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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Cable management systems – Test method for content of halogens

Systèmes de gestion de câblage – Méthode d'essai relative à la teneur en halogènes

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CABLE MANAGEMENT SYSTEMS – TEST METHOD FOR CONTENT OF HALOGENS

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The text of this International Standard is based on the following documents:

Draft	Report on voting
23A/997/FDIS	23A/999/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

CABLE MANAGEMENT SYSTEMS – TEST METHOD FOR CONTENT OF HALOGENS

1 Scope

This document specifies a method for the determination of the content of halogens in cable management system (CMS) products or system components made completely or partly of combustible material(s). The determination is made by combustion and subsequent analysis of the combustion product by ion chromatography. This document specifies how CMS products or system components can be declared as halogen-free.

This document is for environmental performance purposes only.

Compliance with this document does not imply the absence of toxicity, corrosivity or opacity of produced smoke, or other reaction to fire characteristics. If any of these characteristics are to be evaluated, the appropriate standards can be used.

The detection limit of this test method is typically 0,025 g of halogen per kg (0,002 5 %).

Halides insoluble in aqueous solution present in the original sample or produced during the combustion step are not determined by this method.

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 1716, *Reaction to fire tests for products – Determination of the gross heat of combustion (calorific value)*

ISO 3696, *Water for analytical laboratory use – Specification and test methods*

3 Terms and definitions

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

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

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

3.1
halogen content
content of fluorine, chlorine, bromine and iodine as organic and inorganic compounds that can be converted to halides (fluoride, chloride, bromide, iodide) by combustion and then absorbed or dissolved in an aqueous solution

Note 1 to entry: The above definition is valid for this document only and does not strictly comply with the scientific definition of halogen content.

3.2
combustible, adjective
capable of being ignited and burned

[SOURCE: ISO 13943:2017, 3.52]

4 Principle

For the purpose of this document, a material is considered as being non-combustible if its gross calorific potential is assumed to be lower than 3,0 MJ/kg. In case of doubt ISO 1716 is used to measure the calorific potential.

Examples of non-combustible materials are:

– uncoated stainless steel,
– steel with metallic coating,
– uncoated aluminium,
– copper,
– ceramic.

The test sample is oxidized by combustion in a closed system containing oxygen under pressure using a calorimetric decomposition bomb (bomb).

Nearly all of the halogens in compounds are converted to halides (fluoride, chloride, bromide and iodide), and nearly all of these (see Clause 5) are dissolved in an absorption solution.

The detection limit of this test method is typically 0,025 g of halogen per kg (0,002 5 %). When this test method is used for poorly burning samples, a combustion enhancer may be used.

5 Interferences

5.1 General

Inorganic halides insoluble in aqueous solution present in the original samples or produced during the combustion step are not determined by the method described here. Subclauses 5.2 and 5.3 show the differences that occur between the determination of the content of organic halogen compounds and inorganic halogen compounds. The inorganic halogen compounds in the material can have their origin as an additive deliberately added to the material or as an impurity.

5.2 Organic halogen compounds

Organic compounds containing halogens are known under several names. Different expressions are used like organohalogens, halogenated compounds, halocarbons or organic halides. They are all substances in which one or more carbon atoms are linked by covalent bonds to one or more halogen atoms.

Among the organohalogens, some of them are efficient flame retardants. Chlorinated, brominated and fluorinated organohalogens are used separately or in combination. Organohalogens will be converted into inorganic halides by combustion and will then be absorbed or dissolved in an aqueous solution. This allows the subsequent analysis of halogen content.

5.3 Inorganic halogen compounds

Inorganic compounds containing halogens are known as inorganic halides. Inorganic halides used as additives are salts between a halogen and a metal linked together with an ionic bond, for example magnesium chloride ($MgCl_2$), potassium bromide (KBr) or sodium fluoride (NaF). These salts may have varying degrees of solubility in water.

However, this limitation is considered as not significant as no example has been found where inorganic halides have been used in CMS products.

Impurities containing inorganic halides will occur in several additives used in polymers. They can occur as impurities in, for example, fillers (like $CaCl_2$ in $CaCO_3$), pigments (like $TiCl_4$ in TiO_2) or other inorganic additives (like $AlCl_3$ in $Al(OH)_3$). These inorganic halides can have more or less solubility in water, but they will only be measured if they dissolve in the aqueous solution. Investigations have shown that the content of each halogen in impurities in inorganic additives for CMS products is low and therefore does not significantly contribute to the total content of each halogen. Insoluble inorganic halides will not be considered and will not be measured by the method described here. Examples of insoluble inorganic halides are halide salts of silver and barium (AgCl, AgBr and $BaCl_2$). Soluble inorganic halides will be dissolved in the aqueous solution and will be measured together with halides coming from the combustion of the organohalogens.

6 Classifications, limits and declaration

6.1 Halogen content classification

6.1.1 Not declared

6.1.2 Halogen-free

6.2 Limits

A CMS product or system component classified according to 6.1.2 shall comply with the following specified limits:

- fluorine (F) content ≤ 3,0 g/kg (corresponding to 0,30 % weight/weight)
- chlorine (Cl) content ≤ 1,5 g/kg (corresponding to 0,15 % weight/weight)
- bromine (Br) content ≤ 1,5 g/kg (corresponding to 0,15 % weight/weight)
- iodine (I) content ≤ 3,0 g/kg (corresponding to 0,30 % weight/weight)
- total halogen content: fluorine (F) content + chlorine (Cl) content + bromine (Br) content + iodine (I) content ≤ 4 g/kg (corresponding to 0,40 % weight/weight).

6.3 Declaration

A CMS product or system component classified according to 6.1.2 can be declared as "halogen-free according to IEC 63355" if the CMS product or system component meets the requirements of 6.2.

7 Reagents and control mixtures

7.1 Reagents

7.1.1 General

All reagents shall be at least of analytical grade and suitable for the specific purposes, see Clause 12.

7.1.2 Water

The water shall be grade 1 as specified in ISO 3696.

7.1.3 Absorption solution 1, for the determination of fluorine, chlorine and bromine

The nature and concentration of solution 1 may depend on the end-determination technique and on the expected content of halogens. For example:

– water (7.1.2); or
– 0,3 mol/l potassium or sodium hydroxide solution: dissolve 16,8 g of KOH or 12,0 g of NaOH pellets in water (7.1.2) and dilute to 1 l; or
– carbonate-bicarbonate solution: dissolve 2,52 g sodium bicarbonate $NaHCO_3$ and 2,54 g sodium carbonate Na_2CO_3 in water (7.1.2) and dilute to 1 l.

7.1.4 Absorption solution 2 for the determination of iodine

Solution 2 shall be ascorbic acid-solution, ($C_6H_8O_3$), 10 g/kg.

7.1.5 Oxygen

The oxygen shall be free of combustible material, available at a pressure of 3 MPa to 4 MPa (e.g. medical grade).

7.1.6 Combustion enhancer

The combustion enhancer may be, for example, paraffin.

7.2 Control samples

Annex A Table A.1 lists examples of control substances that give complete (90 % to 110 %) recovery rate of halogens. By spiking (standard addition) a sample polymer considered not to contain any halogen with one or more of these substances, a control sample can be created. The halogen content of this sample shall be within ± 20 % of the specified pass-fail criteria. Specific polymer samples with a halogen content in the same range can also be used as control samples.

8 Sample preparation

For each product, non-combustible parts which can be completely separated through disassembling, cutting, crushing or grinding are separated and are not tested.

NOTE 1 Examples of parts which can be separated are screws, metal inserts and terminals.

The mass of all remaining combustible parts is measured.

A test sample representative of each part is cut or ground into pieces with a grain size not exceeding 2 mm.

NOTE 2 If the grain size is too small, there is a risk of blowing away the test sample when purging and filling the bomb with oxygen. If this occurs, an appropriate method can be adopted to prevent this.

A part made of multiple combustible materials is assessed on its averaged contents. This is achieved by grinding or sawing the part to produce a test sample containing a similar ratio of materials as the original part.

During preparation of the test sample, contact with halogenated polymers, e.g. PVC gloves, shall be avoided.

9 Equipment

9.1 Calorimetric decomposition bomb

The bomb shall have a capacity of at least 200 ml and be equipped with a venting system.

The bomb shall not leak during testing and shall permit a complete recovery of the liquid. The inner surface shall be made of stainless steel or any other material that will not be affected by combustion gases.

Materials used for the bomb assembly, such as the head gasket and wire insulation, shall be resistant against heat and chemical attacks and shall not undergo any reaction that could affect the results.

Bombs with damaged or pitted surfaces shall not be used because of their tendency to retain halides. After repeated use of the bomb, a layer may build up on the inner surface. Such a surface shall be removed by polishing the bomb regularly according to the manufacturer's instructions.

NOTE The internal surface of some bombs can have a ceramic coating or platinum insert. Therefore, they have better resistance to corrosion.

9.2 Sample pan

The sample pan shall be manufactured from platinum or stainless steel.

9.3 Firing wire

The firing wire shall be manufactured from platinum or stainless steel.

9.4 Ignition circuit

The ignition circuit shall be capable of supplying a sufficient current to ignite the sample without melting the wire.

9.5 Usual laboratory equipment

Homogenization devices (e.g. mixers, stirrers, grinders, mills) and analytical balance (accurate to 0,1 mg or better).

10 Procedure

10.1 General

According to Clause 12, before each series of determinations, a blank test, then a control test on a control sample (see 7.2) shall be carried out.

Testing samples of high content of halogens followed by samples of low content of halogens can lead to contamination as it is difficult to rinse the last traces of ions from the internal surfaces of the apparatus and a tendency for residual elements to carry-over from sample to sample has been observed. It is good practice to insert a blank test between the sample tests, unless the series of samples being analysed has similar expected concentrations.