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Alpine skis — Determination of mass and polar moment of inertia — Laboratory measurement method

Skis alpins — Détermination de la masse et du moment d'inertie polaire — Méthode de mesurage en laboratoire

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Foreword

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This document was prepared by Technical Committee ISO/TC 83, *Sports and other recreational facilities and equipment*, Subcommittee SC 4, *Snowsports equipment*.

This third edition cancels and replaces the second edition (ISO 6003:1984), which has been technically revised.

Alpine skis — Determination of mass and polar moment of inertia — Laboratory measurement method

1 Scope

This document specifies laboratory measurement methods for mass and polar moment of inertia of alpine skis.

If laboratory measurement data are determined and published by the ski manufacturer or other institutions, standard measurement procedures can be used to ensure comparability.

This document also specifies a tolerance range which can be met by the measurement data of all manufactured skis, if for the specific model length measurement data are published by the manufacturer of the ski.

NOTE The appropriate ski length can be given with the published measurement data.

It is not the purpose of this document to evaluate the measurement data with regard to their influence on the quality of the ski.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
mass of ski
m
mass of a finished manufactured ski without any mounted parts

Note 1 to entry: Expressed in kilograms.

3.2
polar moment of inertia
I
mass moment of inertia of the ski about its centre of gravity

Note 1 to entry: The unit used to express the polar moment of inertia is the kilogram metre squared.

4 Apparatus

4.1 **Weighing device**, accurate to ±0,02 kg.

4.2 **Fulcrum**, for locating the centre of gravity of the ski.

4.3 Time measurement device (stop watch), accurate to at least 0,1 s.

4.4 Measuring device in accordance with Figure 1, consisting of the following parts.

4.4.1 Clamping device A (see Figure 1), consisting of two clamping fixtures.

The top clamping fixture has a hole with a mark to locate the centre of gravity and a further two holes at a distance *e* from the centre mark for fixation of the filaments B.

The recommended dimension for, *e*, is 25 mm and the mass of the clamping device shall be less than 0,1 kg.

4.4.2 Top plate C, with two holes separated by the distance $2d_f$; for the fixation of filaments B. The plate C shall be fixed on a stiff, horizontal beam.

4.4.3 Two filaments B, with equal length, *l*, which connect the top plate with the clamping device. The ratio d_f:*l* shall be approximately 1:40. With the recommended dimension d_f = 25 mm, the length, *l*, shall be 1 000 mm. The filaments shall be made of materials with low elongation and high strength (for example, tennis string, silk fishing line).

The diameter of the filaments shall be not more than 1,0 mm.

5 Sampling and conditioning

5.1 In order to ensure comparability, it is recommended to use one of the following ski sizes if data of measurements are published:

— 150 cm, 165 cm or 180 cm.

From these three sizes, the one which is most representative for the tested model shall be selected.

5.2 All measurements according to this document shall be taken from a finished manufactured ski without any mounted parts.

5.3 All measurements according to this document shall be taken with a measuring device, which has been conditioned at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 1) % (i.e. the device shall be placed in this atmosphere for at least 24 h before measurement).

6 Calibration of measuring device

Differences in construction between the different measuring devices can lead to different measurement results, which deviate from the theoretical accurate value of the polar moment of inertia.

In order to compensate such deviations, it is recommended to determine a correction factor, *c*, for each measuring device, to correct the measured data and improve reproducibility.

The correction factor is determined from the ratio of the calculated polar moment of inertia to the measured polar moment of inertia of a bar of steel with dimensions 0,1 cm × 2 cm × 170 cm.

The theoretical polar moment of inertia, I_{th}, is calculated by Formula (1):

$$I_{th} = \frac{m(a^2 + b^2)}{12} \quad (1)$$

where

a is the length of the bar in metres;

b is the width of the bar in metres;

m is the mass of the bar in kilograms.

Using this theoretical value and the measured value, the correction factor, c, can be determined by Formula (2):

$$c = \frac{I_{\text{th}}}{I} \tag{2}$$

where

I_{th} is the theoretical polar moment of inertia;

I is the measured polar moment of inertia.

This factor should fall within a range of 0,9 and 1,1.

If this factor lies outside of this range, the measuring device shall be checked and brought into closer conformity with this document.

7 Procedure

Measure the mass of the ski with the weighing device (see 3.1).

Place the ski on the fulcrum (see 3.2), to determine the centre of gravity, until it balances. The centre shall be marked with a cross sign.

Mount the ski in the clamping device A (see 4.4.1) in such a way that the centre of gravity mark is in the centre of the hole of the top clamping fixture midway between the two filaments. The longitudinal centre axis of the ski shall be perpendicular to a line drawn between the two filaments B (see Figure 1).

Let the ski come to rest suspended in the device. Eliminate any swinging motion. It is important that the test area be free of air movement, as this affects test accuracy.

With the hand, rotate the ski horizontally about its perpendicular axis through the centre of gravity. Lateral displacement of the centre of gravity exceeding 10 mm shall be avoided. The twist angle should be approximately 25°.

After displacement, the ski is released to swing freely around the perpendicular axis through the centre of gravity. The time required for the ski to complete five cycles is recorded with the stop watch (see 4.3). The time, T, for 1 oscillation is determined by Formula (3):

$$T = \frac{T_{\text{rec}}}{5} \tag{3}$$

where

T is the oscillation time;

T_{rec} is recorded time.

8 Expression of results

8.1 Mass of the ski

Report the mass, m, of the ski in kilograms.

8.2 Polar moment of inertia of the ski

The polar moment of inertia, I, expressed in kilograms metre squared, is given by Formula (4):

$$I = \left(\frac{T}{2\pi} \right)^2 mg \frac{d_f^{\,2}}{l} \tag{4}$$

where

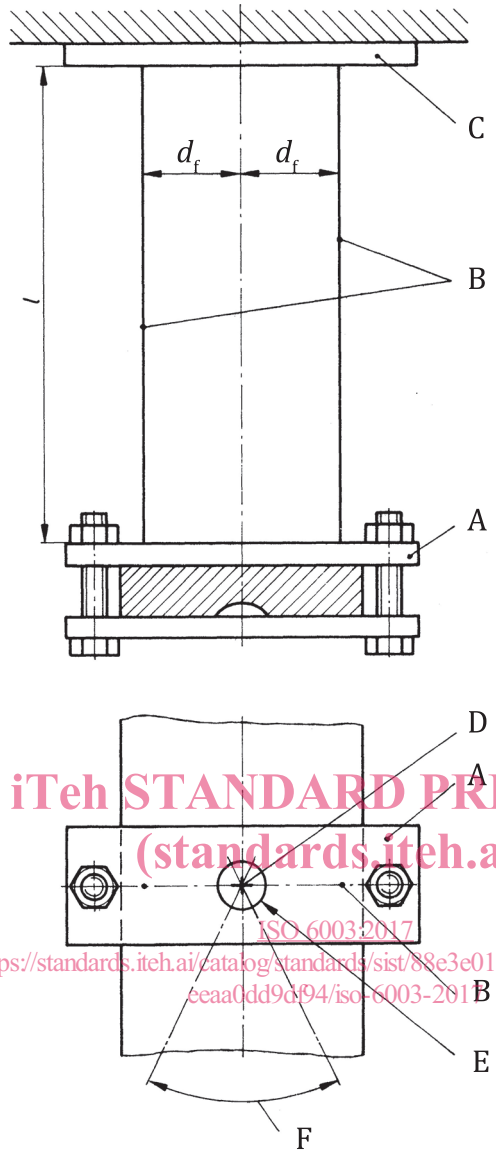
T is the period of oscillation, in seconds;

m is the mass of finished manufactured ski without any ancillary parts, in kilograms;

g is the acceleration due to gravity, in metres per second squared;

d_f is the half distance between the filaments measured on the top plate, in metres;

l is the length of the filaments, in metres



Key

A clamping device
B filaments
C top plate
D centre of gravity
E hole to locate the centre of gravity
F turning displacement: 50°
d_f half distance between the filaments measured on the top plate, in metres
l length of the filaments, in metres

Figure 1 — Measurement device for the determination of the polar moment of inertia