



Anti Slip Solutions Ltd

Pendulum Slip Test Report

Addressee: Colin Masey

Report carried out on behalf of Anti Slip Solutions Ltd
Bridge House
Bewdley
Worcestershire
DY12 1AB

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

Test date 11/05/10
Report date 12/05/10

Report Reference: 120510SAFE----
Purchase Order: n/a

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Summary

| Sample | Slip Risk | Comments |
|---------------|------------------|--------------------------------------------------------------------------------|
| GripCote | Low | Test results indicate a low risk of slip in both dry and water-wet conditions. |
| SafeGrip | Low | Test results indicate a low risk of slip in both dry and water-wet conditions. |



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" 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) may be used to simulate a barefoot or casual shoe slip. Pendulum testing is one of the few methods that models the formation of a hydrodynamic squeeze film between the floor and shoe 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 the same way that a car tyre aquaplanes. The minimum recommended valley to peak height for a water wet surface is 20µm. 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 2005. 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 2005 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 mean. 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 mean 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

Surface Roughness Measurement (Rz)

Surface roughness, in particular the Rz value, describes the ability of a floor to puncture the hydrodynamic squeeze film. 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 tests carried out in random directions in an area local to the pendulum test. This is in line with UKSRG guidelines.

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 (µm) | Slip Potential |
|----------------|-----------------------|
| <10 | High |
| 10-20 | Moderate |
| >20 | Low |

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



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.

Information required to complete the site assessment is gathered primarily at the time and location of the test 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.

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.



Test Equipment

Munro Portable Skid Tester

Serial No: 0852
 Calibrated by: BSI Product Services
 Calibration date: 19/03/10
 Certificate No: 3859
 Calibration due: 19/03/11

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: 15306
 Calibrated by: Munro Stanley London
 Calibration date: 27/01/10
 Certificate No: 63540
 Disposal date: 27/01/11

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: 15377
 Calibrated by: Munro Stanley London
 Calibration date: 06/04/10
 Certificate No: 63645
 Disposal date: 30/03/11

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: 08/04/10
 Certificate No: 121087
 Calibration due: 08/04/11

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: | 62 | 62 | 62 | 63 | 63 | 62 | 63 ±1 |
| Float glass: | 6 | 6 | 7 | 7 | 7 | 7 | 5 to 10 |

Surface Roughness tested value: 21.5 µm
 Surface roughness expected value: 21.5 µm

Please note that all calibration certificates are available on request.



Test Results

GripCote

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

Date of test: 11/05/10
 Flooring type: Anti-slip treatment
 Application: Unknown

Image 1. Test surface

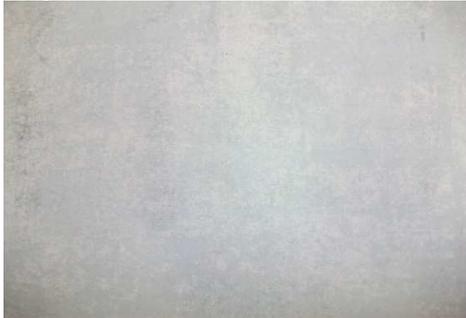


Image 2. Test surface



Pendulum Test Results

Slider #96 (4S)

| Direction | Condition | PTV | | | | | Mean |
|-------------------------|-----------|-----|----|----|----|----|------|
| Principal | Dry | 63 | 64 | 63 | 63 | 63 | 63 |
| 45° | | 62 | 62 | 62 | 62 | 62 | 62 |
| 90° | | 61 | 63 | 62 | 63 | 63 | 62 |
| Mean dry PTV: 63 | | | | | | | |
| Principal | Wet | 51 | 51 | 51 | 51 | 51 | 51 |
| 45° | | 52 | 52 | 52 | 52 | 52 | 52 |
| 90° | | 53 | 52 | 52 | 52 | 51 | 52 |
| Mean wet PTV: 52 | | | | | | | |

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 3, November 2005.

Surface Roughness (Rz) Results

| Sample | Rz (µm) |
|-------------|-------------|
| 1 | 40.9 |
| 2 | 54.2 |
| 3 | 24.2 |
| 4 | 14.4 |
| 5 | 26.3 |
| 6 | 19.2 |
| 7 | 58.6 |
| 8 | 40.9 |
| 9 | 33.0 |
| 10 | 43.5 |
| Mean | 35.5 |

Wet PTV: 52 Rz Value: 35.5

Assuming linear relationship between surface roughness in microns and pendulum test values, the following can be used **as a guide** when monitoring surface roughness of the test surface.

| Rz Value (µm) | Indicative Slip Risk |
|---------------|----------------------|
| ≥ 25 | Low |
| < 25 | Moderate |
| < 17 | High |

Surface roughness measurements on this sample do not indicate a directional profile.



Test Results

SafeGrip

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

Date of test: 11/05/10
 Flooring type: Anti-slip treatment
 Application: Unknown

Image 1. Test surface



Image 2. Test surface



Pendulum Test Results

Slider #96 (4S)

| Direction | Condition | PTV | | | | | Mean |
|-------------------------|-----------|-----|----|----|----|----|------|
| Principal | Dry | 64 | 64 | 64 | 64 | 64 | 64 |
| 45° | | 63 | 63 | 63 | 63 | 63 | 63 |
| 90° | | 62 | 62 | 62 | 62 | 62 | 62 |
| Mean dry PTV: 62 | | | | | | | |
| Principal | Wet | 50 | 50 | 50 | 51 | 51 | 50 |
| 45° | | 49 | 49 | 49 | 49 | 50 | 49 |
| 90° | | 48 | 48 | 48 | 48 | 49 | 48 |
| Mean wet PTV: 49 | | | | | | | |

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 3, November 2005.

Surface Roughness (Rz) Results

| Sample | Rz (µm) |
|-------------|------------|
| 1 | 8.3 |
| 2 | 6.8 |
| 3 | 12.4 |
| 4 | 6.6 |
| 5 | 6.3 |
| 6 | 7.9 |
| 7 | 7.5 |
| 8 | 5.8 |
| 9 | 6.9 |
| 10 | 6.3 |
| Mean | 7.5 |

Wet PTV: 49 Rz Value: 7.5

Assuming linear relationship between surface roughness in microns and pendulum test values, the following can be used **as a guide** when monitoring surface roughness of the test surface.

| Rz Value (µm) | Indicative Slip Risk |
|---------------|----------------------|
| ≥ 5 | Low |
| < 5 | Moderate |
| < 4 | High |

Surface roughness measurements on this sample do not indicate a directional profile.



Conclusion

| GripCote | Result |
|--------------------------------------------|---------------|
| Pendulum (BS 7976) in dry conditions | Low Slip Risk |
| Pendulum (BS 7976) in water wet conditions | Low Slip Risk |
| Current Rz reading | 35.5 |
| Estimated Rz threshold for low slip risk | 25 |
| Current risk management strategies | n/a |

Table 1. Results from various assessment measures employed

| SafeGrip | Result |
|--------------------------------------------|---------------|
| Pendulum (BS 7976) in dry conditions | Low Slip Risk |
| Pendulum (BS 7976) in water wet conditions | Low Slip Risk |
| Current Rz reading | 7.5 |
| Estimated Rz threshold for low slip risk | 5 |
| Current risk management strategies | n/a |

Table 2. Results from various assessment measures employed

In the opinion of Grip Potential Ltd, both samples under test demonstrated a low risk of slip in dry conditions and a low risk of slip in water wet conditions.

The GripCote sample incorporates a micro-grit, increasing surface roughness. An increased surface roughness serves to provide better penetration of the hydrodynamic squeeze film generated in a contaminated slip, securing floor/sole contact and increasing available friction.

Generally, an increase in the micro-roughness of a surface is the most effective way to increase slip resistance. Steps must be taken in order to preserve this roughness or the associated slip resistance will suffer. Wear should be carefully monitored, if the grit becomes excessively smoothed or worn it will no longer puncture the fluid film. Cleaning regimes should be effective at removing dirt. A build up of dirt serves to fill gaps between peaks, effectively smoothing the surface. The cleaning regime should include periodic deep cleaning incorporating mechanical aggravation of the surface.

The SafeGrip sample features a treatment that alters the surface of the tile. Limitations of the Rz measurement mean that two surfaces with different shaped profiles can have the same Rz value. Given the low surface roughness of this sample it is expected that changes have taken place in the shape, rather than height, of peaks. The hydrodynamic squeeze film is still effectively dispersed, providing good grip in wet conditions.

As the SafeGrip sample does not feature an increased surface roughness it is unlikely to suffer from wear or poor cleaning in the same way as a micro-grit surface. The smoother finish also facilitates an easier cleaning process.

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

12/05/10