, reduce the additions of titrant to 0,1 ml and continue titrating past the end -point.

Plot the potential values against the volume of titrant added to obtain the titration curve. The point of inflexion of the curve corresponds to the end -point of the titration.

NOTE 3 The point of inflexion of the curve may conveniently be determined by using the derivative curve.

Carry out a blank determination, using all reagents, for comparison purposes.

4.5 Calculation of results

The halide (excluding fluoride) content, expressed as the percentage, by mass, of chloride in the flux, is given by: **Formula (1)**:

$$\frac{0,0709 \times V}{m} f_1 \frac{0,0709 \times V}{m} f_2 \quad \text{ISO/FDIS 9455-6}$$

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$$\text{--- (1)}$$

where

V is the volume, in ml, of silver nitrate solution used, less the volume needed to titrate the blank;

$f_1 f_2$ is the correlation factor for the silver nitrate solution (see 4.2.2);

m is the mass, in g, of the sample taken.

The halide content of the flux sample is given by the mean of the three results obtained on the triplicate test samples.

The halide content may also be expressed as the percentage, by mass, of chloride in the non-volatile matter ~~by using Formula (2)~~:

$$\frac{7,09 \times V}{mS} f_1 \frac{7,09 \times V}{mS} f_2$$

where

- S is the percentage non-volatile matter content of the sample, determined as described in ISO 9455-1 or ISO 9455-2. For solid flux samples, $S = 100$.

(2)

where S is the percentage non-volatile matter content of the sample, determined as described in ISO 9455-1 or ISO 9455-2. For solid flux samples, $S = 100$.

5 Method B: Titration method for halide (excluding fluoride) content of water-soluble fluxes

5.1 Principle

A prepared sample of the flux is diluted to a known volume with water and a specified volume of sulfuric acid of known concentration. The solution is then treated with a known quantity of silver nitrate solution and the excess silver nitrate is titrated with ammonium thiocyanate. A blank determination using water in place of the flux is carried out simultaneously and the percentage halide content, expressed as chloride, is calculated. The method is not suitable for the determination of fluoride.

The test is applicable to fluxes of classes 2122 to 2124, 3112 to 3114 and 3212 to 3214 only, as defined in ISO 9454-1.

Some liquid fluxes contain free hydrochloric acid and the halide content will consequently be greater than the amount equivalent to the zinc and other chlorides present.

5.2 Reagents

5.2.1 General

Only reagents of recognized analytical quality and distilled or deionized water with a conductivity less than 10 $\mu\text{S}/\text{cm}$ are to be used.

5.2.21 Silver nitrate solution (0,1 mol/l).

16,99 g of silver nitrate (AgNO_3) are dissolved in water (see 4.2.2, Note 1) then transferred to a 1-l volumetric flask and diluted to the mark with water. This is mixed thoroughly. The silver nitrate (AgNO_3) should be dried at $(110 \pm 5)^\circ\text{C}$ for 16 h and cooled in a desiccator before weighing.

Alternatively, a commercially available concentrate is used to prepare 0,1 mol/l standard silver nitrate solution.

~~The Standardize the~~ silver nitrate solution ~~is standardized~~ using the method given in Annex A, to derive the correlation factor f_2 . This is stored in an amber glass bottle.

~~NOTE 1 The silver nitrate (AgNO_3) should be dried at $(110 \pm 5)^\circ\text{C}$ for 16 h and cooled in a desiccator before weighing.~~

~~NOTE 2~~ 1 ml of silver nitrate solution (5.2.2) is equivalent to $0,003\,545 \times f_2$ g of chloride ion.

5.2.32 Ammonium thiocyanate solution (approximately 0,1 mol/l).

8 g of ammonium thiocyanate (NH_4CNS) are dissolved in water then transferred to a 1-l volumetric flask and diluted to the mark with water. This is mixed thoroughly.

Alternatively, a commercially available concentrate is used to prepare 0,1 mol/l standard ammonium thiocyanate solution.

5.2.43 Sulfuric acid solution ~~[(20 % (V/V))-volume fraction]~~. 200 ml of sulfuric acid (density 1,84 g/ml) is cautiously added, with stirring, to 400 ml of water. It is then mixed, cooled, diluted to 1 l and mixed thoroughly.

5.2.54 Ammonium ferric sulfate indicator solution.

10 g of ammonium ferric sulfate $[\text{NH}_4\text{Fe}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}]$ ~~are~~ dissolved in 100 ml water.

5.2.65 Nitrobenzene.

WARNING — Care should be exercised in the handling and disposal of this hazardous reagent.

5.2.76 Nitric acid (density 1,42 g/ml).

5.3 Apparatus

Ordinary laboratory apparatus.

5.4 Procedure

Carry out the following procedure, in triplicate, on the flux sample.

By means of a pipette, transfer 25 ml of the sample to a 500 ml volumetric flask. Add 10 ml of sulfuric acid solution (5.2.43), dilute to the mark with water and mix.

By means of a pipette, transfer 10 ml of this solution to a glass-stoppered 500 ml conical flask and add 50 ml of water, followed by 5 ml of nitric acid (5.2.76).

To a similar flask transfer 60 ml of water and 5 ml of nitric acid (5.2.76) and carry out, simultaneously, a blank determination following the same procedure and using the same quantities of reagents as used for the flux sample.

By means of a burette or a pipette, add 50 ml of silver nitrate solution (5.2.21) to the contents of the flask.

NOTE—2 ml of nitrobenzene (5.2.65) may be added to assist coagulation of the precipitate.

Re-stopper the flask and shake it vigorously. Add 5 ml of ammonium ferric sulfate indicator solution (5.2.54) and titrate with ammonium thiocyanate solution (5.2.31), shaking the flask vigorously between additions of the titrant. The end -point is indicated when a faint orange-red colour first persists throughout the solution in the flask.

5.5 Standardization of the ammonium thiocyanate solution (5.2.32)

Transfer 70 ml of water and 5 ml of nitric acid (5.2.76) to a 500 ml conical flask. By means of a pipette, add 25 ml of silver nitrate solution (5.2.21). Add 5 ml of ammonium ferric sulfate indicator solution (5.2.54) and titrate with the ammonium thiocyanate solution (5.2.32), as in the procedure given in 5.4.

Calculate the correlation factor f_3 ~~f_z~~ for the ammonium thiocyanate, as follows:

$$f_3 = \frac{25 \times f_2}{\text{volume of NH}_4\text{CNS}} \quad f_z = \frac{25 \times f_z}{\text{volume of NH}_4\text{CNS}}$$