

Australian Standard[®]

Slip resistance measurement of existing pedestrian surfaces



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 - Australian Building Codes Board
 - Australian Institute for Non-Destructive Testing
 - Australian Institute of Architects
 - Australian Resilient Floorcovering Association
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-

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Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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Slip resistance measurement of existing pedestrian surfaces

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PREFACE

This Standard was prepared by the Standards Australia Committee BD-094, Slip Resistance of Flooring Surfaces, to supersede AS/NZS 4663:2004, *Slip resistance measurement of existing pedestrian surfaces*.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to provide users, maintenance organizations and facility managers with standardized methods of testing existing in situ pedestrian surface materials for determination of their slip resistance.

The term ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

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FOREWORD

Wet testing is carried out using two types of rubber materials, Slider 55 (also known as TRL rubber), which has been traditionally used for testing outdoor surfaces and Slider 96 (also known as Four S rubber) which was specifically developed to replace the TRL rubber for testing smoother indoor surfaces, as it provides greater discrimination between such internal surfaces.

The use of these rubbers on the pendulum enables universal comparison of test results. The testing does not take into account the performance of different footwear sole materials or profiles. The slip resistance of these materials can vary widely, even within generic groups of polymers such as PVC or polyurethane. The slip resistance of footwear is also a function of the soling material, the tread, effects of ageing, degradation and wear, as well as design and construction parameters. While it may be possible to form sliders using other soling materials, it is outside the scope of this Standard.

This revision incorporates an additional requirement for preparing rubber test feet when testing smooth surfaces. Research has shown that when a slider 96 (Four S rubber) is only prepared with P400 abrasive paper, the pendulum result on smoother surfaces may be more representative of the rubber roughness than the slip resistance of the pedestrian surface that is being tested. A more representative reading that also enables a greater level of discrimination between smoother surfaces may be obtained by preparing the slider on a 3 µm lapping film as detailed in the Standard. A slider prepared in this way is a closer representation of a worn and polished heel and may best reflect the lower slip resistance attributable to the contact of two smoother surfaces under water-wet conditions.

Adoption of the lapping film preparation to condition the slider enables more sensitive differentiation between potentially slippery surfaces than was previously the case. It will cause some pedestrian surfaces to provide a lower result than would have been obtained if tested according to AS/NZS 4663:2004.

HB 197, *An introductory guide to the slip resistance of pedestrian surface materials*, provides guidance for specifying pedestrian surface materials for various locations based on minimum wet slip resistance classifications that are obtained when testing to AS/NZS 4586:2004, *Slip resistance classification of new pedestrian surface materials*. HB 197 recognizes that slip resistance test methods have inherent limitations.

A new pedestrian surface is considered to become an existing pedestrian surface once it has been installed and made available for pedestrian traffic, other than movements specifically for purposes of formal testing to determine compliance with AS 4586. New pedestrian surfaces are to be tested in accordance with AS 4586.

STANDARDS AUSTRALIA

Australian Standard

Slip resistance measurement of existing pedestrian surfaces

1 SCOPE

This Standard provides methods of measuring the frictional characteristics of existing pedestrian surfaces in wet and dry conditions.

NOTE: This Standard does not specifically cover gratings, although it is possible to use the test methods specified herein for some gratings.

2 APPLICATION

The test methods in this Standard shall be used for existing pedestrian surfaces.

This Standard may also be used for evaluating surface applications and treatments, including products such as sealers, polishes and etchants that modify the surface characteristics of pedestrian surfaces.

The method specified for the measurement of wet slip resistance shall be used for all external areas and those internal pedestrian surfaces where such measurements are required. It does not contemplate shoe sole materials, characteristics of individual gaits, or other factors that may contribute to slips.

NOTES:

- 1 In Appendix A, provision has been made for either of two rubbers to be used in the wet pendulum test method. Clay and concrete pavers have traditionally been tested using Slider 55 (TRL rubber), whereas Slider 96 (Four S rubber) is used for other pedestrian surfaces. When testing highly profiled surfaces such as shown in Figure 1, Slider 55 (TRL rubber) generally produces more consistent results than Slider 96 (Four S rubber). The standard Slider 96 (Four S rubber) was prepared so as to have poor abrasion resistance such that the rubber would be less likely to become contaminated, as fresh surfaces would be produced during testing. It was also formulated to be temperature independent. When assessing products for wet barefoot areas, or unusually rough products, the use of the softer more resilient Slider 55 (TRL rubber) is preferable.
- 2 Caution should be exercised when comparing friction/slip resistance test results of existing pedestrian surfaces and test results that were obtained on new pedestrian surface materials. The latter may be unexpectedly high on some surfaces because, after installation, the presence of contaminants and surface wear and/or polishing can significantly alter some results.
- 3 Where heavily profiled surfaces have been specifically manufactured to have high slip resistance, which relies heavily upon the interlock action between the highly profiled pedestrian surface and the heavily profiled soles of some footwear, the 'pendulum test' method in Appendix A may not provide accurate indications of the slip resistance (see Clause 1).
- 4 The 'dry floor friction' test method in Appendix B is not suitable for heavily profiled surfaces or carpets.
- 5 Some examples of highly profiled surfaces are shown in Figure 1. Such surfaces generally have a displacement volume greater than or equal to $4 \text{ cm}^3/\text{dm}^2$.
- 6 When conducting a test in situ, adequate safety measures should be in place to maintain a safe working area, as pedestrians may fail to notice the equipment and operator, as they may be well below normal eye level.

3 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS

1683.15 Methods of test for elastomers

1683.15.1 Method 15.1: International rubber hardness

4586 Slip resistance classification of new pedestrian surface materials

ISO

7619 Rubber, vulcanized or thermoplastic—Determination of indentation hardness

7619-1 Part 1: Durometer method (Shore hardness)

BS

7976 Pendulum testers

7976-3 Part 3: Method of calibration

CEN/TS

16165 Determination of Slip resistance of Pedestrian Surfaces—Methods of Evaluation

4 DEFINITIONS

For the purposes of this Standard, the definitions below apply.

4.1 British Pendulum Number (BPN)

Dimensionless unit of slip resistance when measured using the pendulum friction tester.

4.2 Carpet

Heavy fabric floor covering of wool, nylon or similar material, with or without underlay.

4.3 Clean

Free of significant contamination.

4.4 Coefficient of friction (COF)

The ratio of the tangential force required to move a body across a horizontal surface to the vertical load imposed on the surface by the body.

4.5 Contamination

The presence of any substance (wet or dry) on the walking surface that may significantly reduce the slip resistance.

4.6 Contaminant

Any substance, liquid, solid, or both, that is foreign to the pedestrian surface.

NOTE: Any material that breaks away from the pedestrian surface material itself is to be regarded as foreign to the pedestrian surface.

4.7 Dynamic coefficient of friction

The coefficient of friction required to maintain movement at a constant speed.

4.8 Friction

An intrinsic property of two interfacing, interacting surfaces resulting from their micro- and macro-roughness, inter- intra-molecular forces of attraction and repulsion, and their visco-elastic properties.

4.9 Profiled surface

A surface with a designed raised geometrical pattern that provides volumetric displacement.

NOTE: For examples of profiled surfaces, see Figure 1.

4.10 Sample

A prescribed number of individual test specimens, which together are considered a reasonable representation of a single type of pedestrian surface and its condition.

NOTE: The prescribed number of specimens that constitutes a sample is as stated elsewhere.

4.11 Specimen

An individual pedestrian surface test location.

4.12 Slip resistance value (SRV)

The mean BPN value for the sample that has been tested and calculated in accordance with Appendix A, regardless of whether the surface was level or on a slope.

4.13 Slip resistive

Property of a pedestrian surface where the available friction is sufficient to enable a person to traverse that surface without an unreasonable risk of slipping.

4.14 Slip resistant

A property of a surface having a frictional force-opposing movement of an object across a surface.

4.15 Slope correction value (SCV)

When the slip resistance of a sloping surface of known maximum gradient is measured, the SCV is an adjusted SRV, giving a value equivalent to that of the equivalent SRV for a level surface.

4.16 Slope design value (SDV)

The mean BPN value required on a slope of a known maximum gradient.

4.17 Structured surface

A constructed surface with distinct irregularities of the surface profile.

5 TEST METHODS

5.1 Frictional characteristics

The frictional characteristics of pedestrian surfaces that are wet, or potentially wet during service, shall be measured in accordance with the wet pendulum test method set out in Appendix A.

If required, the frictional characteristics of pedestrian surfaces that are dry may also be measured in accordance with the wet pendulum test method set out in Appendix A.

When this Standard is used for the testing the slip resistance of carpets (or carpet-like products) in potentially wet locations, the carpet shall be tested using the wet pendulum test method set out in Appendix A, and shall be reported as such.

When this Standard is used for the testing of the slip resistance of carpets in dry locations, the test shall be carried out in the dry condition using the pendulum test method set out in Appendix A modified in accordance with Paragraph A2, and shall be reported as such.

5.2 Coefficient of friction (COF) of dry surfaces

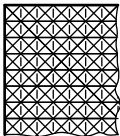
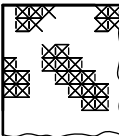
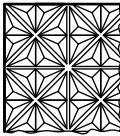
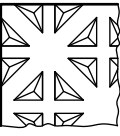
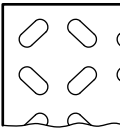
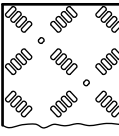
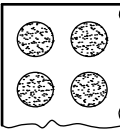
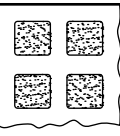
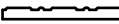
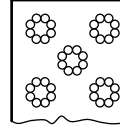
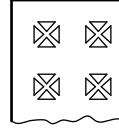
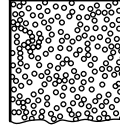
The COF of surfaces that are dry and unlikely to become wet during service shall be measured in accordance with the method set out in either Appendix A or B.

The dry floor friction test method in Appendix B shall not be used for heavily profiled surfaces or carpets.

6 INTERPRETATION OF TEST RESULTS

NOTES:

- 1 For guidance on interpretation of test results, see HB 197.
- 2 The SDV may be calculated by using the tables that are given in Appendix C, using the minimum SRV that is considered appropriate for a level surface (see example in Appendix C).

Type of profile	Pyramids	Interrupted pyramids	Tetrahedrons	Interrupted tetrahedrons
Top view				
Cross-section				
Type of profile	Webs	Interrupted webs	Studs	
Top view				
Cross-section				
Type of profile	Interrupted cams resp. nubs		Hemispheres	
Top view				
Cross-section				

(NOT TO SCALE)

FIGURE 1 EXAMPLES OF HIGHLY PROFILED SURFACES

APPENDIX A
WET PENDULUM TEST METHOD
(Normative)

A1 SCOPE

This Appendix sets out a method for the in situ measurement of the frictional characteristics of existing pedestrian surfaces under wet conditions using a pendulum friction tester.

A2 CARPETS

When this pendulum test method is used for the measurement of the frictional characteristics of existing carpet or 'carpet-like' surface materials, the presence of any underlay and the condition of the surface shall be reported.

When this pendulum test method is used for the measurement of frictional characteristics of existing carpet or 'carpet-like' surface material that is intended for use in only dry conditions, the following variations to the test method shall apply:

- (a) The test surface shall be tested dry (not saturated with potable water).
- (b) The surface contact length for the slider shall be determined with the slider resting on the surface (not held up so that the first and last contact with the rubber slider is at the top of the carpet pile).
- (c) Reporting of test values shall state 'Surface Tested Dry'.

A3 PRINCIPLE

The frictional characteristics of the surface are assessed by determining the wet dynamic friction between the test surface and the slider of a pendulum swinging in a vertical plane.

A4 APPARATUS

A4.1 Pendulum friction tester

A pendulum friction tester shall be constructed, and shall comply with the following:

NOTE: An example of a pendulum friction tester is shown in Figure A1.

- (a) All bearings and working parts of the instrument shall be enclosed as much as practicable, and all materials shall be suitably treated to prevent corrosion under wet conditions.
- (b) When not in use on site, the apparatus shall be stored in a dust-free environment that is not subject to significant temperature variations.
- (c) The pendulum friction apparatus shall be calibrated to ensure compliance with BS 7976-3 or CEN/TS 16165. After the apparatus has been calibrated, regular internal checking shall be conducted on a set of control specimens and the results recorded. When results obtained from the control specimens vary from the values established following calibration by more than three units, the apparatus shall be partially or completely recalibrated.

NOTES:

- 1 Calibration may be arranged through a suitable accredited laboratory proficient in calibration and repair of friction apparatus. Australian laboratory accreditation authorities have traditionally expected that equipment be calibrated at intervals not exceeding two years. However, submissions for the extension of calibration intervals are considered on the basis of factors such as history of stability, frequency of use, required accuracy, ability of staff to perform in-house checks, internal laboratory equipment assurance programs, and successful participation in proficiency testing programs.
 - 2 The control specimens should be stable with time and be of a range of surface roughness typical of the materials that the apparatus is used for measuring. New control specimens may benefit from having been subjected to an appropriate accelerated conditioning procedure.
- (d) The tester shall incorporate the following:
- (i) A spring-loaded rubber slider of the mass, size and shape specified in Paragraph A4.2, mounted on the end of the pendulum arm so that the sliding edge is 514 ± 3 mm from the axis of suspension.
 - (ii) Means for levelling the instrument.
 - (iii) Means for raising and lowering the axis of suspension of the pendulum so that the slider can—
 - (A) swing clear of the surface of the test specimen; and
 - (B) be set to slide over a fixed length of surface.
 - (iv) Means for holding and releasing the pendulum arm so that it falls freely from a horizontal position.
 - (v) A pointer balanced about the axis of suspension, indicating the position of the pendulum arm throughout its forward swing and moving over the circular scale attached to the instrument. The mass of the pointer, excluding felt friction washers, shall be not more than 85 g and the friction in the pointer mechanism shall be adjustable to that, with the pendulum arm swinging freely from a horizontal 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, the point corresponding to the zero position on the attached circular scale.

The mass of the swinging arm, including the slider, shall be 1.50 ± 0.03 kg with the centre of gravity lying on the axis of the arm at a distance of 410 ± 5 mm from the centre of suspension.

The slider shall be mounted on an axis set at an angle of $26 \pm 3^\circ$ to the horizontal when the pendulum is at the lowest point of its swing, so that only the rear edge of the slider contacts the test surface and the nominal static force on the slider is set by the calibration procedure.

Where required, a device for rigidly locating the abrasive paper shall be provided such that—

- (A) the abrasive paper is bisected by a vertical plane perpendicular to the frame of the instrument and passing through the axis of suspension of the pendulum; and
- (B) the full width of the slider backing plate will align with the abrasive paper over a length of 124 ± 1 mm.

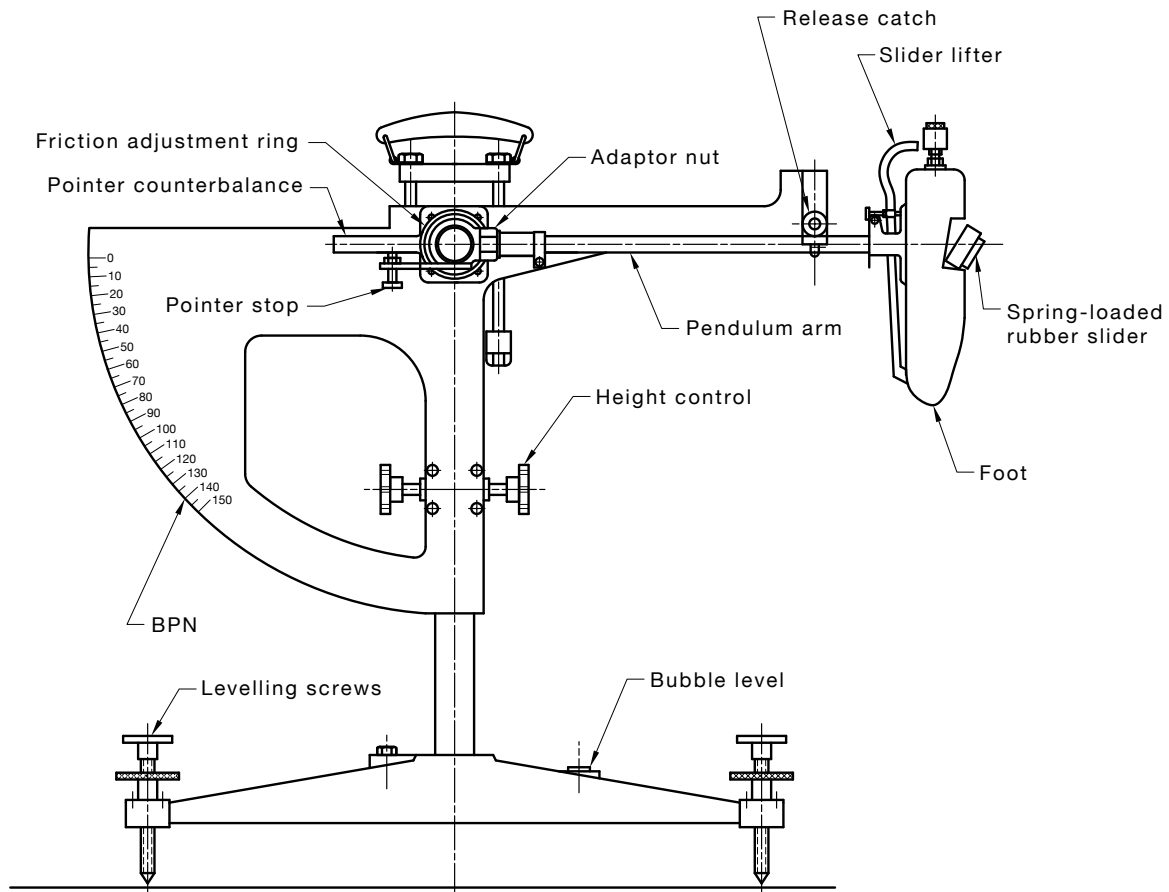


FIGURE A1 EXAMPLE OF PENDULUM FRICTION TESTER

A4.2 Rubber sliders

A4.2.1 General

Rubber sliders used in the friction tester shall be 25.4 ± 1.0 mm wide and 6.4 ± 0.50 mm thick and rigidly backed. The sliding edges shall be square, clean cut and free from contamination. Sliders shall be 76.0 ± 1.0 mm long and, with the rigid backing plate, shall have a total mass of 39 ± 2 g for Slider 96 and 35 ± 2 g for Slider 55.

A4.2.2 Slider material

The standard slider material shall be either Slider 96 (IRHD 96 ± 2 at $23 \pm 3^\circ\text{C}$) or Slider 55 (IRHD 55 ± 5 at 0 to 40°C).

When not in use, sliders shall be stored in the dark at a temperature below 25°C and preferably below 15°C . They shall be discarded when—

- (a) they are more than 12 months old from their issue date, unless they comply with the hardness requirements of ISO 7619-1;
- (b) they do not comply with the hardness requirements of ISO 7619-1; or
- (c) the chamfers worn on the two trailing edges of the slider are in excess of 4 mm wide.

The chamfer measurement shall be made on the most representative portion of the trailing edge.

NOTE: An example of maximum permissible edge chamfer is shown in Figure A2.

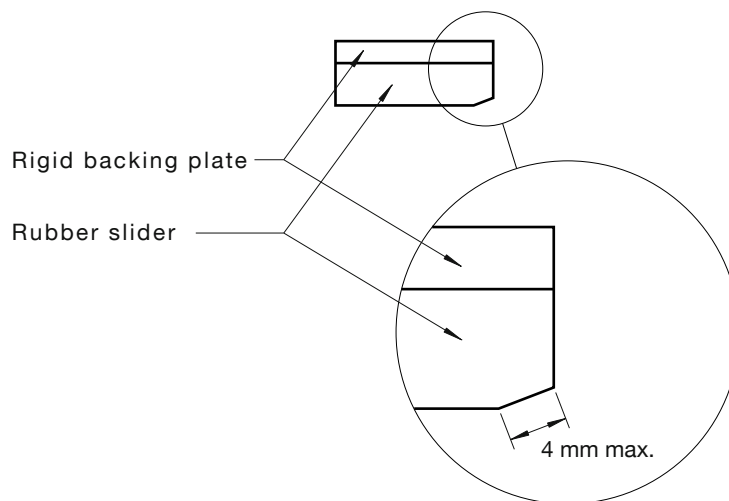


FIGURE A2 EXAMPLE OF THE MAXIMUM PERMISSIBLE EDGE CHAMFER

A4.3 Water spray bottle

Water spray bottle containing clean water at ambient temperature.

A4.4 Thermometer

Thermometer with a range of 0°C to 50°C.

A4.5 Abrasive paper

Wet and dry abrasive paper, Grade P 400, mounted on a flat rigid surface.

A4.6 Lapping film

Sheet of 3M 261X Imperial Lapping Film Grade 3MIC, mounted on a flat rigid surface.

NOTE: Equivalent products may be used, provided they can be shown to lead to the same results.

A4.7 Cleaning agents

Where it is assessed that the product should be cleaned, appropriate cleaning agent(s) shall be used depending on the state and type of contamination to be removed from the surface.

A5 PREPARATION FOR TESTING

A5.1 Equipment adjustment

The equipment shall be adjusted as follows:

- Bring the apparatus (including the slider) and contents of the water spray bottle into the test area at least 10 min before testing. There may be occasions where this is not practicable due to the effect of the test area environment on the operation of the apparatus (e.g. the inside of freezer rooms). Such occurrences shall be noted on the report.
- Record the ambient temperature at the time of testing if conducting test with a Slider 55.
- Mount the tester on its base and adjust the levelling screws so that the levelling bubble is centred and the tester is appropriately aligned with the test surface.
- Install a rubber slider (see Paragraph A4.2) in position.
- Raise the axis of suspension of the pendulum so that the arm swings freely.
- Adjust the friction rings in the pointer mechanism so that, when the pendulum arm and pointer are released from the right-hand horizontal position, the pointer will zero repeatedly.