



GripDeck

BS 7976-2 Slip Test Report

Addressee: James Baldwin

Report carried out on behalf of GripDeck
Fairfields Farm
Fordham Road
Wormingford
Colchester
Essex CO6 3AQ

Tests conducted at Grip Potential Ltd
Ringstead Business Centre
1-3 Spencer Street
Ringstead
Northants
NN14 4BX

Test date 24/01/12
Report date 24/01/12

Report Reference: 1267GRIP200111R
Purchase Order: PO-1911

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Summary

Test Surface	Slip Risk		Comments
	Dry	Wet	
Hardwood decking with GripDeck RetroGrip strips	Low	Low	Surface features an aggressive anti-slip resin strip and substantial macro-profile with excellent wet and dry anti-slip properties.



Theory

Research carried out by the Health and Safety Laboratory, in conjunction with the UK Slip Resistance Group (UKSRG), has shown that it is possible to assess the characteristics of floor surface materials needed for satisfactory slip resistance. The Health and Safety Laboratory has developed a "reliable and robust" test method that forms the basis of Grip Potential's assessment procedure.

The pendulum skid test forms the basis of the coefficient of dynamic friction measurement of a floor. A calibrated 'foot' swings from a horizontal point of release, strikes the flooring surface for a known distance, then reads the "Pendulum Test Value" (PTV) on its overswing. The rubber slider that contacts the floor is constructed of '4S' rubber (Standard Simulated Shoe Sole) and is designed to replicate the most common slipping motion experienced by pedestrians wearing shoes. A softer, more malleable, rubber (TRL rubber) can be used to simulate a barefoot slip or when aggressive profiles are present. Pendulum testing is one of the few methods that models the formation of a hydrodynamic squeeze film between the floor and sole, a major factor in a wet slip.

A surface roughness meter is used to measure the ability of the floor's surface to puncture the hydrodynamic squeeze film. The film forms a barrier between sole and floor and significantly reduces grip, in a similar way that a car tyre aquaplanes. The HSE recommend a minimum valley to peak height of 20µm for a water wet surface. A thicker contaminant, such as motor oil, will require a much greater surface roughness in order to facilitate a sole-floor contact. For this reason it is important to take into account expected contaminants when specifying a floor surface.

A site assessment is an important component in determining the slip risk of any given floor. The HSE's pedestrian slip potential model highlights important environmental factors in a slip. Contaminating substances, frequency and methods of cleaning, types of footwear and likely pedestrian behaviour all affect the potential for a slip incident and are given due consideration.



Method

BS 7976-2:2002 - Pendulum Testers, Method of Operation

Coefficient of dynamic friction measurement is carried out in accordance with BS 7976 and the UKSRG Guidelines 2011. These industry standard methods of testing are essentially the same but with a slight difference between the two methods of preparation of the rubber sliders. Testing has been carried out in accordance with the UKSRG Guidelines 2011 as both the HSE and UKSRG agree that this is best practice.

A prepared standard rubber slider attached to a weighted 'shoe' is allowed to swing from a horizontal point of release. The slider is mounted on a spring loaded bracket and makes contact with the floor for a known distance. The height to which the shoe travels after contacting the floor gives a reading of the Pendulum Test Value (PTV, formally known as SRV Slip Resistance Value). The dynamic coefficient of friction of a test surface has a direct and measurable effect on the PTV reading obtained.

Test surfaces are subject to eight measurements of the PTV with the first three being discounted from calculations of the median. Tests are carried out in the principal direction, at 45° to the principal direction and at 90° to the principal direction. Each direction is tested under both wet and dry conditions, totalling 48 measurements. A median value is generated for wet and dry tests based on the performance in different directions. A slip potential classification can then be applied using the following table from the UKSRG Guidelines.

PTV	Slip Potential
<25	High
25-35	Moderate
>35	Low

Table 1. Slip Potential classifications from Pendulum Test Values

An alternative measure of flooring slip resistance is its coefficient of dynamic friction (CoDF). PTV can be converted to CoDF using the formula below. It should be noted, however, that CoDF describes an interaction between two specific surfaces. This relationship is further complicated by the behaviour of any lubricating film between the two surfaces.

$$\text{CoDF} = (3 \times \text{PTV}) / (330 - \text{PTV})$$

The pendulum skid tester is one of the few test methods that accurately models the hydrodynamic squeeze film formed in a contaminated slip and as experienced by pedestrians. This should be taken into consideration when comparing CoDF values for contaminated surfaces from other test methods.



Surface Roughness Measurement (Rz)

Surface roughness, in particular the Rz value, describes the mean vertical peak to valley distance over a given horizontal sample. The microscopic construction of a surface affects its ability to puncture the fluid film generated in a slip. It is also a valuable tool to assess the wear level as over time traffic will smooth a floor surface, changing its slip risk potential.

Grip Potential use a Surtronic Duo surface roughness meter for assessment. The meter moves a stylus along the test surface, measuring the floor profile's average vertical peak to valley distance in microns. A test site will be measured ten times using this method, with samples taken randomly across the surface. Where results indicate a directional profile, ten measurements will be conducted along the profile and ten across the profile. This is in line with UKSRG guidance.

Surface roughness can be used to give a general indication of the slip risk potential of a floor, though it is by no means a comprehensive test. Grip Potential use surface roughness measurements married to pendulum results to enable accurate ongoing monitoring of the surface. The UKSRG published the data shown in the table below to use in conjunction with pendulum testing.

Rz	Slip Potential
<10µm	High
10-20µm	Moderate
>20µm	Low

Table 2. Slip Potential classifications from surface roughness (Rz) values

Whilst there is ongoing research into the effect of surface roughness on slip resistance it is generally considered that the Rz parameter is a good *indication* of slip risk. Limitations of the Rz measurement are that it does not take into account the density or construction of micro-profile, simply its average height. The stylus measuring peak to valley height may travel around anti-slip particulate or may be too wide to measure the depth of narrow valleys. It is possible for surfaces to have similar Rz values and ultimately differing contaminated slip resistances. Furthermore, Rz does not take into account macro-profiling or the deformation of a softer floor.

Grip Potential use the relationship between Rz roughness and Pendulum Test Value to determine likely thresholds for high, moderate and low slip risk. Where pendulum testing is impossible, Rz measurements married to a similar nearby surface is sometimes the only way to relate a PTV, as recognised by the UKSRG guidelines. This is based on a linear approximation of the relationship between Rz and PTV and is to be considered *as a guide only*.



Site Assessment

A site assessment is designed to highlight factors that have an impact on slip risk potential. The Grip Potential site assessment follows the pedestrian slip risk potential model as developed by the HSE alongside guidance published by the UKSRG and CIRIA and our own expert knowledge and experience.

A Grip Potential site assessment aims to provide the client with all necessary information of the factors contributing to slip risk of the tested areas. Drawing assessment criteria from a wide range of expert sources ensures that a complete and thorough report of slip risk is produced. Knowledge of factors adversely affecting slip risk allows intelligent decision making in ongoing health and safety procedures.

Our site assessment regime broadly covers the following factors;

- Surface composition and condition, construction and wear.
- Contamination, likely types, sources, levels and effects.
- Footwear, control, expected soles and their effects.
- Cleaning regime, effectiveness, risk of any wet processes.
- Surface usage, moving heavy loads, running, turning, high risk user groups.
- Environmental factors, lighting, distractions, weather etc.
- General comments, specific factors of the individual site affecting slip risk.

This is in line with the Health and Safety Laboratory developed 'Slips Potential Model' considered to give the most accurate assessment of factors affecting slip risk.

Depending on the function of the report as an accident investigation, standard risk assessment or product certification the site assessment will focus on appropriate factors. An accident investigation will seek to highlight all factors contributing to a particular slip, where a risk assessment will highlight factors that should be considered in the effective ongoing management of the surface.

Information required to complete the site assessment is gathered primarily at the time and location of the test and is based on observations made by the test operator. Less obvious information, such as cleaning regimes or shoe control measures, is supplied by the person responsible for the site, or a representative of that person. Where information is uncertain, or an assumption is made, it is made clear that this is the case.



Test Equipment

Munro Portable Skid Tester

Serial No: 0852
 Calibrated by: Wessex Test Equipment Ltd
 Calibration date: 17/03/11
 Certificate No: C2251
 Calibration due: 16/03/12

Notes:

Calibration checks are carried out regularly by way of check testing on lapping film previously tested by a UKAS accredited laboratory. Further to this, check testing is conducted on site using lapping film and float glass of a known value.

Surface Roughness (Rz) Meter Calibration Plate

Serial No: 112-2916
 Calibrated by: GB Quality Assurance Ltd
 Calibration date: 27/04/09
 Certificate No: 55283
 Calibration due: 27/04/14

Notes:

The Surtronic Duo surface roughness meter comes equipped with a calibration plate of known roughness. Prior to testing on site, check testing is carried out on the calibrated plate.

4S Rubber Sliders (Slider #96)

Batch No: 16557
 Calibrated by: Munro Stanley London
 Calibration date: 31/08/11
 Certificate No: 64342
 Disposal date: 30/08/12

Notes:

Sliders are prepared in line with guidance by the UKSRG. Check testing is conducted both on lapping film previously tested by a UKAS accredited laboratory and float glass. This procedure is conducted prior to a site visit and is in addition to the site check testing.

TRRL Rubber Sliders (Slider #55)

Batch No: 16764
 Calibrated by: Munro Stanley London
 Calibration date: 09/09/11
 Certificate No: 64342X1
 Disposal date: 07/09/12

Notes:

Sliders are prepared in line with guidance by the UKSRG. Check testing is conducted both on lapping film previously tested by a UKAS accredited laboratory and float glass. This procedure is conducted prior to a site visit and is in addition to the site check testing.

Digital Level

Serial No: 6029
 Calibrated by: MD Calibration Services
 Calibration date: 20/04/11
 Certificate No: 134952
 Calibration due: 21/04/12

Notes:

The digital level is used to determine the gradient of the test surface. The UKSRG give guidance on the effect a slope has on the recommended minimum PTV.

Daily Check Test Values

	PTV					Mean	Expected
Lapping film:	55	55	55	55	55	55	55 ±1
Float glass:	8	8	8	8	8	8	5 to 10
Pavigres tile:	35	35	35	35	35	35	34 ±1

Surface roughness tested value: n/a µm
 Surface roughness expected value: 21.5 µm

Please note that all calibration certificates are available on request.

Test Results

Hardwood decking with GripDeck RetroGrip strips

Test carried out by: Ben Powers
 Site location: Grip Potential Ltd

Date of test: 24/01/12
 Flooring type: Timber
 Application: Unknown

Image 1. Pendulum tester in-situ



Image 2. Test surface



Pendulum Test Results

Slider #55 (TRL)

Direction	Condition	PTV					Median
Principal	Dry	79	81	81	80	81	81
45°		98	96	96	96	96	96
90°		108	112	106	102	110	108
Median dry PTV							96
Principal	Wet	72	72	72	72	72	72
45°		82	828	2	81	81	81
90°		67	67	67	67	67	67
Median wet PTV							72

Pendulum test values indicate that slip risk potential in the dry is
 Pendulum test values indicate that slip risk potential in the wet is

Low
Low

The above results have been classified in accordance with the UKSRG Guidelines Issue 4, 2011.

Surface Roughness (Rz) Results not applicable (macro-profile)

Surface under test features a macro-profile unsuitable for measurement with a surface micro-roughness meter. Macro-profiled surfaces can present readings outside of the effective range of the roughness meter which may damage the meter. Rz values obtained on a macro-profiled surface are likely to be misleading given the differing contact area and pressure between sole, floor and lubricating film.



Conclusion


In the opinion of Grip Potential Ltd, the product referenced "Hardwood decking with GripDeck RetroGrip strips" presents a low risk of slip in both dry and water wet conditions. The test surface presents a highly directional finish with significant variation in slip resistance dependent on orientation. Test sampling was conducted in order to provide a 'worst case' minimum slip resistance. Minimum test values achieved still comfortably exceed the 'low risk of slip' minimum requirement.

The sample presents a macro-profile with reduced contact area between sole and floor. The inclusion of aggressively profiled anti-slip resin strips on the high pressure macro-profile peaks provides excellent wet and dry slip resistance. The strips effectively disperse the high pressure fluid film generated in a wet slip, securing sole/floor contact and associated grip.

Surface roughness (Rz) values were not recorded on the products due to the macro-profile finish. The Rz value is generated by dragging a stylus across a sample and measuring the mean vertical displacement in microns. On macro-profiles the variation in profile is often out of the range of the test meter. In addition, the macro-profile significantly alters the contact area and pressures involved in interacting with the hydrodynamic squeeze film, making the approximations generated using Rz data inaccurate.

If a slip were to occur on the products under test, responsible parties would need to demonstrate that 'reasonably practicable' measures had been taken to ensure the surface is safe for use. In the case of the product referenced "Hardwood decking with GripDeck RetroGrip strips" it is expected that 'reasonably practicable' measures have been taken in providing a slip resistant surface in both dry and water wet conditions. It is not expected that responsible parties would be found liable for any slips occurring in dry or water wet conditions on the tested surface.

The above assessment was carried out by Grip Potential adhering to the UKSRG, HSE and CIRIA guidelines on pedestrian slip risk assessment. The results given are accurate representations of data acquired on site and through the client. The results have been interpreted to give slip risk classifications based on parameters recommended by the UKSRG and HSE.

Signed: 
Ben Powers, BSc (Hons)
Slip risk consultant
24/01/12



BS 7976-2 Slip Test Certificate

This is to certify that the product referenced: **Hardwood decking with GripDeck RetroGrip strips**

Tested: **24/01/12**

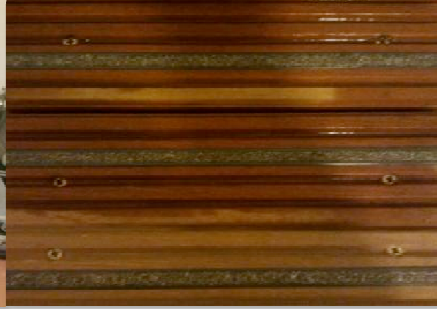
By: **Ben Powers**

Submitted by: **GripDeck**
Wormingford
Essex CO6 3AQ

Image 1. Pendulum tester in-situ



Image 2. Test surface



Achieved the following results;

BS 7976-2 Pendulum slip testing

Mean PTV in dry conditions:	96	Low risk of slip
Mean PTV in water wet conditions:	72	Low risk of slip

Rz Surface roughness measurement

Mean Rz value: **n/a** μm


Additional information

Dry CoDF results:	1.23
Wet CoDF results:	0.84

Rz value estimated to represent the limit of low slip risk: **n/a** μm

SATRz value to replace Rz values as input for the HSE's SAT: **400**
(For further information regarding SATRz see "Method: Site Assessment" above)

The above assessment was carried out by Grip Potential adhering to the UKSRG, HSE and CIRIA guidelines on pedestrian slip risk assessment. The results given are accurate representations of data acquired in testing and through the client. The results have been interpreted to give slip risk classifications based on parameters recommended by the UKSRG and HSE.

Signed: 
Ben Powers, BSc (Hons)
Slip risk consultant
24/01/12