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# International Standard



# 3856/2

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## **Paints and varnishes – Determination of “soluble” metal content –**

### **Part 2: Determination of antimony content – Flame atomic absorption spectrometric method and Rhodamine B spectrophotometric method**

*Peintures et vernis – Détermination de la teneur en métaux «solubles» – Partie 2: Détermination de la teneur en antimoine – Méthode par spectrométrie d'absorption atomique dans la flamme et méthode spectrophotométrique à la rhodamine B*

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 3856/2 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*.

ISO 3856/2 was first published in 1980. This second edition cancels and replaces the first edition, of which it constitutes a thorough revision.

## Paints and varnishes — Determination of "soluble" metal content —

### Part 2: Determination of antimony content — Flame atomic absorption spectrometric method and Rhodamine B spectrophotometric method

#### 0 Introduction

This International Standard is a part of ISO 3856, *Paints and varnishes — Determination of "soluble" metal content*.

#### 1 Scope and field of application

This part of ISO 3856 describes two methods for the determination of the antimony content of the test solutions prepared according to ISO 6713 or other suitable International Standards.

The methods are applicable to paints having "soluble" antimony contents in the range of about 0,05 to 5 % (m/m).

The flame atomic absorption spectrometric (AAS) method (clause 3) should be used as the referee method in cases of dispute. Other methods can be used by agreement between the interested parties. If a spectrophotometric method is agreed, the Rhodamine B spectrophotometric method (clause 4) should be used.

#### 2 References

ISO 385/1, *Laboratory glassware — Burettes — Part 1: General requirements.*<sup>1)</sup>

ISO 648, *Laboratory glassware — One-mark pipettes*.

ISO 1042, *Laboratory glassware — One-mark volumetric flasks*.

ISO 3696, *Water for laboratory use — Specifications.*<sup>2)</sup>

ISO 4800, *Laboratory glassware — Separating funnels and dropping funnels*.

ISO 6713, *Paints and varnishes — Preparation of acid extracts from paints in liquid or powder form*.

#### 3 Flame atomic absorption spectrometric method

##### 3.1 Principle

Aspiration of the test solution into an acetylene/air flame. Measurement of the absorption of the selected spectral line, emitted by an antimony hollow-cathode or antimony discharge lamp, in the region of 217,6 nm (see also 3.5).

##### 3.2 Reagents and materials

During the analysis, use only reagents of recognized analytical grade and only water of at least grade 3 purity according to ISO 3696.

**3.2.1 Hydrochloric acid**, approximately 37 % (m/m) ( $\rho$  approximately 1,18 g/ml).

**3.2.2 Hydrochloric acid**,  $c(\text{HCl}) = 1 \text{ mol/l}$ .

**3.2.3 Acetylene**, commercial grade, in a steel cylinder.

**3.2.4 Compressed air**.

1) At present at the stage of draft. (Partial revision of ISO/R 385-1964.)

2) At present at the stage of draft.

**3.2.5 Antimony**, standard stock solution containing 1 g of Sb per litre.

Weigh, to the nearest 0,1 mg, 119,7 mg of dried antimony trioxide, dissolve in 40 ml of the hydrochloric acid (3.2.1) in a 100 ml one-mark volumetric flask, dilute to the mark with water and mix well.

1 ml of this standard stock solution contains 1 mg of Sb.

**3.2.6 Antimony**, standard solution containing 100 mg of Sb per litre.

Prepare this solution on the day of use.

Pipette 10 ml of the standard stock solution (3.2.5) into a 100 ml one-mark volumetric flask, dilute to the mark with the hydrochloric acid (3.2.2) and mix well.

1 ml of this standard solution contains 100 µg of Sb.

### 3.3 Apparatus

Ordinary laboratory apparatus and

**3.3.1 Flame atomic absorption spectrometer**, suitable for measurements at a wavelength of 217,6 nm and fitted with a burner fed with acetylene and air.

**3.3.2 Antimony hollow-cathode lamp or antimony discharge lamp.**

**3.3.3 Burette**, of capacity 50 ml, complying with the requirements of ISO 385/1.

**3.3.4 One-mark volumetric flasks**, of capacity 100 ml, complying with the requirements of ISO 1042.

### 3.4 Procedure

**3.4.1 Preparation of the calibration graph**

**3.4.1.1 Preparation of the standard matching solutions**

Prepare these solutions on the day of use.

Into a series of five 100 ml one-mark volumetric flasks (3.3.4), introduce from the burette (3.3.3), respectively, the volumes of the standard antimony solution (3.2.6) shown in the following table, dilute each to the mark with the hydrochloric acid (3.2.2) and mix well.

Standard matching solution No.	Volume of the standard antimony solution (3.2.6)	Corresponding concentration of Sb in the standard matching solution	
		ml	µg/ml
0 *	0		0
1	5		5
2	10		10
3	20		20
4	40		40

\* Blank matching solution.

**3.4.1.2 Spectrometric measurements**

Install the antimony spectral source (3.3.2) in the spectrometer (3.3.1) and optimize the conditions for the determination of antimony. Adjust the instrument in accordance with the manufacturer's instructions and adjust the monochromator to the region of 217,6 nm in order to obtain the maximum absorbance.

Adjust the flow of the acetylene (3.2.3) and of the air (3.2.4) according to the characteristics of the aspirator-burner, and ignite the flame. Set the scale expansion, if fitted, so that the standard matching solution No. 4 (see table) gives almost a full-scale deflection.

Aspirate into the flame each of the standard matching solutions (see 3.4.1.1) in ascending order of concentration, and repeat with the standard matching solution No. 3 to verify that the instrument has achieved stability. Aspirate water through the burner between each measurement, taking care to keep the rate of aspiration uniform.

**3.4.1.3 Calibration graph**

Plot a graph having the masses, in micrograms, of Sb contained in 1 ml of the standard matching solutions as abscissae and the corresponding values of the absorbances, reduced by the reading for the blank matching solution, as ordinates.

**3.4.2 Test solutions**

**3.4.2.1 Pigment portion of the liquid paint**

Mix thoroughly 9 parts by volume of each of the solutions obtained by the procedure described in sub-clause 8.2.3 of ISO 6713 with 1 part by volume of the hydrochloric acid (3.2.1).

**3.4.2.2 Liquid portion of the paint**

Mix thoroughly 9 parts by volume of each of the solutions obtained by the procedure described in sub-clause 9.3 of ISO 6713 with 1 part by volume of the hydrochloric acid (3.2.1).

**3.4.2.3 Other test solutions**

Use the test solutions obtained by other specified or agreed procedures. Take care that the acidity of the solutions is about 1 mol/l.

### 3.4.3 Determination

Measure first the absorbance of the hydrochloric acid (3.2.2) in the spectrometer (3.3.1) after having adjusted it as described in 3.4.1.2. Then measure the absorbance of each test solution (3.4.2) three times and, afterwards, that of the hydrochloric acid again. Finally, re-determine the absorbance of standard matching solution No. 3 (see 3.4.1.1) in order to verify that the response of the apparatus has not changed. If the absorbance of a test solution is higher than that of the standard matching solution with the highest antimony concentration, dilute the test solution appropriately (dilution factor  $F$ ) with a known volume of the hydrochloric acid (3.2.2).

### 3.5 Interferences

Spectral interference occurs in the presence of lead, calcium or copper on the resonance line at 217,6 nm. In the presence of lead, use the antimony resonance line at 206,8 nm, or 231,1 nm. In the presence of calcium, measure the absorbance at 217,0 nm and subtract the result from the absorbance at 217,6 nm. In the presence of copper, use the antimony resonance line at 231,1 nm.

Use a deuterium background corrector to correct for background absorption. Alternatively, the solutions can be re-aspirated using a neighbouring non-absorbing line for the background correction (see the note).

NOTE — Some hollow-cathode lamps for antimony have a non-absorbing line at 216,9 nm.

## 3.6 Expression of results

### 3.6.1 Calculations

#### 3.6.1.1 Pigment portion of the liquid paint

Calculate the mass of "soluble" antimony in the hydrochloric acid extract obtained by the method described in sub-clause 8.2.3 of ISO 6713, using the equation

$$m_0 = \frac{a_1 - a_0}{10^6} \times V_1 \times \frac{10}{9} \times F_1$$

$$= (a_1 - a_0) \times V_1 \times F_1 \times \frac{10^{-5}}{9}$$

where

$a_0$  is the antimony concentration, in micrograms per millilitre, of the blank test solution prepared by the method described in sub-clause 8.4 of ISO 6713;

$a_1$  is the antimony concentration, in micrograms per millilitre, of the test solution obtained from the calibration graph;

$F_1$  is the dilution factor referred to in 3.4.3;

$m_0$  is the mass, in grams, of "soluble" antimony in the hydrochloric acid extract;

$V_1$  is the volume, in millilitres, of the hydrochloric acid plus ethanol used for the extraction described in sub-clause 8.2.3 of ISO 6713 (assumed to be 77 ml).

Calculate the "soluble" antimony content of the pigment portion of the paint, using the equation

$$c_{\text{Sb}1} = m_0 \times \frac{10^2}{m_1} \times \frac{P}{10^2} = \frac{m_0 \times P}{m_1}$$

where

$c_{\text{Sb}1}$  is the "soluble" antimony content, of the pigment portion of the paint, expressed as a percentage by mass of the paint;

$m_1$  is the mass, in grams, of the test portion taken to prepare the solution described in sub-clause 8.2.3 of ISO 6713;

$P$  is the pigment content of the liquid paint, expressed as a percentage by mass, obtained by the appropriate method described in clause 6 of ISO 6713.

#### 3.6.1.2 Liquid portion of the paint

Calculate the mass of antimony in the solution (extract), obtained by the method described in sub-clause 9.3 of ISO 6713, using the equation

$$m_2 = \frac{b_1 - b_0}{10^6} \times V_2 \times \frac{10}{9} \times F_2$$

$$= (b_1 - b_0) \times V_2 \times F_2 \times \frac{10^{-5}}{9}$$

where

$b_0$  is the antimony concentration, in micrograms per millilitre, of the blank test solution prepared by the method described in sub-clause 6.5 of ISO 6713;

$b_1$  is the antimony concentration, in micrograms per millilitre, of the test solution obtained from the calibration graph;

$F_2$  is the dilution factor referred to in 3.4.3.;

$m_2$  is the mass, in grams, of antimony in the liquid portion of the paint;

$V_2$  is the volume, in millilitres, of the solution obtained by the method described in sub-clause 9.3 of ISO 6713 (= 100 ml).

Calculate the antimony content of the liquid portion of the paint, using the equation

$$c_{\text{Sb}2} = \frac{m_2}{m_3} \times 10^2$$

where

$c_{\text{Sb}2}$  is the antimony content of the liquid portion of the paint, expressed as a percentage by mass of the paint;

$m_3$  is the total mass, in grams, of paint comprising a "set" as described in sub-clause 6.4 of ISO 6713.

### 3.6.1.3 Liquid paint

Calculate the total "soluble" antimony content of the liquid paint as the sum of the results obtained according to 3.6.1.1 and 3.6.1.2, thus

$$c_{\text{Sb}_3} = c_{\text{Sb}_1} + c_{\text{Sb}_2}$$

where  $c_{\text{Sb}_3}$  is the total "soluble" antimony content of the paint, expressed as a percentage by mass.

### 3.6.1.4 Paint in powder form

The total "soluble" antimony content of the paint in powder form is obtained by appropriate modification of the calculations given in 3.6.1.1.

### 3.6.1.5 Other test solutions

If the test solutions were prepared by methods other than those given in ISO 6713 (see 3.4.2.3), it will be necessary to modify the equations for the calculation of antimony content given in 3.6.1.1 and 3.6.1.2.

## 3.6.2 Precision

No precision data are currently available.

## 4 Rhodamine B spectrophotometric method

### 4.1 Principle

After oxidation, extraction of the antimony from strong hydrochloric acid solution with di-isopropyl ether. Formation of a red complex with Rhodamine B solution, and spectrophotometric measurement of the colour at a wavelength of about 553 nm.

### 4.2 Reagents

During the analysis, use only reagents of recognized analytical grade and only water of at least grade 3 purity according to ISO 3696.

**4.2.1 Hydrochloric acid**, approximately 37 % (m/m) ( $\varrho$  approximately 1,18 g/ml).

**4.2.2 Nitric acid**, approximately 65 % (m/m) ( $\varrho$  approximately 1,40 g/ml).

**4.2.3 Sulfuric acid**, approximately 98 % (m/m) ( $\varrho$  approximately 1,84 g/ml).

**4.2.4 Di-isopropyl ether**.

**4.2.5 Rhodamine B solution**.

Dissolve 150 mg of Rhodamine B (this is the trade name for tetraethylrhodamine) in 1 000 ml of hydrochloric acid,  $c(\text{HCl}) = 0,8 \text{ mol/l}$ , and mix well.

### 4.2.6 Cerium(IV) sulfate.

**4.2.7 Antimony**, standard stock solution containing 200 mg of Sb per litre.

Weigh, to the nearest 0,1 mg, 239,4 mg of dried antimony trioxide, dissolve in 100 ml of the hydrochloric acid (4.2.1) in a 1 000 ml one-mark volumetric flask, dilute to the mark with water and mix well.

1 ml of this standard stock solution contains 200 µg of Sb.

**4.2.8 Antimony**, standard solution containing 4 mg of Sb per litre.

Prepare this solution on the day of use.

Pipette 20 ml of the standard stock solution (4.2.7) into a 1 000 ml one-mark volumetric flask, add 50 ml of the hydrochloric acid (4.2.1), dilute to the mark with water and mix well.

1 ml of this standard solution contains 4 µg of Sb.

### 4.3 Apparatus

Ordinary laboratory apparatus and

**4.3.1 Spectrophotometer**, suitable for measurements at a wavelength of about 553 nm, fitted with cells of optical path length 10 or 20 nm.

**4.3.2 Separating funnels**, of capacity 100 ml, complying with the requirements of ISO 4800.

**4.3.3 Pipettes**, of capacity 20 ml, complying with the requirements of ISO 648.

**4.3.4 Burette**, of capacity 25 ml, complying with the requirements of ISO 385/1.

**4.3.5 One-mark volumetric flasks**, of capacity 50 ml, complying with the requirements of ISO 1042.

### 4.4 Procedure

#### 4.4.1 Preparation of the calibration graph

##### 4.4.1.1 Preparation of standard colorimetric solutions

Prepare these solutions on the day of use.

Into a series of five 100 ml beakers, introduce from the burette (4.3.4), respectively, the volumes of the standard antimony solutions (4.2.8) shown in the following table.