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# International Standard



# 1014

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## **Coke — Determination of true relative density, apparent relative density and porosity**

*Coke — Détermination de la densité relative vraie, de la densité relative apparente et de la porosité*

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## Foreword

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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 1014 was prepared by Technical Committee ISO/TC 27, *Solid mineral fuels*.

ISO 1014 was first published in 1975. This second edition cancels and replaces the first edition, of which it constitutes a minor revision.

# Coke — Determination of true relative density, apparent relative density and porosity

## 1 Scope and field of application

This International Standard specifies methods of

- determining the true relative density of coke, crushed to 212  $\mu\text{m}$ , in relation to water<sup>1)</sup>
- determining the apparent relative density of coke, i.e. the ratio of the mass of a volume of dry coke to the mass of an equal volume of water
- calculating the porosity of the coke.

## 2 Reference

ISO 687, *Coke — Determination of moisture in the analysis sample*.

## 3 True relative density

### 3.1 Principle

The mass of water displaced by a known mass of dry coke, ground to pass a sieve of nominal size of openings 212  $\mu\text{m}$ , is determined using a pyknometer. Air is displaced by boiling during the determination. Air-free distilled water<sup>1)</sup> is specified, as the use of organic liquids, or of water with wetting agents added, has been found to give variable results. Thermostatic control of the temperature is essential since a difference of 1 °C can cause an error of about 0,012 in the result.

### 3.2 Apparatus

#### 3.2.1 Pyknometer, 50 ml capacity

**3.2.2 Water bath**, with stirrer, thermostatically controlled to maintain a desired temperature  $\theta$  °C to within  $\pm 1$  °C.

**3.2.3 Two wash bottles**, each containing about 50 ml of air-free distilled water. One wash bottle is kept hot (80 to 90 °C) and the other is left in the water bath (3.2.2).

**3.2.4 Reflux air condenser**: a glass tube about 1 m long, of the same external diameter as the neck of the pyknometer (3.2.1) with a short length of rubber tubing for attaching it to the latter.

**3.2.5 Glycerol bath**: a suitable vessel in which sufficient glycerol can be heated for the lower two-thirds of the pyknometer (3.2.1) to be immersed.

**3.2.6 Balance**, accurate to 0,1 mg.

### 3.3 Preparation of sample

The coke used for the determination is the analysis sample, ground to pass a sieve of nominal size of openings 212  $\mu\text{m}$ . Before commencing the determination, mix the sample thoroughly for at least 1 min, preferably by mechanical means.

### 3.4 Procedure

Clean the pyknometer (3.2.1) using a mixture of potassium dichromate and sulfuric acid, rinse thoroughly and fill with air-free distilled water. Insert the stopper and immerse the pyknometer up to the neck in the water bath (3.2.2) at  $\theta$  °C for 2 h. The value of  $\theta$  should be about 5 °C above the ambient temperature. At the end of 1 h, remove the blob of water from the top of the stopper with a piece of filter paper, remove the pyknometer from the water bath, rapidly cool under cold running water, dry, allow to stand beside the balance (3.2.6) for 30 min and weigh with an accuracy of  $\pm 0,1$  mg. Empty the pyknometer and dry the neck.

Dry a portion of the coke sample for 1 h at 105 to 110 °C (see the note), cool, then weigh about 5 g of the dry coke to the nearest 0,1 mg and transfer it completely to the pyknometer. Wash down any coke adhering to the neck or side of the pyknometer with air-free distilled water, making up the volume to about 25 ml. Attach the air condenser (3.2.4) to the neck of the pyknometer with the rubber tubing and immerse the pyknometer in the glycerol bath (3.2.5). Heat the bath so that the water in the pyknometer begins to boil vigorously. Wash down any scum of coke with a few millilitres of the hot, air-free distilled water. After boiling for 30 min, remove the pyknometer from the glycerol bath, detach the air condenser and allow the pyknometer to cool. Fill the pyknometer with air-free distilled water at  $\theta$  °C, insert the stopper and immerse the pyknometer up to the neck in the water bath at  $\theta$  °C for 1 h, compensating for any contraction of the liquid by the addition of air-free distilled water and ensuring that air bubbles are not trapped, either below the stopper or in the capillary. At the end of 1 h, remove the blob of water from the top of the stopper, remove the pyknometer from the water bath, cool, dry, allow to stand beside the balance for 30 min and weigh as before.

1) It should be noted that "true relative density" varies according to the displacement liquid used.