1 May 2019

Volaré Concepts
Attention: Jack Purcell
5 Sharon Court
Geelong North VIC 3215

Our Ref: R-3133

RE: SLIP RESISTANCE TESTING

EVALUATION FOR FLOORING SAMPLES SUPPLIED

You requested that we carry out slip resistance testing on five (5) carpet flooring products per the criteria set out in AS 4586: 2013, using the wet pendulum test method (Surface Tested Dry).

The types of carpet flooring product were as follows:

Sample No. 1:	Advantage Flooring, Hip Hop Carpet – Rust, 680 x 1100mm
Sample No. 2:	Advantage Flooring, Hip Hop Carpet - Silver Moon, 680 x 1100mm
Sample No. 3:	Advantage Flooring, Hip Hop Carpet - Shadow, 680 x 1100mm
Sample No. 4:	Advantage Flooring, Hip Hop Carpet - Steel, 680 x 1100mm
Sample No. 5:	Advantage Flooring, Hip Hop Carpet - Spring, 680 x 1100mm

The testing was carried out on May 1st 2019 by Ms Cassandra Sullivan; this report has been prepared by Ms Cassandra Sullivan.

The objective for this engagement was to undertake slip resistance testing to AS 4586: (2013) Slip resistance measurement of new pedestrian surface materials[1] and to assess whether the surfaces would probably meet applicable slip resistance guidelines.

The samples tested, test conditions and results are summarised in Table 1 of the Testing Summary (below); in-depth information regarding test results for each sample is expounded in the 'Test Results' section of our report, where discussion and conclusions that may be drawn are listed.

This report provides information on testing with the Tortus Floor Friction Tester and Pendulum Portable Skid Resistance Tester, as well as the results obtained according to Australian Standard AS 4586: 2013 Slip Resistance Measurement of New Pedestrian Surface Materials, the relevant standard at the time of testing.

Classifications assigned are derived from AS 4586: 2013, "Slip Resistance Classification of New Pedestrian Surface Materials"; results were evaluated against both HB 198: 2014 Guide to the specification and testing of slip resistance of pedestrian surfaces[3] and/or the relevant National Construction Code (NCC) section.

This report is meant to be read in its entirety. **See Appendix A for in-depth information on methodology, classification, interpretation and remediation.**

Induction Group is a 3rd party external auditor trusted to provide independent and authoritative assessments to stakeholders, and as such, has no agreements, schemes or arrangements of any description that may give rise to an actual or perceived conflict of interest in relation to our involvement with this assessment. We would be pleased to discuss your results and can also provide additional recommendations upon request.

Yours sincerely,

INDUCTION GROUP

Reviewed by:

Cassandra Sullivan
Testing Technician BSc (Hons)

Trevor Rowlands
Engineering Director

I. Test Methodology

Induction Group conducted testing consistent with the test methodology specified by Australian Standard AS 4586: 2013, with specific consideration to the following subsections of the standard:

5 CLASSIFICATION OF SLIP RESISTANCE

5.1 Slip resistance

Pedestrian surfaces shall be classified using at least one of the combinations given in Table 1 and shall be reported as noted.

When this Standard is used for the testing and classification of 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 and classification 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.

The 'dry floor friction' test method in Appendix B is not suitable for heavily profiled surfaces or carpets.

A2 CARPETS

When this pendulum test method is used for the measurement of the frictional characteristics of new 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 new 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 and classifications shall state 'Surface Tested Dry'.

II. Testing Summary

Test Standard: AS 4586: 2013 '*Slip resistance measurement of new pedestrian surface materials*.

Sampling: Test specimens selected by Volare Concepts; individual specimens selected by Induction Group.

Test Conditions:

1. Test Equipment: Pendulum Serial No: 1714
2. Slider Rubber: Slider 96 Batch No. #1852 prepared on P400 & 3µm lapping film
3. Preparation: As found
4. Slope of Test Areas: N/A (≤ 1.5º)
5. Test direction: N/A
6. Surfaces Tested Dry

7. SRV = Slip Resistance Value
8. Classifications assigned are derived from AS 4586: 2013, "*Slip Resistance Classification of New Pedestrian Surface Materials*"[2].
9. Result Interpretation: The interpretations of all test results are based on HB 198: 2014 *Guide to the Specification and Testing of Slip Resistance of Pedestrian Surfaces*[3] and/or the relevant sections of the NCC.

All results apply only to the specimens and areas tested.

The test results are summarised below:

Table 1: Test Results

Sample No.	Flooring Material	Mean SRV	Classification
1	Advantage Flooring, Hip Hop Carpet - Rust	**55***	**P5**
2	Advantage Flooring, Hip Hop Carpet – Silver Moon	**60***	**P5**
3	Advantage Flooring, Hip Hop Carpet - Shadow	**61***	**P5**
4	Advantage Flooring, Hip Hop Carpet - Steel	**65***	**P5**
5	Advantage Flooring, Hip Hop Carpet - Spring	**62***	**P5**

NOTE:

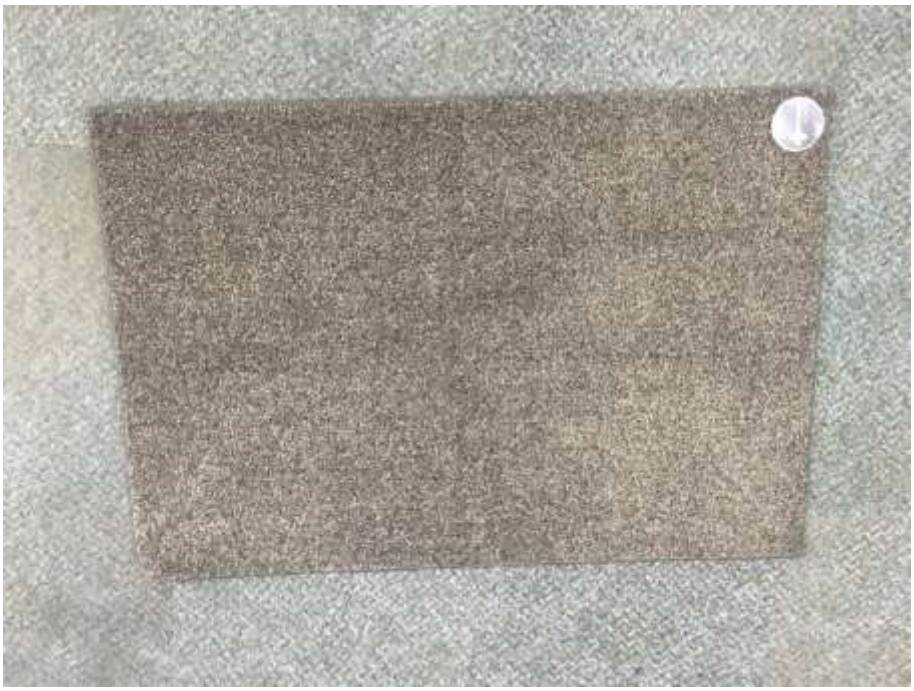
- * Surface Tested Dry

III. Test Results

* All results apply only to the specimens and areas tested.

A. Sample No. 1 - Advantage Flooring, Hip Hop Carpet – Rust

1. Pendulum - Wet Slip Resistance



Sample No. 1: Hip Hop Carpet - Rust

Sample No.	Floor Surface Material	British Pendulum Number						Rating
		Specimen Number					SRV	
		1	2	3	4	5		
1	Advantage Flooring, Hip Hop Carpet - Rust, 680 x 1100mm	50	58	56	57	54	55	**P5**

NOTE:

- * Surface Tested Dry

Test Results: The wet slip resistance test results for Area No. 1 indicate that the contribution of the floor surface to the risk of slipping under dry conditions for Hip Hop Carpet - Rust was *very low* and has a SRV of 55 (**P5**) when tested with Slider 96.

B. Sample No. 2 - Advantage Flooring, Hip Hop Carpet – Silver Moon

1. Pendulum - Wet Slip Resistance

Sample No. 2: Hip Hop Carpet – Silver Moon

Sample No.	Floor Surface Material	British Pendulum Number						Rating
		Specimen Number					SRV	
		1	2	3	4	5		
2	Advantage Flooring, Hip Hop Carpet - Silver Moon, 680 x 1100mm	55	56	60	60	70	60	**P5**

NOTE:

- * Surface Tested Dry

Test Results: The wet slip resistance test results for Area No. 2 indicate that the contribution of the floor surface to the risk of slipping under dry conditions for Hip Hop Carpet – Silver Moon was *very low* and has a SRV of 60 (**P5**) when tested with Slider 96.

C. Sample No. 3 - Advantage Flooring, Hip Hop Carpet – Shadow

1. Pendulum - Wet Slip Resistance

Sample No. 3: Hip Hop Carpet – Shadow

Sample No.	Floor Surface Material	British Pendulum Number						Rating
		Specimen Number					SRV	
		1	2	3	4	5		
3	Advantage Flooring, Hip Hop Carpet - Shadow, 680 x 1100mm	59	54	54	68	69	61	**P5**

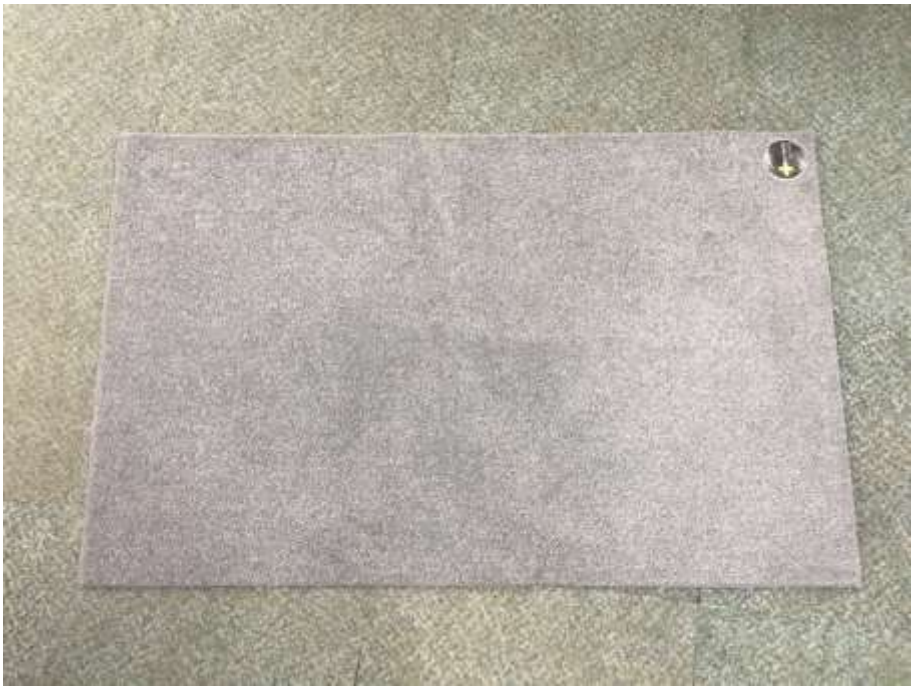
NOTE:

- * Surface Tested Dry

Test Results: The wet slip resistance test results for Area No. 3 indicate that the contribution of the floor surface to the risk of slipping under dry conditions for Hip Hop Carpet – Shadow was *very low* and has a SRV of 61 (**P5**) when tested with Slider 96.

D. Sample No. 4 - Advantage Flooring, Hip Hop Carpet – Steel

1. Pendulum - Wet Slip Resistance



Sample No. 4: Hip Hop Carpet – Steel

Sample No.	Floor Surface Material	British Pendulum Number						Rating
		Specimen Number					SRV	
		1	2	3	4	5		
4	Advantage Flooring, Hip Hop Carpet - Steel, 680 x 1100mm	65	58	65	64	74	65	**P5**

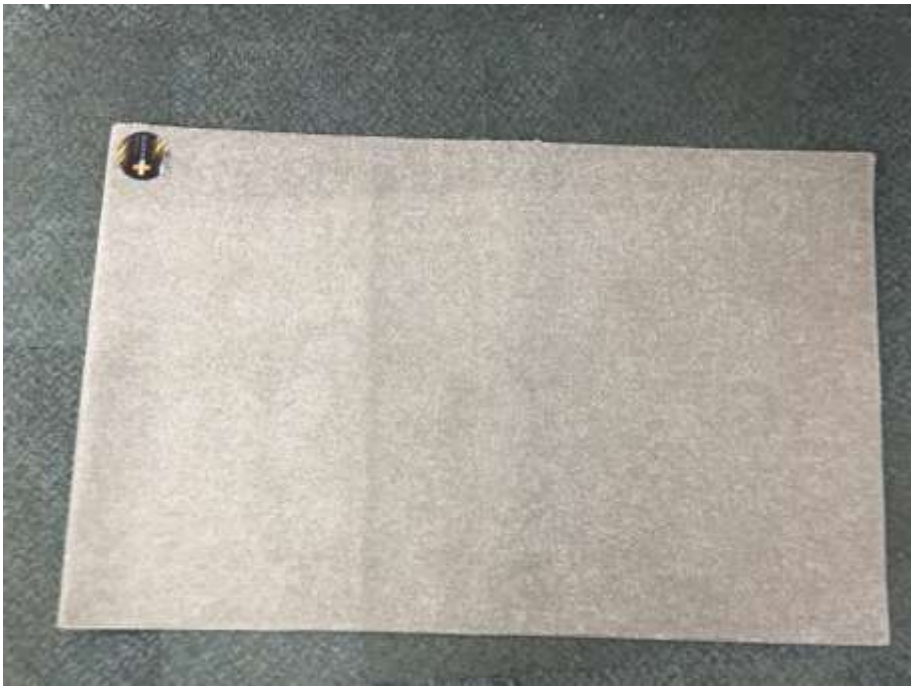
NOTE:

- * Surface Tested Dry

Test Results: The wet slip resistance test results for Area No. 4 indicate that the contribution of the floor surface to the risk of slipping under dry conditions for Hip Hop Carpet – Steel was *very low* and has a SRV of 65 (**P5**) when tested with Slider 96.

E. Sample No. 5 - Advantage Flooring, Hip Hop Carpet – Spring

1. Pendulum - Wet Slip Resistance



Sample No. 5: Hip Hop Carpet – Steel

Sample No.	Floor Surface Material	British Pendulum Number						Rating
		Specimen Number					SRV	
		1	2	3	4	5		
3	Advantage Flooring, Hip Hop Carpet - Shadow, 680 x 1100mm	55	61	58	67	69	62	**P5**

NOTE:

- * Surface Tested Dry

Test Results: The wet slip resistance test results for Area No. 5 indicate that the contribution of the floor surface to the risk of slipping under dry conditions for Hip Hop Carpet – Spring was *very low* and has a SRV of 62 (**P5**) when tested with Slider 96.

IV. References

1. Australian Standard AS 4586: 2013, *Slip resistance classification of new pedestrian surface materials*, Standards Australia, Sydney, New South Wales.
2. Australian Standard AS 4663: 2013 *Slip Resistance measurement of existing pedestrian surfaces*, Standards Australia, Sydney, New South Wales.
3. Standards Australia Handbook HB 198: 2014, *Guide to the specification and testing of slip resistance of pedestrian surfaces*, Standards Australia, Sydney, New South Wales.
4. Australian and New Zealand Standard AS/NZS 4663: 2004 *Slip Resistance measurement of existing pedestrian surfaces*, Standards Australia, Sydney, New South Wales.
5. Australian and New Zealand Standard AS 4586: 2004, *Slip resistance classification of new pedestrian surface materials*, Standards Australia, Sydney, New South Wales.
6. AS/NZS 3661.2:1994 *Slip resistance of pedestrian surfaces - Guide to the reduction of slip hazards*, Standards Australia, Sydney, New South Wales.

Appendix A Guide to Slip Resistance Testing and Compliance

F. Duty of Care: Demonstrating Sufficient Compliance

Slip and fall incidents are one of the main causes cited in personal injury litigation. As the onus is increasingly put onto cleaning companies, facilities managers and other stakeholders to be responsible for slip resistance, making an informed decision can be business-critical should an incident occur.

Just having the testing done may not be enough to reduce liability if it is proven that:

1. Appropriate testing methodology has not been employed,
2. Test results have not been properly interpreted and classified, and
3. Suitable control measures have not been implemented.

Your investment in slip resistance information for your floor surface(s) indicates your awareness of duty of care as an employer, owner, manager or occupier, to provide a safe working environment and safe access for visitors to your building.

In fulfilling your duty of care under the OH&S/WHS Act and the Wrongs Act, it is important to respond to the information you now have. Used appropriately, the information from your tests may reduce serious injury and assist in the event of any legal action.

G. Applicable Legislation

Victorian Occupational Health and Safety Regulations 2007, Part 3.3 – Prevention of Falls requires that an employer identifies tasks that an employee is required to undertake that involves a fall hazard, including slippery or potentially unstable surfaces [Clause 3.3.3 (b)]. The OHS Reg at Part 3.3 provides specific requirements for an employer to control the risk to health and safety associated with a slip and fall hazards at the workplace.

H. Assessing the Risk

Your first step is to assess the risk along with relevant personnel; it may be appropriate to incorporate the outcome from your tests into a risk matrix. This will require you to determine the likelihood of a slip occurring (from your test results) and the consequence of injury. If you are unsure about the consequence of the injury, assume the worst – after all, falls from slips and trips constitute a large and costly public health problem in Australia with estimated health system costs to the public from related injuries being $1.28 billion per annum. This exceeds the cost of road injuries.

Australian standard AS 4663:2013 provides methods of measuring the frictional characteristics of existing installations, and may be used as part of an overall risk assessment procedure. It may also be used for evaluating the effects of surface treatments, including sealers, polishes and etchants which change surface characteristics.

Selecting the right test areas and appropriate method/s is the first step in constructing a suitable risk assessment. The choice of location/s as well as the number and type of tests must provide a complete and accurate representation of the site, and is dependent on the number of different flooring materials present as well as the probability of a range of contamination or exposure conditions, and nature of any anticipated activities.

I. Methodology

Two tests are used in Australia to assess and categorise slip resistance of pedestrian surfaces *in situ*. They are the (Tortus) Dry Floor Friction Test (performed under dry conditions), and the Wet Pendulum Test (performed under wet conditions). The Wet Pendulum and Dry Floor Friction tests are conducted in accordance with AS 4663: 2013. The previous version of this standard, of the same title, was AS/NZS 4663: 2004[4].

The aim of AS 4663: 2013 is to provide methods of measuring the frictional characteristics of existing pedestrian surfaces in wet and dry conditions, and it is only used for existing installations i.e. *in situ*. It is a useful tool for the evaluation of risk for facilities managers and floor maintenance businesses and may be used as part of an overall risk assessment procedure for public locations or buildings. It 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.

1. The Tortus Dry Floor Friction Tester

Based on extensive scientific studies by the British Ceramic Research Association, the Tortus measures the dynamic coefficient of friction between the floor or paving surface and common shoe sole materials. Because the coefficient of friction measurement is dependent upon several factors, including the shoe sole material, Four S rubber has been adopted as the material to be used in this type of test. Some shoe sole materials may result in lower coefficients of friction, but Four S has been adopted as the International Standard.

Figure 1: Tortus Dry Floor Friction Tester

The test speed (17mm/sec), the size of the friction slider (9mm diameter) and the load (200g) used in the instrument have been chosen to reproduce the contact area and pressure of the heel when it first touches the ground. The slider is fitted into the bottom of the measuring head, so that the frictional drag on the slider deflects the springs of the measuring assembly. In turn this displaces the strain gauge on the springs, giving a signal proportional to the coefficient of friction, where:

Coefficient of friction = Horizontal drag on slider/Vertical load on slider

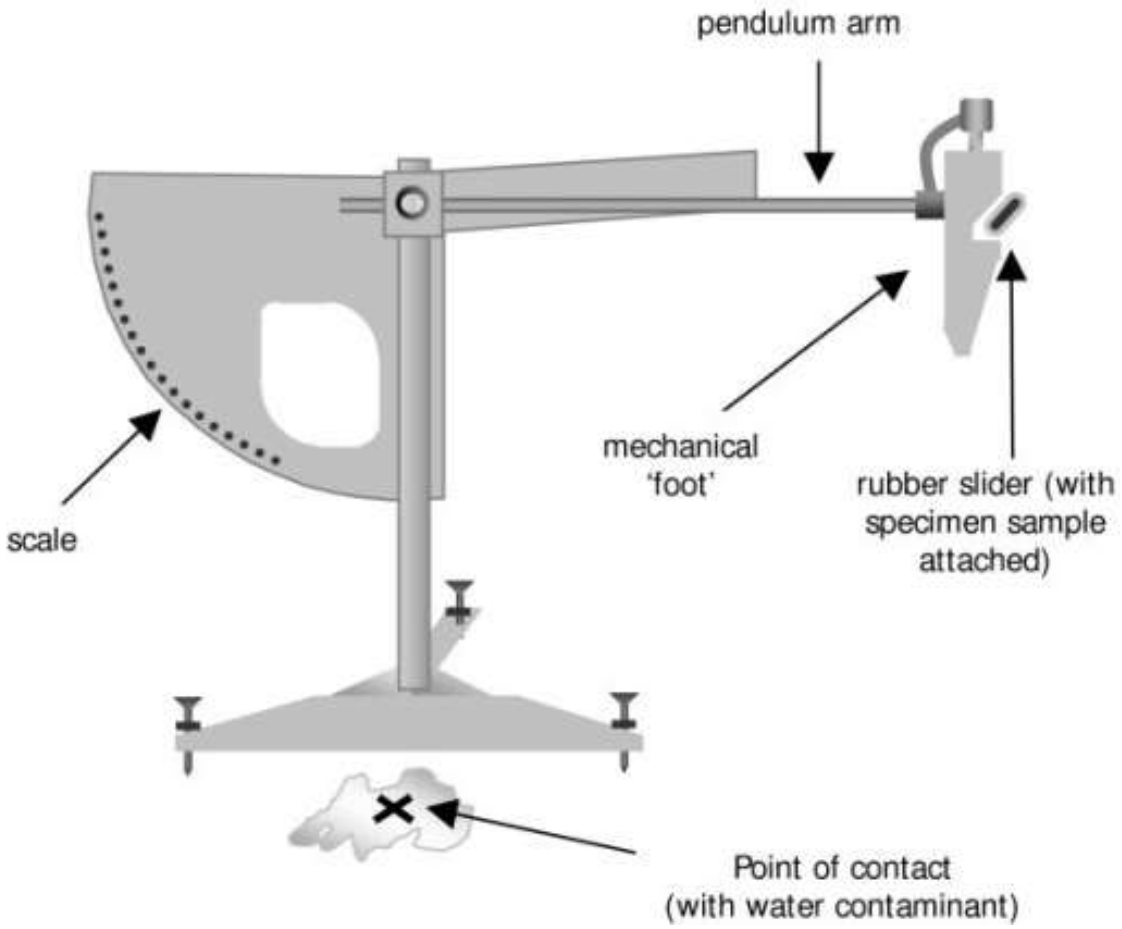
Thus the instrument gives a direct read out of the dynamic coefficient of friction as it crosses the floor at a constant velocity. The read-out can be recorded on a plotter and digitally stored as a permanent record.

Dry testing alone should only be performed in areas almost certain to remain dry – and is not a compliance loop-hole if wet testing is not done in (potentially) wet environments. Often revealing the problematic effect of dirt and dust contaminants, dry tests which produce a dynamic coefficient of friction result below 0.40 (in the as-found condition) then above (after wiping) may indicate cleaners should be mindful of fringe-mop sweeping or mopping.

2. The Wet Pendulum Test

Based on the pendulum test developed by the UK Transport and Roads Research Council, the equipment used is called a Portable Skid Resistance Tester, consisting of a heavy mechanical foot on the end of an arm which pivots such that the foot can swing in a vertical plane. Australian Standards require that the test be carried out wet.

Figure 2: Skid Resistance Tester and the Wet Pendulum Test



The foot of the pendulum arm is fitted with a Rubber Slider which has a specific hardness and resilience; either 4S or TRL rubber is used. In operation, a pendulum arm rotates about a vertical spindle: when released from a horizontal position, the arm of the pendulum passes through the bottom of its arc causing the slider to contact the floor surface for a fixed distance of 126-128mm. As the slider is at an angle to the floor, only the back edge of 75mm width sweeps across the floor; this causes energy to be absorbed, which is measured on a scale by the use of a pointer; the value is called a British Pendulum Number (BPN), which is recorded.

AS 4663: 2013 provides for a revised method for Wet Pendulum testing compared to AS/NZS 4663: 2004, to reflect more accurately, and provide greater discrimination, between the interaction of a worn or polished shoe heel and a smooth pedestrian surface. The change in method incorporates the use of 3µm lapping film as part of the rubber slider conditioning process, after conditioning on P400 grit sandpaper. It is considered to better reflect the lower slip resistance attributable to the contact of two smoother surfaces under water-wet conditions.

3. Sliders

Wet slip resistance testing can be performed using two types of rubber materials: Slider 55 (TRL) rubber, which has been traditionally used for testing outdoor surfaces such as roads and footpaths as well as wet barefoot areas, and Slider 96 (Four S) rubber which was developed to replace the Slider 55 rubber for testing smoother indoor surfaces, as it provides more discrimination. (The numbers '55' and '96' refer to the Shore A hardness of the rubber compounds used for each; the higher the number, the harder the rubber compound.) Whilst both rubber types can be used for the Wet Pendulum test method, only Slider 96 rubber is used for the Dry Floor Friction Test. The use of these two rubbers for wet and dry slip resistance testing allows direct comparison between slip resistance testing results.

Figure 3: Wet Pendulum Slider

4. Corrections for Slope and Temperature

For sloped areas, the slope correction formula and tables contained in AS 4663: 2013 and the same slope correction formula in HB 198: 2014 are used. Slip resistance testing conducted on a slope of ≥1.5° (2.6%) will have a Slope Correction Value (SCV) applied dependant on the maximum gradient of the area tested. The corrected results, where applicable, are applied to the Slip Resistance Value (SRV), under wet conditions, or the mean coefficient of friction under dry conditions and reported as the SCV within the results.

Wet slip resistance testing carried out using a Slider 55 rubber may have a Temperature Correction Value (TCV) applied dependent on the air temperature at the time of testing. The corrected results, where applicable, are applied to the Slip Resistance Value (SRV) and reported as the TCV within the results. Testing with the Slider 96 rubber requires no such correction.

5. General

As with any other scientific evaluation, test results must be reproducible within the allowed margin of error. Ensuring the standard's exacting testing methodologies, including appropriate choice of wet pendulum 'sliders', conditioning for both the dry and wet methods, and implementing corrections for slope and temperature are key factors in obtaining both accurate and precise results.

A Slip 'Test' report is now generated, ready for interpretation as to classification and compliance.

J. Classification of Results

Test reports (recording data only) do not provide interpretative information on classification and compliance. While AS 4663: 2013 details the testing equipment and methodologies, it does not provide interpretative information or a classification system about what the results of the dry and wet testing mean. However, AS/NZS 4663: 2004 does contain information that estimates the notional contribution of the floor surface to the occurrence of a slip under wet or dry conditions. The guidelines in AS/NZS 4663: 2004, which have been used as acceptance criteria in the slip resistance testing industry since its release in 2004, have been used to interpret the test data contained in this report.

Tables 1 and 2 (below), reproduced from AS/NZS 4663: 2004, estimate the 'notional contribution of the pedestrian surface to the risk of slipping under wet and dry conditions'. For reference, Table 2 has also been expanded upon to include the classifications provided in AS 4586: 2013. The only difference, other than the designation system, compared to the British Pendulum Number (BPN) classifications contained in AS/NZS 4663: 2004 and AS/NZS 4586: 20045, is that instead of a single classification for BPNs below 25, AS 4586: 2013 references two classifications of 12-24 BPN and <12 BPN. This has become necessary because of the greater discrimination achieved incorporating 3µm lapping film during conditioning, and the resulting higher sensitivity achieved when testing smoother surfaces.

1. Dry Testing

Dry floor friction slip resistance test results are analysed using Table 1 below which has been derived from Australian Standards AS/NZS 4663: 2004 and AS 4586: 2013.

Table 1: Analysis of Dry Floor Friction Results

Floor Friction Tester Mean Value	AS 4586: 2013 Dry Floor Friction Classifications	Notional† Contribution of the Floor Surface to the Risk of Slipping When Dry
≥0.4	D1	*Moderate to very low*
<0.4	D0	*High to very high*

NOTES:

- † The term *'notional'* has been used to highlight the need to consider all potential contributing factors to a slip incident
- *For a *'moderate to very low'* interpretation, each individual test result shall be equal to or greater than 0.35

2. Wet Testing

Wet Pendulum slip resistance test results are analysed using Table 2 below which has been derived from Australian Standards AS/NZS 4663: 2004 and AS 4586: 2013.

Table 2: Analysis of Wet Pendulum Results

Pendulum* Mean BPN		Notional† Contribution of the Floor Surface to the Risk of Slipping When Wet	AS 4586: 2013 Equivalent Classification
Slider 96	Slider 55		
>54	>44	*Very Low*	P5
45-54	40-44	*Low*	P4
35-44	35-39	*Moderate*	P3
25-34	20-34	*High*	P2
12-24	<20	*Very High*	P1
<12		*Extremely High*	P0

NOTES:

- *While either of these rubbers may be used, the test report shall specify which was used
- † The term 'notional' has been used to highlight the need to consider all potential contributing factors to a slip incident
- It is expected that these wet surfaces will be more slip resistant when dry

In Table 2, the term '*Extremely High*' for BPN test results below 12 (AS 4586: 2013 classification P0) has been used. This terminology is not contained in any of the referenced standards, however Induction Group considers this to be a reasonable and appropriate assessment and description of the pedestrian surface condition when such results are obtained.

K. Guide to Interpretation: The SA HB 198:2014 Handbook

HB 198: 2014 contains useful and practical information about what minimum slip resistance classifications are appropriate for various public locations, including stairways. However, this reference only contains information for the Wet Pendulum and Oil-Wet Inclining Platform Tests, not the Dry Floor Friction Test, and is intended as a guideline for persons with relevant engineering authority.

The following paragraphs discuss the results against the classifications for the area types in accordance with Table 1 for dry floor friction test results and Table 2 for wet pendulum test results (noted above). HB 198: 2014 lists minimum pendulum (wet) classifications for specific locations; however, it does not provide interpretation of dry floor friction results. HB 198: 2014 establishes a basis for specifying pedestrian surface materials for various applications for new buildings and, therefore, is used here only as a guide.

Induction Group does not accept any liability arising from its use. Compliance with the minimum classifications contained in HB 198: 2014 will not alleviate all hazards, although conformance will reduce certain risks.

Table 3B provides guidance for pedestrian surfaces for particular applications. The values represent a consensus view of Committee BD-094, although not all experts agree on all values. The values in Table 3B have been determined by the following process:

1. Applications and corresponding values were selected initially from HB 197: 1999;
2. A subcommittee of Committee BD-094 modified some applications and values, and these were further modified during the review process; and
3. The contents of Table 3B are subject to further review by Committee BD-094, in its ongoing project to provide guidance on specifying and testing for slip resistance.

For completeness, Table 3A is also reproduced here from the previous Section.

There are some fundamental differences in the purpose and nature of Tables 3A and 3B.

1. Table 3A applications and values have been determined by the Australian Building Codes Board for use in regulations based on the NCC. It provides the minimum wet pendulum test or oil-wet inclining platform test classifications that are deemed-to-satisfy specific applications in buildings covered by the NCC. These values may be used as acceptance criteria in a range of situations, including those where the building incorporates only the minimum regulated NCC requirements for handrails, lighting and the like.

2. Table 3B applications and values have been determined by Committee BD-094 for use in applications that are not regulated by the NCC. It provides wet pendulum test or oil-wet inclining platform test classifications for applications where the NCC does not specifically require slip resistance. The applications listed are some of those for which slip resistance is warranted for reasons other than NCC compliance. The use of these values should be in the context of design, which also considers abnormal wear, maintenance, abnormal contamination, the presence (or otherwise) of water or other lubricants, the nature of the pedestrian traffic (including age, gait and crowding), the footwear (or lack thereof), slope, lighting and handrails.

Table 3A

Minimum Wet Pendulum or Oil-Wet Inclining Platform Test Classifications Deemed to Satisfy NCC Building Applications

Location	Wet Pendulum test	Oil-wet inclining platform test
Stair Treads and Stairway Landings in Buildings Covered by NCC Volumes One and Two		
Stair treads and a stairway landing (when dry)	P3	R10
Stair treads and a stairway landing (when wet)	P4	R11
Nosings for Stair Treads and Stairway Landings in Buildings Covered by NCC Volumes One and Two		
Dry stair tread, a stair non-skid nosing strip and a stairway landing	P3	
Wet stair tread, a stair non-skid nosing strip and a stairway landing	P4	
Ramps in Buildings Covered by NCC Volumes One and Two		
Ramps not steeper than 1:14 gradient (when dry)	P3	R10
Ramps not steeper than 1:14 gradient (when wet)	P4	R11
Ramps steeper than 1:14 up but not steeper than 1:8 (when dry)	P4	R11
Ramps steeper than 1:14 up but not steeper than 1:8 (when wet)	P5	R12

NOTE: NCC compliance is demonstrated by achieving the values set out in this Table for either the wet pendulum test or the oil-wet inclining ramp test. It is not necessary to meet both criteria.

Table 3B

Wet Pendulum or Oil-Wet Inclining Platform Test Classifications
For Applications Where the NCC Does Not Require Slip Resistance

Location	Wet Pendulum test	Oil-wet inclining platform test
External Pavements and Ramps		
External ramps including sloping driveways, footpaths etc. Steeper than 1 in 14	P5	R12
External ramps including sloping driveways, foot paths etc., under 1:14, external sales areas (e.g. Markets), external carpark areas, external colonnades, walkways, pedestrian crossings, balconies, verandas, carports, driveways, courtyards and roof decks.	P4	R11
Undercover car parks	P3	R10
Hotels, Offices, Public Buildings, Schools and Kindergartens		
Entries and access areas including hotels, offices, public buildings, schools, kindergartens, common areas of public buildings, internal lift lobbies.		
Wet Area	P3	R10
Transitional Area	P2	R9
Dry Area	P1 (see Note 3)	R9
Toilet Facilities in offices, hotels and shopping centres	P3	R10
Hotel apartment bathrooms, ensuites and toilets	P2	A
Hotel apartment kitchens and laundries	P2	R9
Supermarkets and Shopping Centres		
Fast food outlets, buffet food servery areas, food courts and fast food dining areas in shopping centres	P3	R10
Shop and supermarket fresh fruit and vegetable areas	P3	R10
Shop entry areas with external entrances	P3	R10
Supermarket aisles (except fresh fruit areas)	P1 (see Note 3)	R9
Other separate shops inside shopping centres - wet	P3	R10
Other separate shops inside shopping centres - dry	P1 (see Note 3)	R9
Loading docks, Commercial Kitchens, Cold Stores, Serving areas		
Loading docks undercover and commercial kitchens	P5	R12
Serving areas behind bars in public hotels and clubs, cold stores and freezers	P4	R11
Swimming pools and Sporting Facilities		
Swimming pool ramps and stairs leading to water	P5	C
Swimming pool surrounds and communal shower rooms	P4	B
Communal changing rooms	P3	A
Undercover concourse areas of sports stadiums	P3	R10
Hospitals and Aged Care Facilities		
Bathrooms and ensuites in hospitals and aged care facilities	P3	B
Wards and corridors in hospital and aged care facilities	P2	R9

Notes to Table 3B

1. The slip resistances of pedestrian surface materials set out in Table 3B are intended as guidance in the context of design for pedestrian safety, taking account other factors including abnormal wear, maintenance, abnormal contamination, the presence (or otherwise) of water or other lubricants, the nature of the pedestrian traffic (including age, gait and crowding), the footwear (or lack thereof), slope, lighting and handrails.

2. The contents of Table 3B are subject to further review by Committee BD-094, in its on-going project to provide guidance on the specification and testing of slip resistance.

3. The minimum classifications listed in Table 3B are P1 and R9. It is inappropriate for Table 3B to list the lower classification, P0, since there is no lower limit on Classification P0. Notwithstanding, some smooth and polished floor surfaces, which do not achieve Classification P1, may be considered to provide a safe walking environment for normal pedestrians walking at a moderate pace, provided the surfaces are kept clean and dry; however, should these surfaces become contaminated by either wet or dry materials, or be used by pedestrians in any other manner, then they may become unsafe. Therefore, the type of maintenance, the in-service inspection of floors, other environmental conditions and use should be taken in to account when selecting such products.

4. When using the oil-wet inclining platform 'R' classifications, consideration should also be given to the determination and use of volumetric displacement 'V' classifications. In some cases, a specifier may choose either a particular combination of R and V values, or a more severe R value alone. For example, either R10 + V4, or R11.

L. Summary

To evaluate the slip resistance under dry conditions, the test method in AS 4663: 2013 is used in accordance with the classification system in AS 4586:2013. For interpretation of test results, the criteria from AS/NZS 4663: 2004 pertaining to the notional contribution of the surface to the risk of slipping when wet are employed.

To evaluate the slip resistance under wet conditions, the test method in AS 4663: 2013 is used in accordance with the classification system in AS 4586: 2013 is used. For interpretation of test results, the criteria from AS/NZS 4663: 2004 are employed. When applicable, the obtained British Pendulum Number (BPN) test results are evaluated against both HB 198: 2014 and/or the relevant National Construction Code (NCC) section for stairways, for the required minimum slip resistance interpretation for such areas.

M. Compliance Reporting

A Compliance Report must not only (1) state the test data, but also (2) deliver the assessment outcome stating conclusively whether (or not) defined minimal criteria have been met, (3) how the results have been interpreted in accordance with the standards, (4) what conclusions have been reached and (5) why – (6) as determined by someone with the relevant authority.

The objective of the Compliance Report is to make an unambiguous, defensible, clear and concise assessment, so that corrective actions and control measures are initiated to reduce risk, as required by your Duty of Care.

N. Limitations in Methodology

The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

Ideally the slip resistance of surfaces will be relatively stable; however, the performance of many seemingly slip resistant materials may vary significantly with time and usage conditions.

O. Control Measures

Control measures such as sufficient entry matting, awnings, air-lock doors, signage and cleaning regimes may help reduce risk or liability; remediation alternatives include grinding, surface treatments, or replacement of the floor.

If the risk cannot be eliminated one or more of the hierarchy of controls may be used to minimise the risk. Implemented control measures are then to be maintained and reviewed before the installation of new surfaces, when the function of the activity within an area changes, after advice that a slip related incident has occurred, or if a stakeholder requests a review.

If it is anticipated that the surface will become wet, control measures may further reduce the risk of an incident occurring on the surface. The floor should be maintained in a clean and dry condition with regular inspections to identify, isolate and clean spills and foreign objects. Actions should be in the form of immediate controls, which may include restricting access to an area, particularly if a disproportionate number of incidents have occurred which indicate that a surface is inherently slippery. In the longer term, it is recommended that prevention and engineering given preference as outlined within the Hierarchy of Controls (outlined below)

Usually, it is more appropriate to reduce the *likelihood* of a risk than it is to reduce the *consequences* of the risk. This can be achieved in a number of ways, as noted on the following page:

Table 4: Hierarchy of Controls

Eliminate the hazard	• Remove slip, trip or fall on the same level hazards at the planning and design stage, or when renovating a facility
Substitute the hazard to give rise to a lesser risk	• Modify or substitute an existing surface to reduce the risk of slipping • Replace substances or equipment currently being used • Contain spills • Improve lighting
Isolate the hazard by restricting access to the hazard	• The use of signage and barriers in the event of a spill • Cordon off and areas while cleaning is in progress and surfaces are slippery • Limit access to high-risk areas • Conduct cleaning out of normal usage hours
Use engineering methods to control hazards at the source	• Reduce the likelihood of water via use of water absorbent matting • Use of airlocks or similar to minimise contamination from outside • Apply floor resurfacing treatments such as acid etching, grinding, coatings on a regular basis • Contain spills using bunding and umbrella wrapping machines • Improve lighting • Install handrails
Administrative controls to raise awareness	• Review of cleaning regime and/or chemicals used • A review of the extent of vigilance and 'walk throughs' • Regular slip resistance testing • Wet weather procedures • Adopting safe working practices • Providing appropriate training, instruction or information • Regular monitoring of relevant records, data and statistics: Review reported incidents occurring on the surface and assess further whilst actively monitoring evidence of the surface affording inadequate slip resistance. • Housekeeping and cleaning • Use of umbrella wrapping machines • Signage to warn people of the hazard • Implementing slip resistance within a Quality Management System
Personal Protective Equipment (PPE)	• Use PPE such as slip-resistant footwear

Regardless of whether your floor's slip resistance results in a high or low level of risk, an appropriate plan to reduce the risk will always be beneficial. Induction Group can recommend appropriate action be undertaken which may include, but not be limited to the points above

Ongoing monitoring for wear and tear through regular testing will ensure the risk remains known, a responsible risk management plan is sustained and compliance demonstrated.

These are simple and effective ways you can reduce the risk of slips, trips and falls. Guidance available from Induction Group can highlight other contributing factors to slips, trips and falls. To assist in your assessment of each of these, speak with Induction Group consultants so that we may provide you with advice in the assessment and selection of the most appropriate solution for your floors and walkways.

P. Factors that Affect Slip Resistance

1. Surface Deterioration

A significant contribution to slips, trips and falls is the deterioration of the floor surface or walkway over time. To account for this and subsequently reduce the risk of slips, a regular slip resistance testing program is recommended. Floors are often laid without regard to their durability. What might start out as a suitable surface for slip resistance, may deteriorate rapidly from the harsh effects of traffic and/or cleaning. So regular testing is most important. The frequency of tests depends on factors such as location and traffic. To simplify and provide professional judgement, Induction Group technicians can provide you with an audit of your floor surfaces that includes a recommended test program.

2. New Floor Surfaces

If you are considering a new surface, its durability can be assessed on the basis of an Accelerated Wear Test (AWT). An Induction Group provided AWT can indicate surface or surface treatment characteristics over time after subjecting the surface to controlled abrasion testing. This is a valuable method to assess suitability and compare proposed flooring surfaces or surface treatment products.

3. Surface Treatments

The application of surface treatments to existing flooring surfaces is an option that has gained popularity as the technology and the need for safer floors has grown. The increased range of options provides choice for clients but it can make a decision so complex it can hinder timely solutions.

Selecting the right surface treatment requires an understanding of options, their advantages and their weaknesses. Induction Group's team of engineers and technicians can guide you with independent advice on the selection of the most appropriate surface treatment for your circumstances to satisfy your need to increase slip resistance and/or prolong slip resistance characteristics.

4. Building Code Regulations

Often overlooked in slips, trips and falls are contributing factors other than the condition of the floor's surface. Building code regulations provide standards that we are obligated to comply with and conditions such as lighting, the slope of the floor and even stairway and handrail dimensions can contribute to slips, trips and falls.

Q. Methods of Improving the Slip Resistance of Existing Floors

The following methods of increasing the slip resistance of floors is outlined in AS/NZS 3661.2:1994 *Slip resistance of pedestrian surfaces - Guide to the reduction of slip hazards:*

Table 5: AS/NZS 3661.2:1994 *Slip resistance of pedestrian surfaces - Guide to the reduction of slip hazards*[6]

Surface	Acid Etch	Blasting	Grind	Paint & sand	Groove	Floor sander	Proprietary treatment	Adhesive strip
Concrete	√	√	√	√	√			√
Ceramic tiles		√	√	√	√		√	√
Granite		√	√		√		√	√
Marble		√	√		√		√	√
Pavers – Concrete	√	√	√	√	√			√
Pavers – Clay		√	√	√	√		√	√
Porcelain enamel							√	√
Steel plate		√		√				√
Wood				√		√		√
PVC sheet and tiles							√	√

It is recommended that when modifying the surface, samples of treatments be evaluated in terms of the increase in slip resistance and any other characteristic deemed to be important to the form and function of the floor surface. This may include but is not limited to:

- Cost
- Cleanability
- Mechanical properties
- Chemical properties
- Surface adhesion
- Aesthetics

Control measures and remediation schemes are not 'one-size fits all', the choice of suitable products and services depends on the flooring materials used as well as other relevant practicalities. Companies responsible for specifying recovery schemes can get into trouble with misidentified materials, ill-chosen surface treatments (e.g. unsuitable slip and adherence properties, or causing degradation), and the ever-present battle between cleanliness and slip resistance. A rule of thumb is to undertake test patches on discreet areas before committing to the entire project and major capital expenditure.

A trial of suitable options will provide the required information to conduct a cost-benefit analysis of the identified treatments. When considering the selected treatment the long term sustainable slip resistance should also be assessed.

R. Conclusion

In the event of a slip incident, liability may not be eliminated, but if due diligence has been conducted as part of an overall risk assessment and an appropriate standard of care has been implemented, exposure will in most cases be minimised and the well-being of all parties safeguarded as far as reasonably practicable.