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Natural stone test methods — Determination of the slip resistance by means of the pendulum

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Foreword

Rwanda Standardsarepreparedby Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS534was prepared by Technical Committee RSB/TC 9, *Civil engineering and building materials.*

In the preparation of this standard, reference was made to the following standard:

BS EN 14231:2003, Natural stone test method — DDetermination of the slip resistance by means of the pendulum tester

The assistance derived from the above source is hereby acknowledged with thanks.

Committee membership

The following organizations were represented on the Technical Committee on *Civil engineering and building materials*(RSB/TC 9) in the preparation of this standard.

A+Construction Group Ltd

Africeramics Ltd

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Natural stone test methods — Determination of slip resistance by mean of pendulum tester

1 Scope

This Draft Rwanda Standard specifies a test method to determine the slip resistance value of the surface of the exposed face of natural stone elements intended to be used for flooring in buildings.

NOTE 1 If the surface of the exposed face has a roughness measured according to DRS 530 higher than 1 mm it will be considered as not slippery, without performing the test.

NOTE 2 This method may be used for laboratory measurements or on floors in service.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the editioncited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 48, Rubber, vulcanized or thermoplastics – Determination of hardness (hardness between 10 IRHD and 100IRHD)

ISO 4662, Rubber – Determination of rebound resilience of vulcanizates

ISO 7619, Rubber – Determination of indentation hardness by means of pocket hardness meters

3 Terms and definitions

For the purposes of this standard,the terms and definitions given in DRS 515 and the following apply.

3.1

slip resistance

is the property of the floor surface to maintain the adhesion of pedestrian footwear.

NOTE Loss of adhesion leads to loss of control by the pedestrian with consequent increase in the risk of falling.

3.2

friction

is the resistance to relative motion between two bodies in contact, in this case the slider and the test specimen or the footwear sole and the trafficked surface. The frictional force is the force acting tangentially in the contact area.

3.3

slip resistance value (SRV)

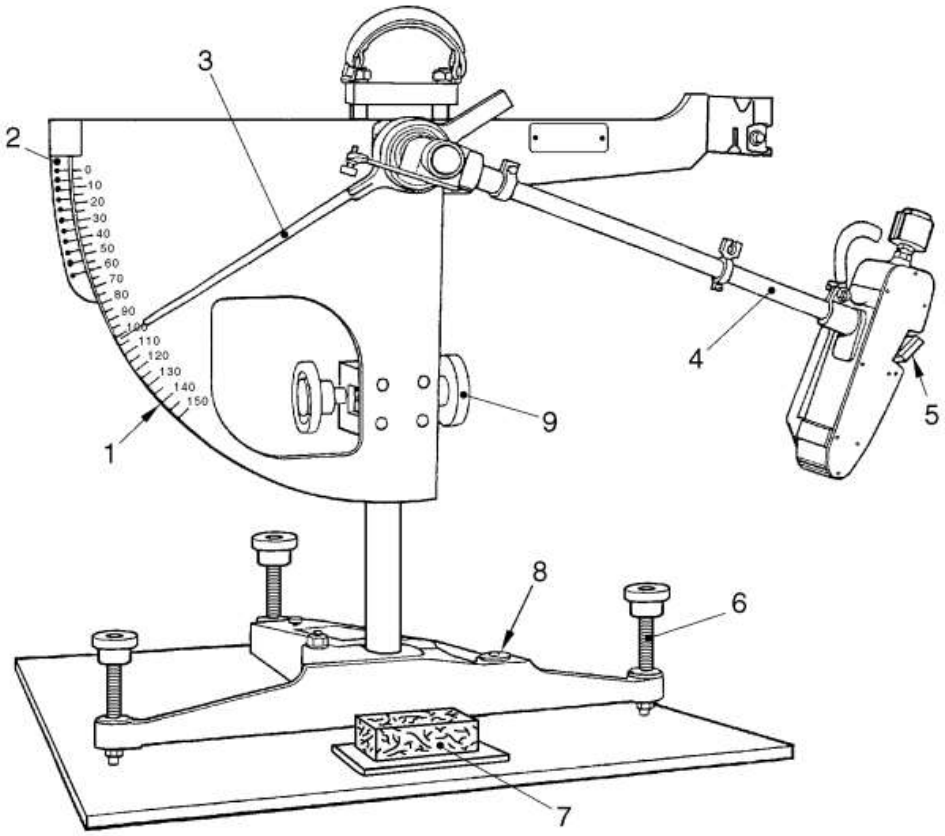
the pendulum friction tester incorporates a slider manufactured of rubber. It measures the friction between the slider and the test surface and provides a standardised value of the slip resistance. This is called the slip resistance value (SRV) and shall be measured both in dry and wet conditions.

4 Principal

The pendulum friction tester incorporates a spring-loaded slider made of a standard rubber attached to the end ofthe pendulum. On swinging the pendulum, the frictional force between slider and test surface is measured by the reduction in length of the swing using a calibrated scale

5 Apparatus

5.1 The pendulum friction tester shall be manufactured as shown in Figure 1. All bearings and working parts shall be enclosed as far as possible, and all materials used shall be treated to prevent corrosion under wet conditions.



1 C scale (126 mm sliding length)
2 F scale (76 mm sliding length)
3 Pointer
4 Pendulum
5 Rubber slider
6 Levelling screw
7 Spirit level
8 Vertical adjustment screw
9 Test specimen holder

Figure 1 — Pendulum friction tester

5.2 The pendulum friction tester shall have the following features:

1) A spring-loaded rubber coated slider as specified in clauses 5.4 to 5.10. It shall be mounted on the end of a pendulum arm so that the sliding edge is (510 ± 1) mm from the axis of suspension.

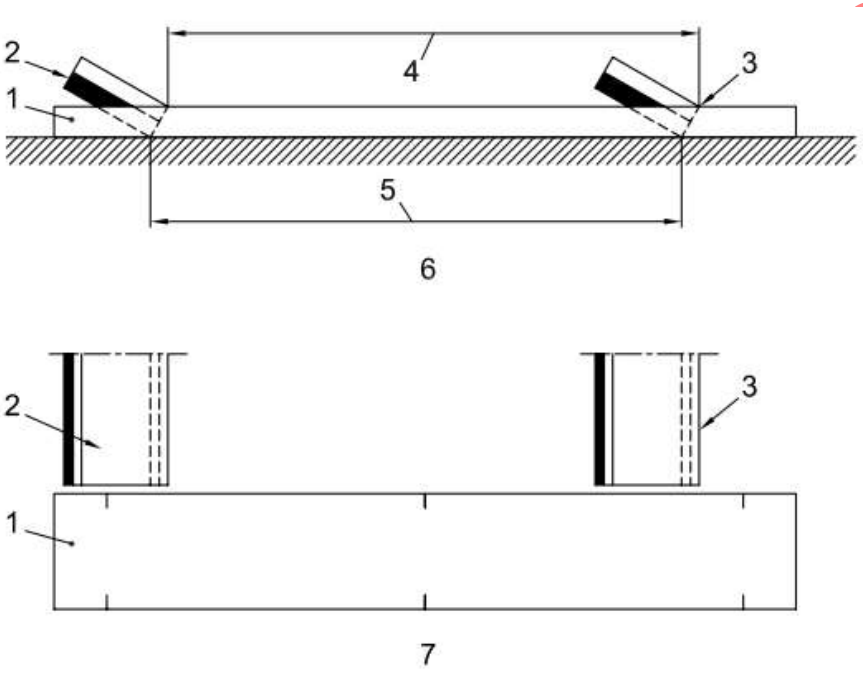
2) Means of setting the support column of equipment vertical.

3) A base of sufficient mass to ensure that the equipment remains stable during the test.

4) Means of raising and lowering the axis of suspension of the pendulum arm so that the slider can:

a. swing clear of the surface of the specimen; and

b. be set to traverse a surface over a fixed length of (126 ± 1) mm when using the wide slider or (76 ± 1)mm when using the narrow slider. Gauges with these distances marked are required as shown inFigure 2.



1 Gauge
2 Slider
3 Reference edge
4 Sliding length measured
5 Actual sliding length
6 Side view
7 Plan view

Figure 2 — Sliding length gauge

5) Means of holding and releasing the pendulum arm so that it falls freely from a horizontal position.

6) A pointer of nominal length of 300 mm, balanced about the axis of suspension, indicating the position of thependulum arm throughout its forward swing and moving over the circular scale. The mass of the pointer shall be not more than 85 g.

7) The friction in the pointer mechanism shall be adjustable so that, with the pendulum arm swinging freely from ahorizontal position, the outward tip of the pointer may be brought to rest on the forward swing of the arm at a point(10 ± 1) mm below the horizontal. This is the 0 reading.

8) A circular scale (C scale), calibrated for a sliding length of 126 mm on a flat surface, marked from 0 to 150 atintervals of five units.

A circular scale (F scale) calibrated for a sliding length of 76 mm on a flat surface and marked from 0 to 1 at intervals of 0,05.

5.3 The mass of the pendulum arm, including the slider, shall be (1,50 ± 0,03) kg. The centre of gravity shall be on the axis of the arm at a distance of (410 ± 5) mm from the axis of suspension.

5.4 The wide slider shall consist of a rubber pad (76,2 ± 0,5) mm wide, (25,4 ± 1,0) mm long (in the direction of swing) and (64,0 ± 0,5) mm thick, the combined mass of slider and base shall be (32 ± 5) g.

The narrow slider shall consist of a rubber pad (31,8 ± 0,5) mm wide, (25,4 ± 1,0) mm long and (64,0 ± 0,5) mm thick; the combined mass of the slider and base shall be (20 ± 5) g.

5.5 The slider shall be held on a rigid base with a centre pivoting axis which shall be mounted on the end of the

pendulum arm in such a way that, when the arm is at the lowest point of its swing with the trailing edge of the slider in contact with the test surface, the plane of the slider is angled at (26 ± 3) degrees to the horizontal. In this configuration the slider can turn about its axis without obstruction to follow unevenness of the surface of the test surface as the pendulum swings.

5.6 The slider shall be spring-loaded against the test surface. When calibrated, the static force on the slider as set by the equipment calibration procedure shall be (22,2 ± 0,5) N in its median position. The change in the static force on the slider shall be not greater than 0,2 N per millimetre deflection of the slider.

5.7 The initial resilience and hardness of the slider shall comply with Table 1. The compliance shall be proved with a certificate of conformity including the name of the manufacturer and date of manufacture. A slider shall bediscarded when the IRHD value measured in accordance with ISO 7619 fails to comply with the requirements of the Table 1 or not later than three years after manufacture.

Table 1 — Properties of the slider rubber at 20 °C

Resilience (%)[a]	66 to 73
Hardness (IRHD)[b]	53 to 65

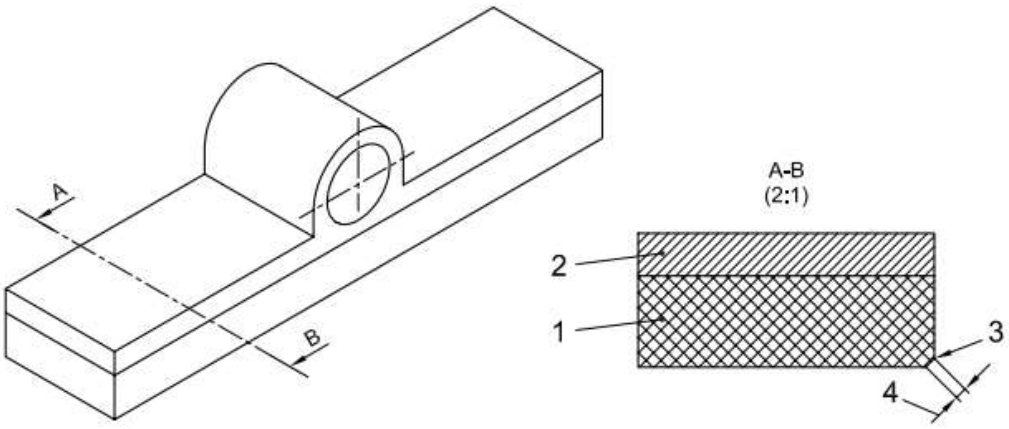
[a] Lüpke rebound test in accordance with ISO 4662

[b] International Rubber Hardness Degrees in accordance with ISO 48

5.8 The edges of the slider shall be square and clean-cut, and the rubber free from contamination by, for example, abrasive or oil. The slider shall be stored in the dark at a temperature in the range 5°C to 20°C.

5.9 Before using a new slider it shall be conditioned to produce a minimum width of striking edge of 1 mm as shown in Figure 3.

This shall be achieved by setting up the tester and carrying out 5 swings on a dry surface with a friction value above 40 on the C scale followed by a further 20 swings on the same surface after wetting.



1 Rubber slider
2 Aluminium backing
3 Striking edge
4 Worn width (between 1 and 3 mm)

Figure 3 — Slider assembly illustrating the worn width of the striking edge

5.10 The slider shall be discarded when the width of the striking edge as shown in Figure 3 exceeds 3 mm or when it becomes excessively scored or burred. The slider can be reversed to expose a new edge, which will

5.11 The apparatus shall be recalibrated at least annually.

The calibration procedure is described in Annex A.

6 Materials

Distilled or deionised water at (20 ± 5)°C in a container for wetting the surfaces of the test specimen and slider, in case of testing in wet conditions.

7 7 Preparation of the specimens

7.1 7.1 Sampling

7.1.1 For laboratory measurements, the sampling is not the responsibility of the test laboratory except where specially requested. At least six specimens, which are considered representative both of the stone being tested, and the surface finish shall be selected.

7.1.2 For measurements in floors in service at least six areas, which are considered representative of the floor surface being tested, shall be selected.

7.2 Dimensions of the test specimens

The test specimens shall be a whole product or a cut piece, incorporating the upper face of the unit. Each specimen shall permit a test area of 136 mm × 86 mm. This area shall be tested using the 76 mm wide slider over a swept length of 126 mm, readings being taken on the C scale.

If this is not possible, a smaller test area of 42 mm × 86 mm may be selected and tested using the 31.8 mm wide slider over a swept length of 76 mm, readings being taken on the F scale.

8 Test procedure

8.1 8.1 General

8.1.1 For laboratory measurements keep the friction tester equipment, slider and the specimens in a room at atemperature of (20 ± 5)°C for at least 2 hours before the test begins.

Select the appropriate slider and test scale for the size of the specimen.

8.1.2 For measurements on floors in service brush the test surface free of loose particles and flush it with water.Measure the temperature of the test surface and slider to the nearest 1°C. The test cannot be carried out if thesurface temperature is outside the range 5°C to 40°C.

8.1.3 Place the friction tester upon a firm level surface and adjust the levelling screws so that the pendulumsupport column is vertical. Then raise the axis of suspension of the pendulum so that the arm swings freely, andadjust the friction in the pointer mechanism so that when the pendulum arm and pointer are released from the righthand horizontal position the pointer comes to rest at zero position on the test scale.

8.1.4 Rigidly locate the test specimen with its longer dimension lying in the track of the pendulum, and centrallywith respect to the rubber slider and to the axis of the suspension of the pendulum. Ensure that the track of theslider is parallel to the long axis of the specimen across the sliding distance.

8.1.5 Adjust the height of the pendulum arm so that in traversing the specimen the rubber slider is in contact withit over the whole width of the slider and over the specified swept length.

8.2 Test procedure (in dry conditions)

9.2.1 Bring the pointer round to its stop. Release the pendulum arm by pressing the release button and catch iton the return swing before the slider re-strikes the test surface. Record the reading indicated on the graduatedscale. Return the arm and pointer to its start position, keeping the slider clear of the surface by means of themechanism provided.

9.2.2 Repeat 9.2.1 in the same orientation until five successive readings (on the C scale) do not differ by morethan three units.

NOTE If the F scale is used the five successive readings shall not differ by more than 0,03.

9.2.3 Raise the head of the tester so that it swings clear of the surface and check the free swing for zero error. Ifthe zero has drifted by more than one unit then repeat steps 9.1.3 to 9.2.2.

9.2.4 For laboratory measurements relocate the specimen after rotating through 180° and repeat steps 9.1.4 to 9.2.3.

9.2.5 For measurements on floors in service rotate the friction tester through 180° and repeat steps 9.1.3 to 9.2.3.

8.2.1 Test procedure (in wet conditions)

9.3.1 For laboratory measurements immediately prior to testing immerse the specimens in water at (20 5)°C forat least 2 hours.

.3.2 Prior to each swing of the pendulum, thoroughly wet the test surface and slider with distilled or deionisedwater at (20 5)°C temperature.

9.3.3 Repeat steps 9.1.3 to 9.2.2 on previously untested areas.

9.3.4 Raise the head of the tester so that it swings clear of the surface and check the free swing for zero error. Ifthe zero has drifted by more than one unit then repeat steps 9.3.2 to 9.3.3

9.3.5 For laboratory measurements relocate the specimen after rotating through 180° and repeat steps 9.1.4 to9.1.5 and steps 9.3.2 to 9.3.4.

9.3.6 For measurements on floors in service rotate the friction tester through 180° and repeat steps 9.1.3 to 9.1.5 and steps 9.3.2 to 9.3.4.

9 Expression of results

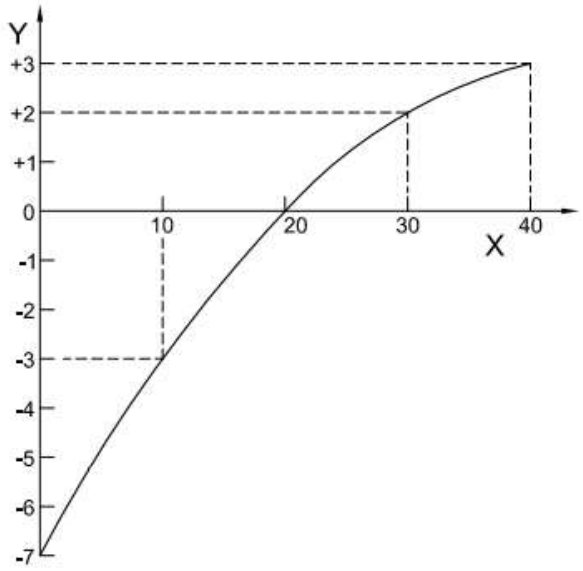
For each specimen or each test area calculate the mean value of each set of five recorded readings measured in opposite directions and both in dry and wet test conditions.

For measurements made with the wide slider calculate the pendulum value of each specimen in dry test condition as the mean of the two recorded mean values measured in opposite directions to the nearest 1 unit on the C scale.

For measurements made with the narrow slider calculate the pendulum value of each specimen as the mean of the two recorded mean values measured in opposite directions to the nearest 0.01 unit on the F scale multiplied by 100 and by a correction factor of 1.2 for scale graduation and the effect of the different swept length.

Repeat this procedure for the results obtained in wet test condition.

For measurements made on floors in service correct the measured values for temperature, using the graph given in Figure 4.



X Test temperature °C
Y Factor to be added to correct to 20°C

Figure 4 — Temperature correction to allow for changes in resilience of the slider rubber

The slip resistance value in dry condition (SRV "dry") is the mean pendulum value obtained on the six specimens in dry test condition.

The slip resistance value in wet condition (SRV "wet") is the mean pendulum value obtained on the six specimens in wet test condition.

10 Test report

The test report shall include the following information:

a) unique identification number of the report;

b) the number, title and date of issue of this Rwanda standard;

c) the name and address of the test laboratory and the address where the test was carried out, if different from the test laboratory;

d) the name and address of the client;

e) it is the responsibility of the client to supply the following information:

the petrographic name of the stone;

the commercial name of the stone;

the country and region of extraction;

the name of the supplier;

the direction of any existing plane of anisotropy (if relevant to the test) to be clearly indicated on the sample or on each specimen by means of two parallel lines;

the name of the person or organization which carried out the sampling;

the surface finish of the specimens (if relevant to the test);

f) the date of delivery of the sample or of the specimens;

g) the date when the specimens were prepared (if relevant) and the date of testing;

h) the number of specimens in the sample;

i) the dimensions of the specimens;

j) for each test specimen the mean pendulum value both in dry and wet test conditions;

k) the slip resistance value (SRV "dry") in dry test condition;

l) the slip resistance value (SRV "wet") in wet test condition;

m) all deviations from the standard and their justification;

n) remarks.

The test report shall contain the signature(s) and role(s) of those responsible(s) for the testing and the date of issue of the report. It shall also state that the report shall not be partially reproduced without the written consent of the test laboratory.

Annex A
(normative)

Calibration of the pendulum friction tester

A.1 Weighing of components

A.1.1 Remove the pendulum arm and pointer.

A.1.2 Weigh the pointer to the nearest 1 g, measure its length to the nearest 1 mm and ensure that it is straight.

A.1.3 Weigh the complete pendulum arm assembly to the nearest 5 g.

A.2 Balancing of the pendulum arm assembly

A.2.1 Balance the pendulum arm on a knife edge with the adapter nut in its extreme position.

A.2.2 With the slider assembly in a horizontal position, adjust the counterweight in the trailing edge of the assembly until it is balanced about the pendulum arm.

A.2.3 Measure the distance from the centre of oscillation to the centre of gravity of the pendulum arm assembly to the nearest 1 mm.

A.3 Setting the effective spring tension

A.3.1 Remove the small retaining plate covering the slider lifting handle.

A.3.2 With the slider assembly foot inverted, suspend a load equivalent to 22.2 N from the spindle.

A.3.3 Adjust the spring tension until the lifting handle is brought to its median position. The complete movement of the slider (parallel to the pendulum arm) when using the lifting handle shall be at least 6.5 mm.

A.3.4 Check the change in force on the slider by the addition and subtraction of weights to the applied load, and measuring the deflection of the slider for each increment of load (Suitable increments are about 20 g).

A.3.5 The complete movement of the slider (deflection) shall be at least 11 mm.

A.4 Setting the pointer stop

A.4.1 Adjust the pointer stop until the centreline of the pointer is parallel with the pendulum arm in a vertical position, with the friction tester assembled and levelled.

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