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# International Standard



# 6992

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## Unplasticized polyvinyl chloride (PVC-U) pipes for drinking water supply — Extractability of cadmium and mercury occurring as impurities

*Tubes en polychlorure de vinyle non plastifié (PVC-U) pour l'alimentation en eau potable — Extractibilité du cadmium et du mercure au titre des impuretés*

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## Foreword

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International Standard ISO 6992 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*.

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# Unplasticized polyvinyl chloride (PVC-U) pipes for drinking water supply — Extractability of cadmium and mercury occurring as impurities

## 0 Introduction

The use of cadmium compounds as stabilizers in unplasticized polyvinyl chloride (PVC-U) is forbidden or unacceptable in many countries. However, they may be present as impurities in acceptable additives.

Similarly, certain catalysts used for polymerization of vinyl chloride may contain mercury.

Therefore, the presence of traces of these metallic compounds in unplasticized polyvinyl chloride pipe is possible. The limits given in section two ensure that the extraction of such impurities by drinking water from unplasticized polyvinyl chloride (PVC-U) pipe in normal service will not exceed the requirements of the World Health Organization (WHO).

## 1 Scope and field of application

This International Standard specifies a test method for the determination of the extractability of certain impurities from unplasticized polyvinyl chloride (PVC-U) pipe in order to verify that the extraction quantities do not exceed a certain concentration. Section one deals exclusively with the extraction method and leaves the analytical method to the choice of the operator. Section two gives limits for these impurities in the extract, which have been found by experience to ensure that actual extraction in service will be acceptable by many regulatory authorities, particularly the World Health Organization (WHO).

This International Standard applies to unplasticized polyvinyl chloride (PVC-U) pipes intended for the transport of drinking water. It only relates to the extractability of

- cadmium and its derivatives;
- mercury and its derivatives.

## Section one : Test methods

### 2 Principle

Pre-washing of test pieces during a fixed time. Filling the test pieces with water acidified with carbon dioxide. Determination of the quantities of cadmium, mercury and their derivatives.

NOTE — The analytical test methods to be used for the determination of the quantity of material taken into solution are not defined. They should, however, allow the analysis to be carried out with an accuracy of 0,005 mg/l for cadmium and of 0,000 5 mg/l for mercury.

### 3 Apparatus

#### 3.1 Glass tube with glass stopcock

3.2 Stoppers in polyethylene or any other material which has been shown not to affect the results.

#### 3.3 Stoppered glass containers.

### 4 Reagents

4.1 Test water, distilled water acidified to a pH of  $4,5 \pm 0,1$  by bubbling carbon dioxide through the water.

#### 4.2 Distilled water.

### 5 Preparation of test pieces

For each test, select three pieces of the pipe at random, each of which is 500 mm in length and has an internal volume at least equal to the volume of the extracting liquid required to determine with the required precision the amount of material which has migrated.

NOTE — The dimensions of the pipe should be indicated in the product standards.

### 6 Procedure

#### 6.1 Pre-washing

6.1.1 Close one end of each test piece with a stopper (3.2) fitted centrally with a length of glass tube (3.1) with a stopcock.

6.1.2 Clamp the test pieces vertically with the open end upwards.

6.1.3 Pass tap water of pH 7 to 8 through the test pieces so that its linear rate of flow is 3 m/min, calculated from the average internal cross-sectional area of the pipe, and the test pieces shall be continuously filled with tap water.

6.1.4 Maintain the water flow for a period of  $60 \pm 10$  min.

6.1.5 At the end of this period, stop the water flow, remove the stoppers and rinse out the test pieces with distilled water (4.2).

#### 6.2 Extractability test

For each series of tests, freshly prepared test water (4.1) shall be used.

6.2.1 Close, with a stopper (3.2), one end of each pre-washed test piece.

6.2.2 Fill each test piece with test water (4.1), the temperature of which has been adjusted to approximately 20 °C.

6.2.3 Close the other end of each test piece by means of a stopper (3.2) and maintain the filled test pieces at  $20 \pm 2$  °C for 48 h.

6.2.4 At the end of 48 h, empty the test water from each test piece into separate stoppered glass containers (3.3).

These are the first extracts on which the quantities of cadmium and mercury and their derivatives shall be determined.

6.2.5 Fill each of the same test pieces, stoppered at one end, with fresh test water at  $20 \pm 2$  °C. Close the other end with a stopper and leave at  $20 \pm 2$  °C for 48 h.

At the end of 48 h, empty the test water from each test piece into separate stoppered glass containers (3.3).

These are the second extracts on which the quantities of cadmium and mercury and their derivatives shall be determined.

6.2.6 Fill each of the same test pieces, stoppered at one end, with fresh test water at  $20 \pm 2$  °C. Close the other end with a stopper and leave at  $20 \pm 2$  °C for 48 h.

At the end of 48 h, empty the test water from each test piece into separate stoppered glass containers (3.3).

These are the third extracts on which the quantities of cadmium and mercury and their derivatives shall be determined.

### 7 Expression of results

#### 7.1 Cadmium

7.1.1 Calculate the arithmetic mean of the quantity of cadmium found in the three test waters at each extract.

7.1.2 Express the results in milligrams per litre, to the nearest 0,005 mg/l.

## 7.2 Mercury

7.2.1 Calculate the arithmetic mean of the quantity of mercury found in the three test waters at each extract.

7.2.2 Express the results in milligrams per litre, to the nearest 0,000 5 mg/l.

## 8 Test report

The test report shall include the following information :

- a) complete identification of the pipe tested;
- b) the number of test pieces;
- c) the analytical method used for the determination of the quantity of cadmium in aqueous solution;
- d) the analytical method used for the determination of the quantity of mercury in aqueous solution;
- e) the duration of the pre-washing;
- f) the quantities of extracted cadmium found for each test piece for the first, second and third extractions;
- g) the arithmetic mean of the quantities of extracted cadmium for the pipe for the first, second and third extractions;
- h) the quantities of extracted mercury found for each test piece for the first, second and third extractions;
- i) the arithmetic mean of the quantities of extracted mercury for the pipe for the first, second and third extractions;
- j) details of the procedure which have not been provided for by this test method and also any accidental circumstances which might have affected the results.

## Section two : Basic specification

Under the arduous test conditions for extractability described in section one, the extracted quantities of cadmium and mercury shall not exceed the values given in clauses 9 and 10 respectively.

### 9 Cadmium

For all three extracts, the cadmium concentration shall not be greater than 0,01 mg/l.

### 10 Mercury

For all three extracts, the mercury concentration shall not be greater than 0,001 mg/l.