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**NATIONAL OCCUPATIONAL HEALTH STANDARD OF THE  
PEOPLE'S REPUBLIC OF CHINA**

**GBZ/T 308-2018**

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**Simultaneous determination of a variety of metals in urine --  
Inductively coupled plasma mass spectrometry method**

尿中多种金属同时测定 电感耦合等离子体质谱法

**(English Translation)**

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### Foreword

This standard is formulated in accordance with the Law of the People's Republic this standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This standard was drafted. Guangdong Provincial Occupational Disease Prevention and Treatment Institute, China Center for Disease Control and Prevention, Occupational Health and Poison Control Institute, Jiangsu Province Disease Prevention and Control Center, Shenzhen Longgang District Center for Disease Control and Prevention, Shenzhen Luohu District Center for Disease Control and Prevention, Qingyuan City Disease Prevention control center.

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Simultaneous determination of various metals in urine by inductively coupled plasma mass spectrometry

## 1 Scope

This standard specifies inductively coupled plasma mass spectrometry for simultaneous determination of vanadium, chromium, cobalt, cadmium, antimony and lead in urine.

This standard applies to the determination of vanadium, chromium, cobalt, cadmium, antimony and lead in the urine of occupational contacts.

## 2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the dated version applies to this document.

For undated references, the latest edition (including all amendments) applies to this document.

GBZ/T 295 General rules for occupational health biological monitoring

## 3 Principle

The urine sample (hereinafter referred to as the urine sample) is diluted with a nitric acid solution and directly injected. Determination of vanadium (V) by inductively coupled plasma mass spectrometry Concentrations of chromium (Cr), cobalt (Co), cadmium (Cd), thallium (Tl), and lead (Pb).

## 4 Instruments

4.1 Inductively coupled plasma mass spectrometer with collision cell.

### 4.2

Ultrapure water preparation instrument.

### 4.3

stoppered polyethylene plastic bottle, 100 mL.

### 4.4

polyethylene plastic tube, 5 mL.

### 4.5

Micropipettes, 5000 L, 1000 L, 200 L, 50 L.

### 4.6

Glass instruments and plastic utensils should be soaked in 20% nitric acid for more than 24 hours, rinsed, and dried for use.

## 5 Reagent

### 5.1

Experimental water. deionized water or double distilled water.

### 5.2

Nitric acid (HNO<sub>3</sub>),  $\rho_{20}=1.42$  g/mL, excellent grade pure or high purity.

### 5.3

Nitric acid solution, 1% (volume fraction). Measure 1.0 mL of HNO<sub>3</sub> and add to 99.0 mL of deionized water.

### 5.4

standard solution. vanadium, chromium, cobalt, cadmium, antimony, lead single element standard solution or mixed standard solution.

### 5.5

Internal standard solution. It is recommended to use (Y), indium (In), (Ho) single element standard solution or mixed standard solution.

### 5.6

Tuning solution. Lithium (Li), yttrium (Y), cerium (Ce), cerium (Tl), cobalt (Co) single element standard solution or mixing is recommended.

standard solution.

### 5.7

Standard stock solution and standard application liquid. Mix standard solution of vanadium, chromium, cobalt, cadmium, antimony and lead with nitric acid solution to make 10.0 g/mL mixture Standard stock solution, diluted with standard nitric acid solution to 1.0 g/mL mixed standard application solution.

### 5.8

Internal standard stock solution and application liquid. The standard solution of bismuth, indium and bismuth is prepared into a concentration of 10.0 g/mL internal standard stock solution with nitric acid solution.

The internal standard stock solution was diluted to 10.0 g/L of the internal standard application solution with a nitric acid solution.

### 5.9

Tuning stock solution and application liquid. Prepare a standard solution of lithium, strontium, barium, strontium and cobalt with a nitric acid solution to a concentration of 10.0 g/mL.

Dilute to 10.0 g/L of the tuning solution with a nitric acid solution at the time of use.

## 6 Sample collection, transportation and storage

Collect urine samples according to GBZ/T 295, collect polyethylene samples from contact or poisoned patients with polyethylene plastic bottles, mix well, and do Quickly measure urine creatinine or specific gravity, add 1 mL of nitric acid to 100 mL of urine sample, transport as soon as possible at room temperature, and save at least 2 °C~6 °C 14 d.

### 7.1 Instrument Operation Reference Conditions

RF power 1450 W; cooling gas flow 15 L/min, carrier gas flow 0.85 L/min, auxiliary gas flow 0.25 L/min; scanning mode.

Full quantification; integration time 0.1 s; acquisition times 3 times; cobalt, cadmium, antimony and lead were measured in standard mode. reaction cell inlet voltage -30 V, the cell outlet voltage is -28 V, the quadrupole lens is at -3 V, and the octopole deflection voltage is -6 V. Vanadium and chromium are measured in collision mode.

The cell inlet voltage is -40 V, the cell outlet voltage is -38 V, the quadrupole focus lens voltage is -13 V, and the octopole deflection voltage is -16 V. Push it is recommended to use bismuth, indium and antimony as the internal standard elements of the element to be tested, as shown in Table 1. The method of introducing internal standard on-line is used for the determination.

Table 1 Recommended mass and internal standard elements of the element to be tested

The mass of the element to be tested, the mass of the internal standard element Vanadium (V) 51 (Y) 89 Chromium (Cr) 53 (Y) 89 Cobalt (Co) 59 (Y) 89 Cadmium (Cd) 111 Indium (In) 115 ?(Ti) 205 ?(Ho) 165 Lead (Pb) 208 (Ho) 165

### 7.2 Instrument Tuning

The plasma is ignited at the start, and after the instrument is preheated for 30 minutes, the tuning liquid is used for mass correction and resolution verification to make the element contained in the tuning liquid.

Sensitivity, precision, mass axis and peak width meet the requirements of the instrument; at the same time, the oxide interference is less than 1.5%, and the double charge interference is small.

At 3.0%.