
**Water quality — Determination of
aluminium — Atomic absorption
spectrometric methods**

*Qualité de l'eau — Dosage de l'aluminium — Méthodes par spectrométrie
d'absorption atomique*

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International Standard ISO 12020 was prepared by Technical Committee ISO/TC 147, *Water Quality*, Subcommittee SC 2, *Physical, chemical and biochemical methods*.

Annexes A and B of this International Standard are for information only.

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Introduction

Aluminium may be present in water in ionic or complex form. It may be dissolved or finely dispersed. Even with the digestion described in 2.5.3, silicates and oxidic aluminium compounds may not in all cases be quantitatively covered by these methods. Clause 2 refers to the determination of aluminium by flame atomic absorption spectrometry (AAS); in clause 3 a graphite furnace AAS method is described.

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Water quality – Determination of aluminium – Atomic absorption spectrometric methods

1 Scope

This International Standard describes two atomic absorption spectrometric (AAS) methods for the determination of aluminium in water.

1.1 Flame AAS

The flame AAS method (clause 2) is applicable for the determination of aluminium in water in mass concentrations from 5 mg/l to 100 mg/l. Higher concentrations may be determined after an appropriate dilution of the sample. Careful evaporation of the sample, acidified with nitric acid, may be used to extend the working range of the method to lower concentrations as long as no precipitation is observed.

NOTE – If the linear range of the instrument is sufficiently large, concentrations < 5 mg/l may be determined with this method; otherwise the determination needs to be carried out in the graphite furnace, as described in clause 3.

If the determination of the total content of aluminium is required, a digestion of the sample according to 2.5.3 is necessary. Silicates and aluminium oxide compounds may, however, not be quantitatively determined with this digestion procedure.

1.2 Graphite furnace

The graphite furnace AAS method (clause 3) is applicable for the determination of aluminium in waters and waste waters in mass concentrations from 10 µg/l to 100 µg/l applying a dosing volume of 20 µl. The working range can be shifted to higher concentrations either by dilution of the sample or by using a smaller sample volume.

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2 Determination of aluminium by atomic absorption spectrometry in a nitrous oxide/acetylene flame

2.1 Interferences

The following ions can interfere with the flame AAS method, if the concentrations listed below are exceeded:

Sulfate	10 000 mg/l
Chloride	10 000 mg/l
Phosphate	10 000 mg/l
Sodium	10 000 mg/l
Potassium	10 000 mg/l
Magnesium	10 000 mg/l
Calcium	10 000 mg/l
Iron	10 000 mg/l
Nickel	10 000 mg/l
Cobalt	10 000 mg/l
Cadmium	3 000 mg/l
Lead	10 000 mg/l

Silicate	200 mg/l
Fluoroborate	2 000 mg/l
Titanium	1 000 mg/l
Fluoride	3 000 mg/l ¹⁾
1) This concentration is applicable for strongly acidic samples or measuring solutions with pH < 1. In less acidic solutions precipitation may occur.	

The total salt content of the measuring solution should not exceed 15 g/l, or its electrical conductivity should not be higher than 2 000 mS/m. For samples whose matrix influence is unknown, the conductivity should be investigated and compensated for, if possible, for example by dilution of the sample or by application of the method of standard additions.

2.2 Principle

Acid is added to the water sample which is then aspirated into a nitrous oxide/acetylene flame of an atomic absorption spectrometer. The absorbance is measured at a wavelength of 309,3 nm and the aluminium content calculated.

2.3 Reagents

2.3.1 General requirements

Use only reagents of at least recognized analytical grade quality and double-distilled water or water of equivalent purity. The aluminium content of the water or the reagents used shall be negligibly low, compared with the lowest concentration of aluminium to be determined.

2.3.2 Hydrochloric acid, $\rho_{\text{HCl}} = 1,16 \text{ g/ml}$.

2.3.3 Nitric acid, $\rho_{\text{HNO}_3} = 1,40 \text{ g/ml}$.

2.3.4 Hydrogen peroxide (dihydrogen dioxide), $w_{\text{H}_2\text{O}_2} = 30 \%$.

2.3.5 Caesium chloride solution, $\rho_{\text{Cs}} = 20 \text{ g/l}$.

Dissolve 25,3 g of CsCl in 100 ml of HCl (2.3.2) and make up to 1 000 ml with water (2.3.1).

2.3.6 Aluminium stock solution, $\rho_{\text{Al}} = 1 000 \text{ mg/l}$.

Dissolve 1,000 g of aluminium, minimum purity 99,9 % or band, in a graduated flask, nominal capacity 1 000 ml, in approximately 15 ml of hydrochloric acid (2.3.2) and make up to volume with water (2.3.1).

Alternatively, prepare the solution with a commercially available aluminium standard which contains $(1,000 \pm 0,002) \text{ g Al}$.

2.3.7 Aluminium standard solution, $\rho_{\text{Al}} = 100 \text{ mg/l}$.

Pipette 100 ml of the aluminium stock solution (2.3.6) into a 1 000-ml graduated flask, add 10 ml of nitric acid (2.3.3), and make up to volume with water (2.3.1).

2.3.8 Aluminium calibration solutions.

In accordance with the aluminium concentration expected in the sample, prepare at least five calibration solutions from the aluminium standard solution (2.3.7). For the working range of 5 mg/l to 50 mg/l, proceed, for example, as follows.

- a) Pipette, into a series of 100-ml graduated flasks, 5 ml, 10 ml, 20 ml, 30 ml and 50 ml of the aluminium standard solution (2.3.7);