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Carbonaceous materials for the production of aluminium — Baked anodes — Determination of the air permeability

Produits carbonés utilisés pour la production de l'aluminium — Anodes cuites — Détermination de la perméabilité à l'air

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15906 was prepared by Technical Committee ISO/TC 226, *Materials for the production of primary aluminium*.

Introduction

Anode performance in aluminium reduction cells can be partially characterized by the measurement of the gas permeability. Higher permeability allows attack and consumption of the anode by air and $C0_2$, thus shortening the life and overall performance of the anode.

Carbonaceous materials for the production of aluminium — Baked anodes — Determination of the air permeability

1 Scope

This International Standard describes a method for the measurement of the air permeability of baked anodes, by determining the resistance to airflow of a specimen of specified volume at room temperature, within the range of air permeability between 0,01 nPm (nanoperms) and 10 nPm.

"Green" anodes are considered to be impermeable to gas. Therefore, this test is most applicable to "baked" carbon material.

NOTE This method can also be used for measuring other carbon materials (e.g. microporous carbon materials), but precision statements are not available for other carbon materials.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8007-2:1999, *Carbonaceous materials used in the production of aluminium — Sampling plans and sampling from individual units — Part 2: Prebaked anodes*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
sample
portion of carbon from a baked anode

3.2
test specimen
article prepared from a sample

4 Principle

The air permeability of a sample is determined by a comparative method. The time necessary to draw a specified volume of air through the test specimen is measured. This time is compared to the time necessary to draw a specified volume of air through a standard with known air permeability. This comparison yields the air permeability of the sample material.

5 Apparatus

5.1 **Callipers**, with 0,01 mm reading precision.

5.2 Air permeability unit equipped as in 5.2.1 to 5.2.3.

5.2.1 Membrane vacuum pump, with an inlet to generate vacuum down to 100 mbar, and an outlet to generate high pressure up to 4 bar. The maximum flow rate has to reach 25 l/min.

5.2.2 Permeability cell, as shown in Figure 1. The cell is designed to ensure an airtight sealing around the periphery of the sample. A rubber tube is forced as a seal against the cylindrical test specimen by means of compressed air. The porous filter-paper and the sponge-rubber protect the vacuum pump from particles and/or dust from the sample.

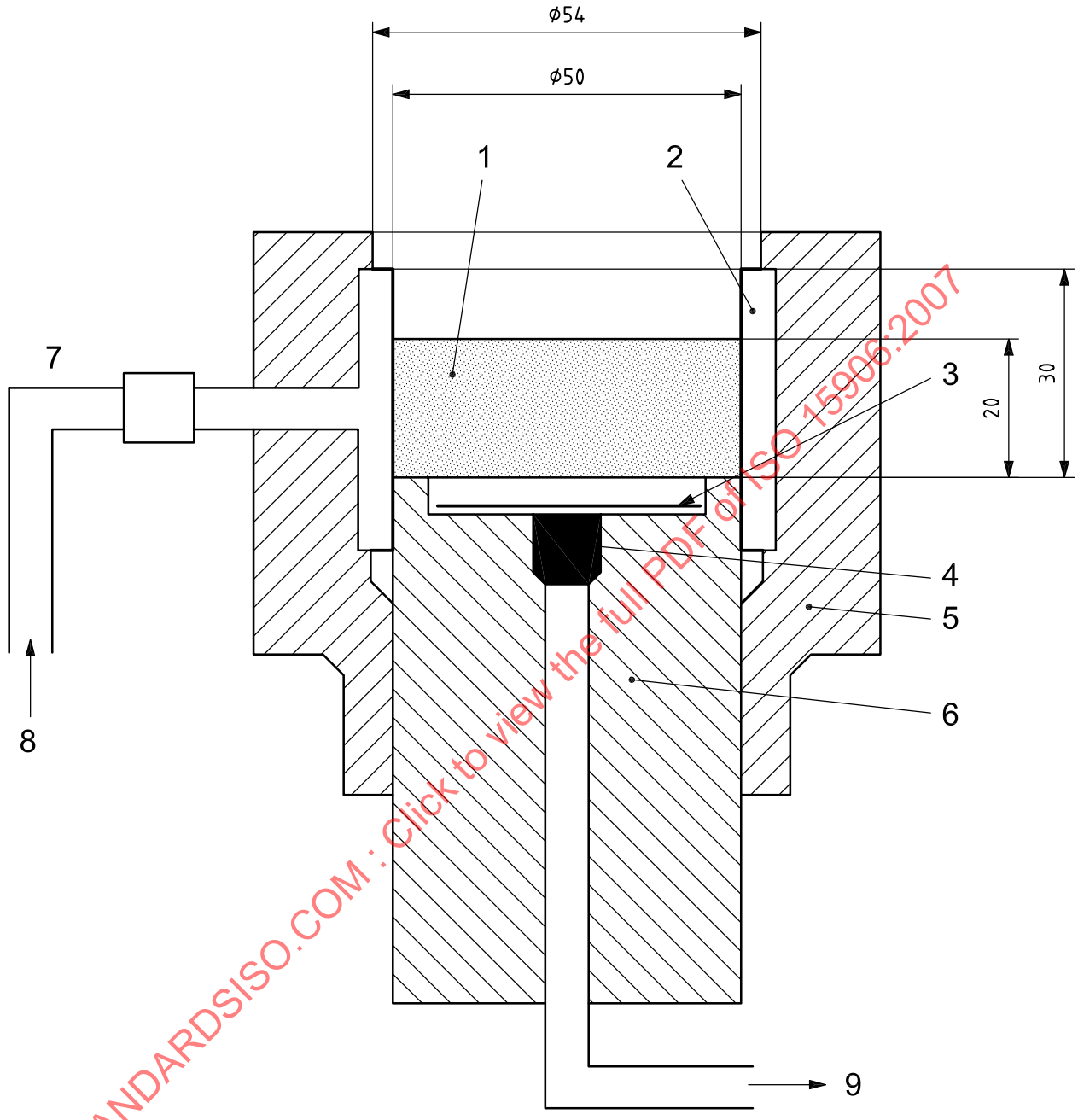
5.2.3 U-tube manometer, with light fork sensors as shown in Figure 2.

The U-tube is directly linked with the vacuum pump and is placed parallel to the permeability cell. It has a working length of 220 mm, an internal diameter of 16 mm ± 1 mm and an external diameter of 20 mm. It is filled to the equilibrium mark with a non-volatile, non-hygroscopic liquid of low viscosity and density, such as dibutylphtalate or a light-grade mineral oil. Thereby, the vacuum and the air volume flowing through the test specimen can easily be measured by following the oil level inside the U-tube.

There are three light fork sensors. The lowest one (sensor 3) is located at 145 mm below the mark line of equilibrium. The two other sensors are located at 30 mm (sensor 1) and at 80 mm (sensor 2) below the equilibrium mark.

The connection to the vacuum pump can be closed by a valve, which then leads to a decrease of the vacuum by air flowing through the test specimen due to its air permeability.

Dimensions in millimetres

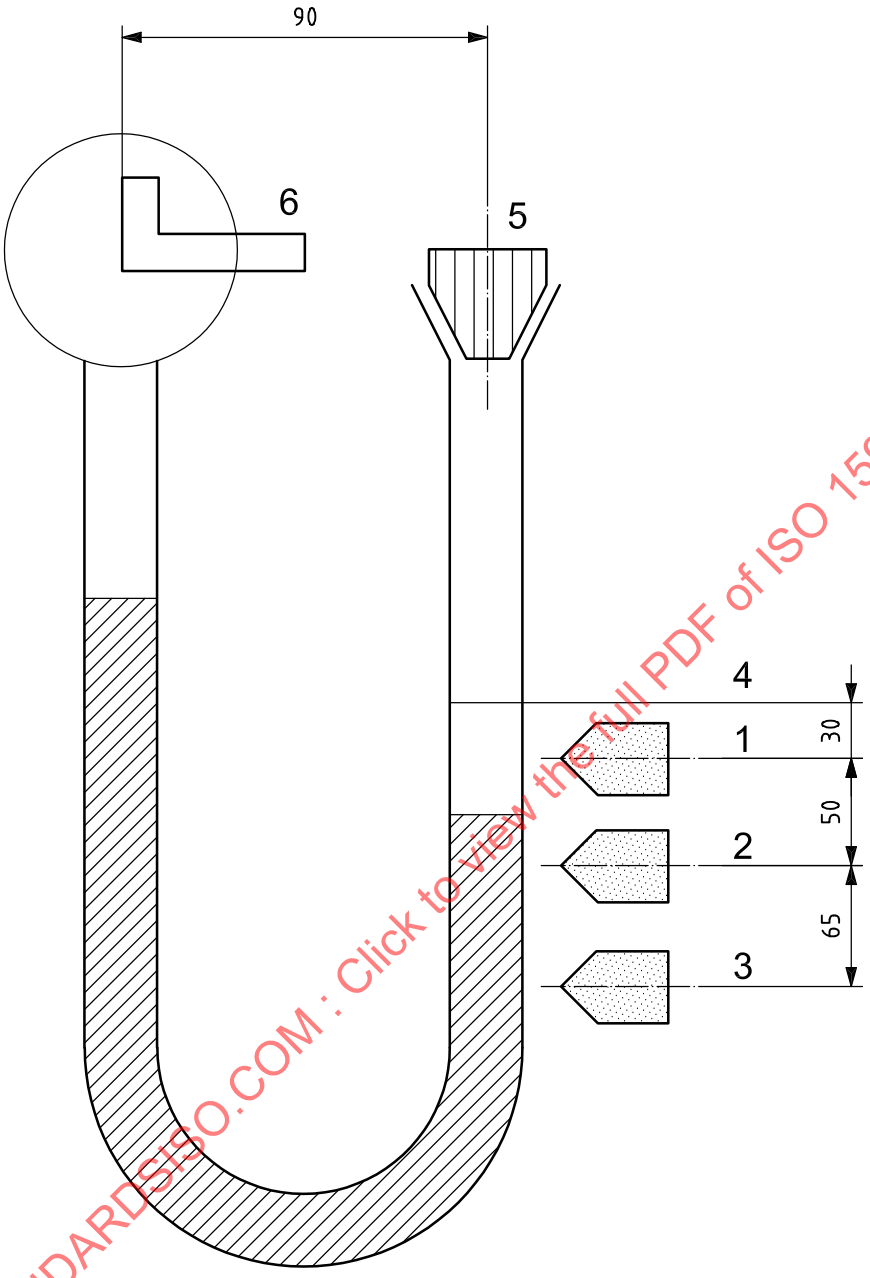


Key

1 test specimen
2 rubber tube
3 porous filter-paper
4 rubber sponge
5 movable clamping device
6 stationary piston
7 plastic hose
8 compressed air intake
9 vacuum system

Figure 1 — Permeability cell

Dimensions in millimetres



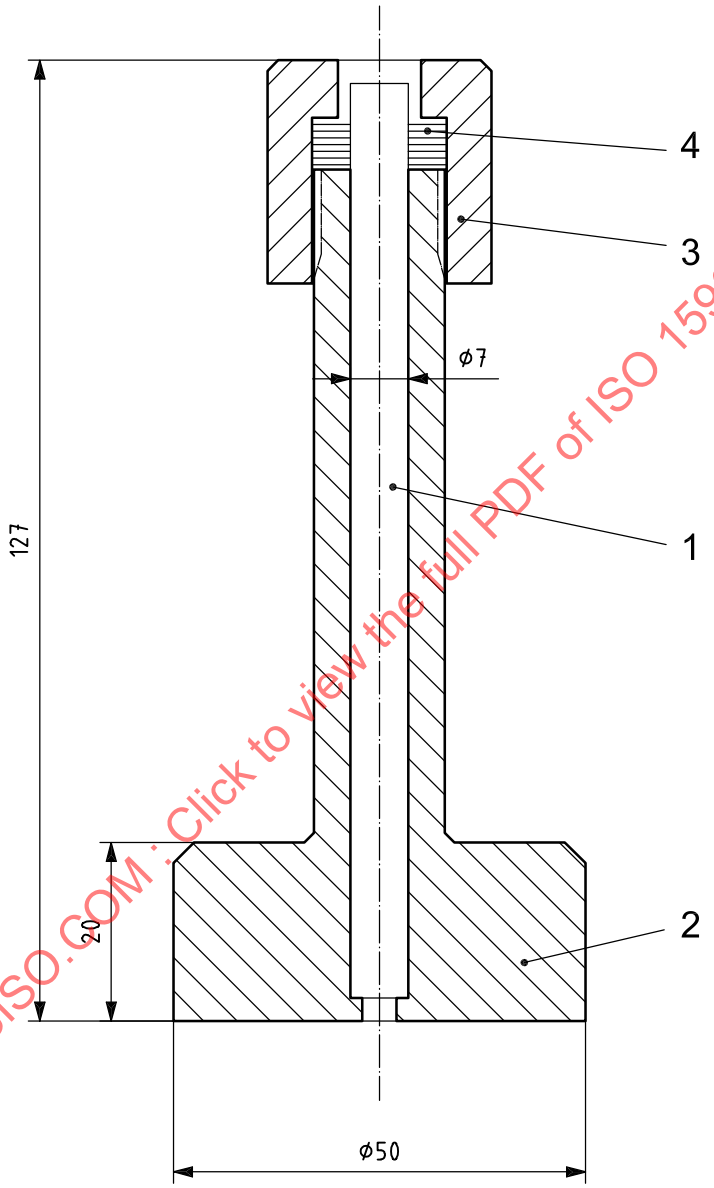
Key

1 proximity sensor 1
2 proximity sensor 2
3 proximity sensor 3
4 mark line of equilibrium
5 air inlet
6 vacuum system

Figure 2 — U-tube manometer

5.3 Standards with known air permeability, high-precision capillaries with known air permeability suitable for calibrating the air permeability unit.[1)] A range of permeability values for this standard of between 1 and 2 nPm is appropriate. The capillaries are mounted in a holder which fits onto the cell clamping device (50 mm diameter) of the air permeability unit, see Figure 3. A proper seal guarantees that there is no air leakage between the capillary and the metallic holder.

Dimensions in millimetres



Key

1 capillary
2 holder
3 screw cap
4 seal

Figure 3 — Standard with known air permeability

5.4 Impermeable disc, having the same dimensions as the test specimen.

1) Standards with known air permeability can be certified from the Netherlands Measurements Institute, NMI, in Dordrecht, The Netherlands.