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Anodizing of aluminium and its alloys — Measurement of reflectance characteristics of aluminium surfaces using integrating-sphere instruments

Anodisation de l'aluminium et de ses alliages — Mesurage des caractéristiques de réflectivité des surfaces d'aluminium à l'aide d'instruments à sphère d'intégration

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 6719 was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 2, *Organic and anodic oxidation coatings on aluminium*.

This second edition cancels and replaces the first edition (ISO 6719:1986), which has been technically revised.

Anodizing of aluminium and its alloys — Measurement of reflectance characteristics of aluminium surfaces using integrating-sphere instruments

1 Scope

This International Standard specifies a method of measuring the total and diffuse luminous reflectance characteristics of aluminium surfaces, using integrating-sphere instruments.

The method described is also applicable to the measurement of specular reflectance (principal gloss value), specularity and diffuseness.

The method is unsuitable for use with lighting reflectors.

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 7724-2, *Paints and varnishes — Colorimetry — Part 2: Colour measurement*

ISO 11664-2:2007, *Colorimetry — Part 2: CIE standard illuminants*

3 Principle

Measurement, using an integrating-sphere reflectometer, of the total and diffuse reflected light at different angles of incidence, close to the normal surface of a test specimen.

4 Apparatus

4.1 General

The reflectometer, suitable for measuring the reflectance of metallic surfaces, consists of a suitable light source, an integrating sphere and a photometer comprising a photo-electric cell with a signal multiplier and recording, indicating, or computing equipment. Figures 1 to 5 show the optical systems and geometry of typical instruments.

The incident light beam is allowed to fall onto the specimen and is reflected into the sphere, the interior of which is white, where it is automatically integrated. The average light flux, as measured by the photometer, is a measure of the quantity of the reflected light.

The spectral product of the light source, spectral filters, and spectral response of the light detector shall closely simulate the spectral product of the CIE source C (or D65) and the spectral luminous efficiency $V(\lambda)$ for photopic vision, in accordance with ISO 11664-2.

4.2 Geometrical specifications of the apparatus

4.2.1 Integrating sphere

The interior of the sphere, white-coated and fitted with a device to permit measurement of reflectance, either including or excluding specular reflectance, serves to collect the reflected light flux.

Any diameter of sphere is satisfactory, provided that the total port area does not exceed 5 % of the total internal surface.

The internal surface shall be diffusing and of a highly reflective white for the whole of the visible spectrum. The entrance and specimen ports of the instrument shall be centred on the same great circle with an arc of more than 170° between their centres. The specimen port shall subtend 8° ± 1° of arc in relation to the centre of the entrance port. The irradiating beam shall pass through the centreline of the entrance and specimen ports. A photometer shall be positioned on the sphere at 90° ± 0,5° from the entrance port.

4.3 Specular-included and specular-excluded determinations

4.3.1 Pivotable sphere

In the pivotable-sphere type of instrument (Figures 1 to 4), the sphere can turn about a vertical axis passing through the specimen port, rotating 9° ± 1° to provide for the measurements of specular-included or total reflectance (Q) and specular-excluded or diffuse reflectance (Q_d).

4.3.2 Fixed sphere (Type 1)

In the fixed-sphere Type 1 instrument, the specimen is held so that the incident beam falls on it at an angle of 9° ± 1° to the normal. A port, of the same dimensions as the entrance port, is provided in order to accept the specular reflection. Interchangeable caps are provided for this port, a black one to absorb the specular reflection for diffuse reflectance (Q_d) measurements and one coated with the same material as the inside of the sphere for total reflectance (Q) measurements.

4.3.3 Fixed sphere (Type 2)

In the fixed-sphere Type 2 instrument (see Figure 5), the sphere is fixed and only the specimen can be inclined. A wedge, as shown in Figure 5, designed to exclude ambient light, and white-coated like the sphere interior, allows adjustment of the angle of the specimen surface. For measurement of diffuse reflectance (Q_d), the specimen surface is adjusted to be perpendicular to the incident beam. For measurement of total reflectance (Q), the specimen surface is inclined at 9° ± 1° from the normal incident beam by insertion of the wedge.

4.4 Irradiation beam

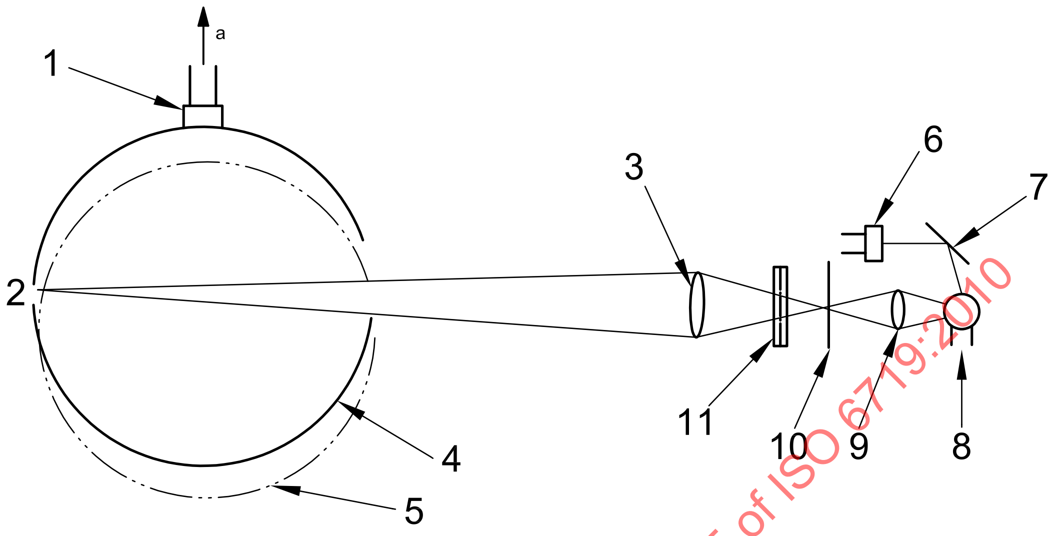
The light beam shall be substantially unidirectional with a maximum angle of any ray being less than 3° from the axis of the beam. It shall not be vignetted at either port.

The incident light beam shall have a circular cross-section concentric with the specimen port and shall have an annulus of 1,3° ± 0,1° subtended at the entrance port. On reflection from a first surface mirror, the specular-excluded beam shall be concentric with the centre of the port when the sphere is in the specular-excluded position. The mirror-reflected beam shall have a concentric circle with the port and shall have an annulus of 0,6° ± 0,2° subtended at the level of the exit port. The size of the exit port shall be not more than 0,1° greater than that of the annulus.

NOTE The dimensions of this beam can be most easily measured at a point beyond the sphere at a distance corresponding to the diameter of the integrating sphere, with no obstruction at either port. However, this will not ensure alignment when specularly reflected.

4.5 Housing

A housing shall be provided to prevent ambient light from entering the entrance port.

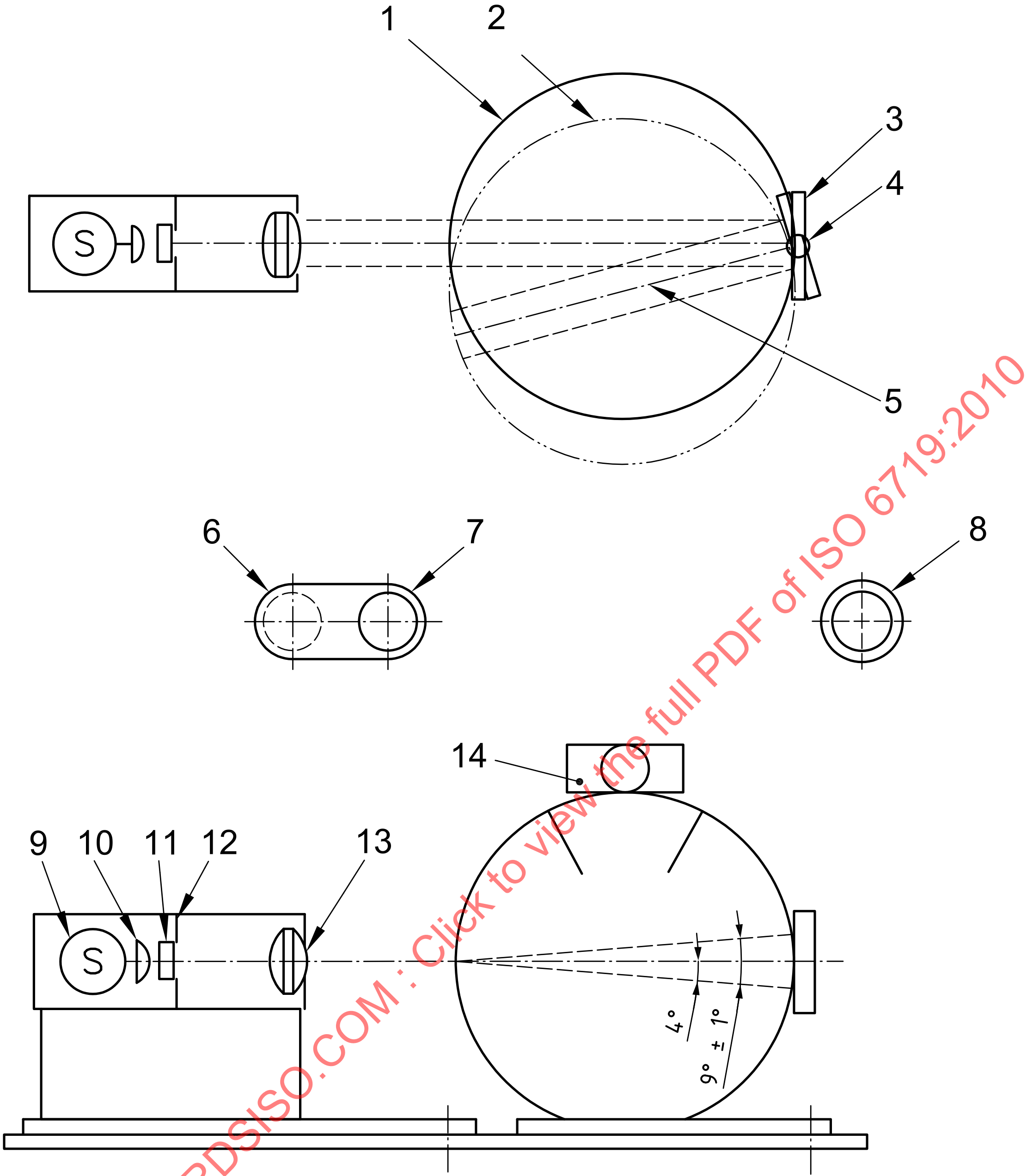


Key

1 photoelectric cell
2 test piece
3 lens
4 0° incidence for diffuse reflectance
5 9° ± 1° incidence for total reflectance
6 photoelectric cell for comparison
7 mirror
8 light source
9 lens
10 aperture
11 spectral filter

a To the amplifiers and recorders.

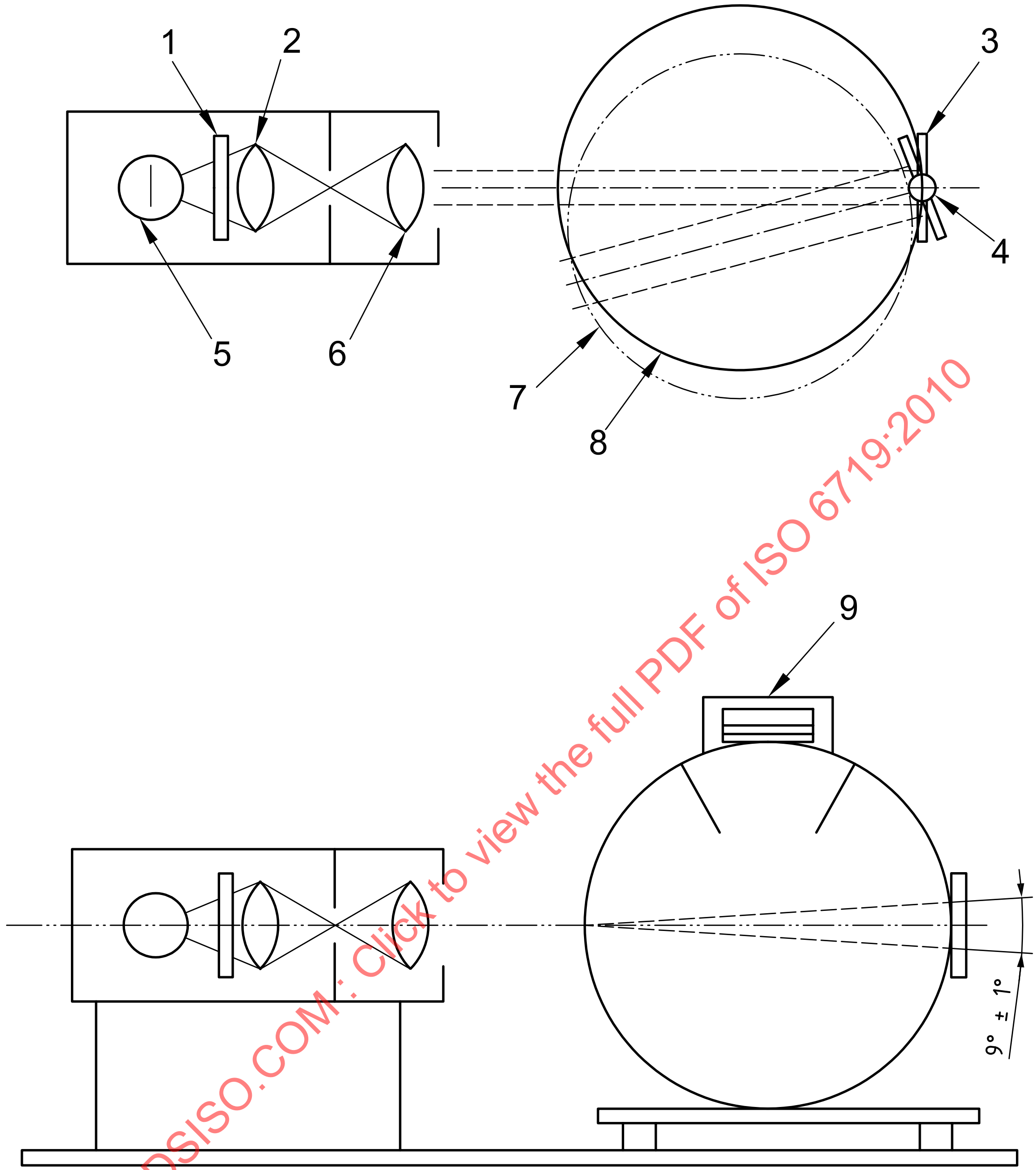
Figure 1 — Schematic optical plan of one type of pivotable-sphere reflectometer



Key

1	sphere in axial position	8	light beam at exit port
2	sphere in pivoted position	9	source
3	test piece	10	convex lens
4	specular pivot	11	specular filter
5	specular beam — sphere in pivoted position	12	aperture
6	incoming light beam from the axial position	13	lens
7	incoming light beam at entrance port (axis positions)	14	receiver

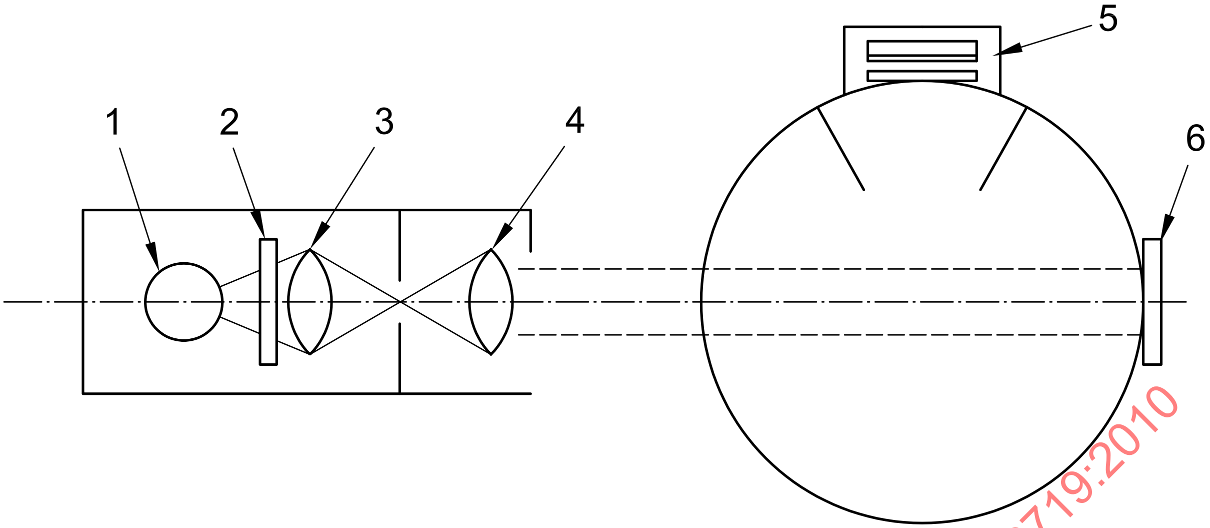
Figure 2 — Schematic optical plan of another type of pivotable-sphere reflectometer



Key

1 spectral filter
2 lens
3 test piece
4 sphere pivot
5 light source
6 lens
7 in pivoted position
8 in axial position
9 recorder

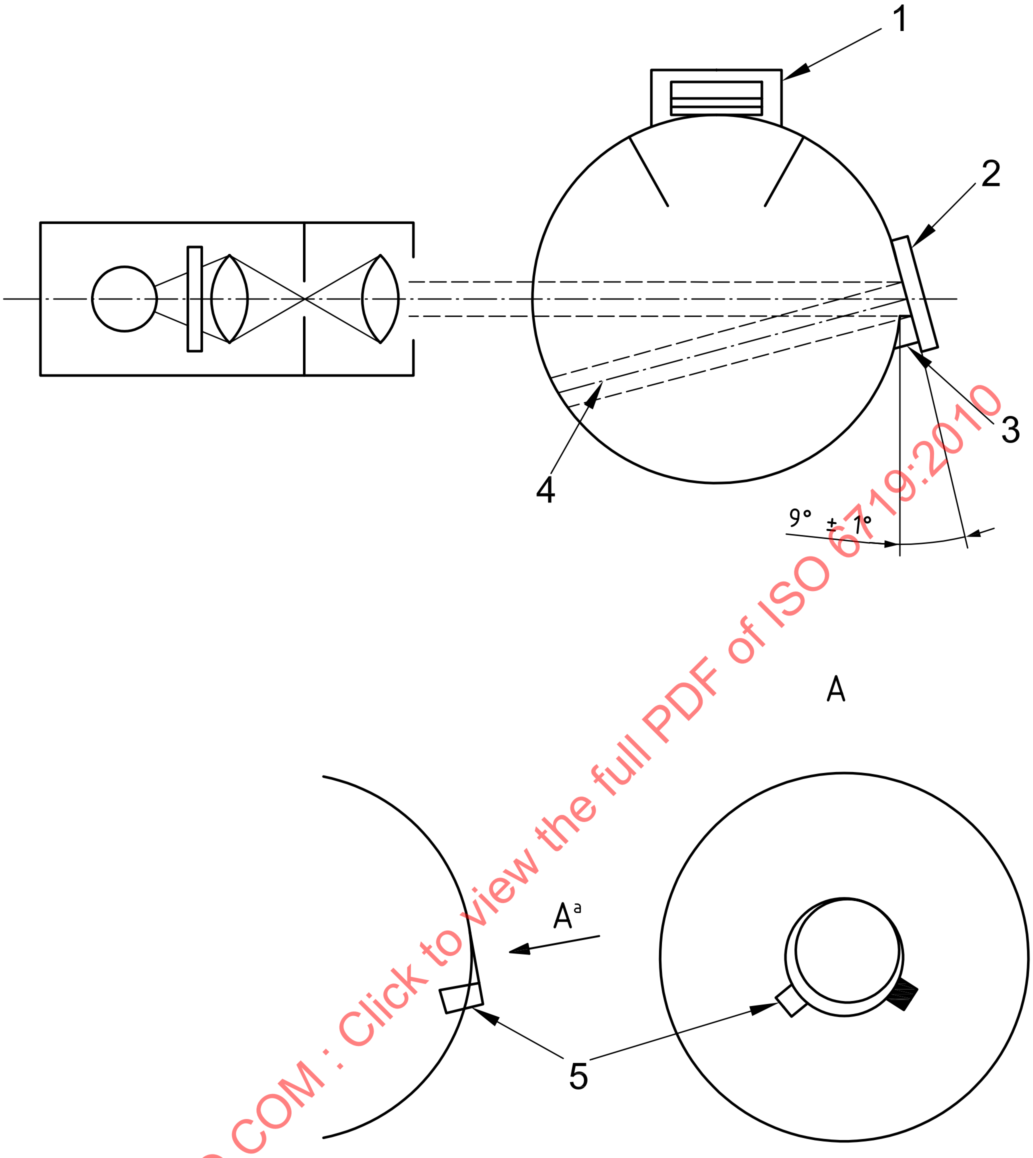
Figure 3 — Geometry of typical pivotable-sphere reflectometers



Key

1 light source
2 spectral filter
3 lens
4 lens
5 receiver
6 test piece

Figure 4 — Geometry of typical pivotable-sphere reflectometers (specular-excluded)



Key

1 receiver

2 test piece

3 wedge (white-coated)

4 specular beam

5 wedge

a Exit port.

Figure 5 — Geometry of a typical fixed-sphere (Type 2), specimen-inclining reflectometer (specular-excluded)

5 Calibration and operation of the reflectometer

5.1 General

The reflectometer shall be operated and calibrated in accordance with the manufacturer's instructions.