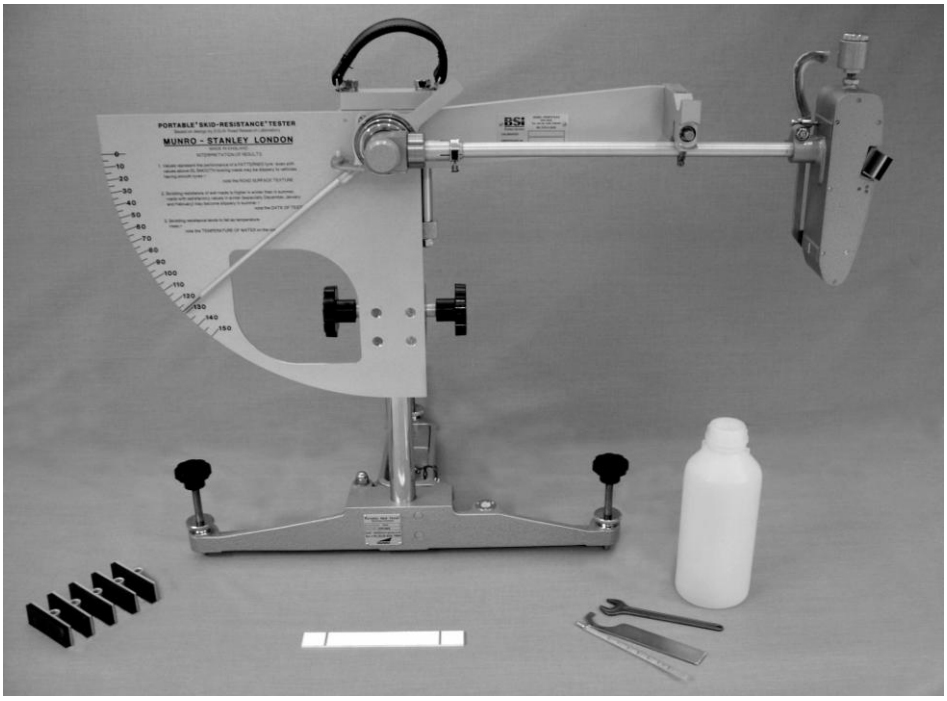


Portable Skid Resistance Tester

(Also known as the British Pendulum Tester)

The Portable Skid Resistance Tester, also known as the British Pendulum Tester, was originally designed in the 1940's by Percy Sigler to measure the slip resistance of floors in government buildings. During the late 1950's the instrument was adopted and redesigned by the then Road Research Laboratory (RRL, now known as the Transport Research Laboratory, TRL). Although basically unchanged, W F Stanley, now part of the Munro Group and known today as Munro Stanley London, has continually refined and improved the original design since production began in the 1960's. Still used to study problems in design and maintenance of public highways, the Portable Skid Resistance Tester is today also utilised to test the frictional resistance of new roads, road markings and iron works.

Research by the Health and Safety Executive (HSE) has identified that in excess of 90% of the slipping accidents in the UK occur on wet floors, most usually, on relatively smooth floors. The Portable Skid Resistance Tester is regularly used to test the slip resistance on pedestrian walkways and flooring, within offices, shopping malls, factories, airports, and on sports surfaces; both at the design stage and in the investigation of accidents.

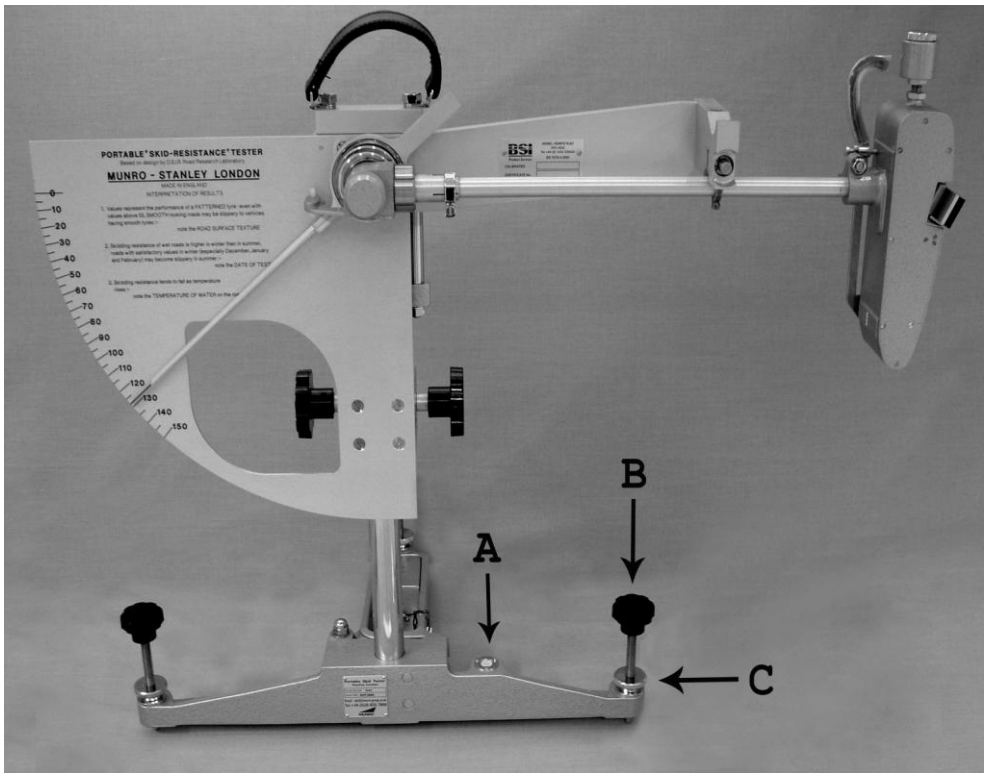
The Portable Skid Resistance Tester is based on the Izod principle. In operation, a pendulum of a known mass rotates about a vertical spindle. The head of the pendulum is fitted with a Rubber Slider, which has a specific hardness and resilience. When released from a horizontal position, the pendulum head strikes the sample surface with a constant velocity. The distance travelled by the pendulum after striking the sample, is determined by the friction resistance of the sample surface. The skid resistance values, which, approximately correspond to the co-efficient of friction times 100, are read directly from the clearly engraved scale.

1.0 Assemble the Tester

1.1 Remove the main body of the instrument from the Transit Case and fasten the hinged Rear Leg into position using the spanner provided.

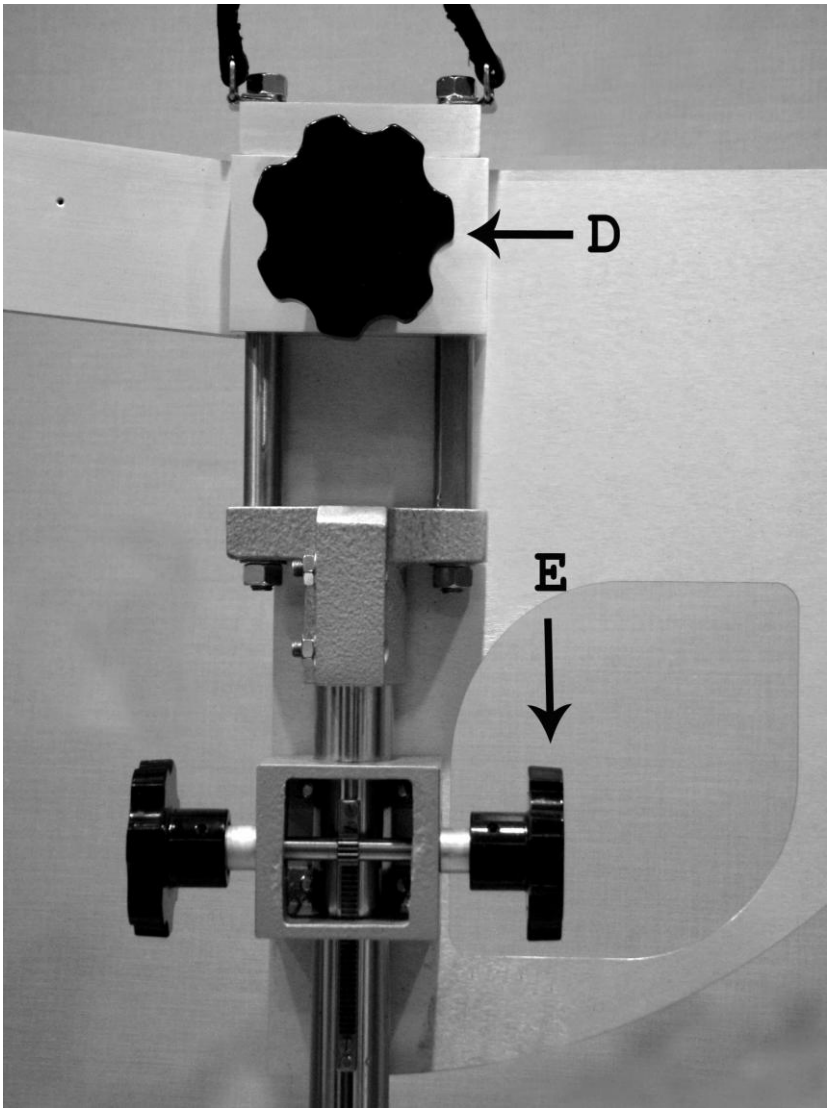
1.2 Attach the Pendulum Arm to the Rotating Head, ensuring that the location pin is engaged. Tighten the adaptor nut using the special spanner provided.

1.3 Select the surface area to be tested. Set the Tester level by means of the spirit level **"A"** and the three levelling screws **"B"** on the base frame. Knurled spring-loaded locking nuts **"C"** are provided to allow adjustment of the levelling screw tension. On soft flooring surfaces, spreader pads should be installed under the apparatus feet. The tester may be used on a sloping surface provided that the slope can be accommodated within the adjustment range of the levelling screws. When testing samples in the laboratory, a Laboratory Base-Plate is required which should be secured to a rigid horizontal surface. Set the Pendulum Tester on the Laboratory Base-Plate in the correct position using the clamps provided.

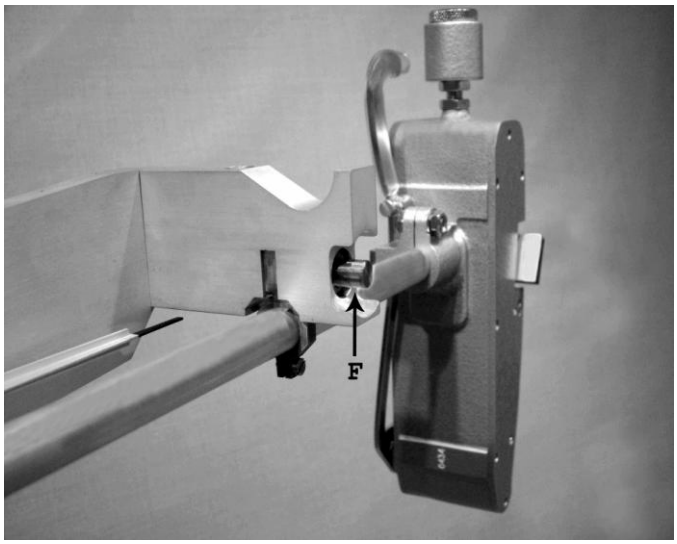


2.0 Setting the Tester

2.1 Raise the Head Unit so that the Pendulum Arm swings clear of the surface. Movement of the Head Unit of the Tester - carrying the Pendulum Arm, Graduated Scale, Pointer, and Release Mechanism - is controlled by a Rack and Pinion on the rear of the Vertical Column. After unclamping the Locking Knob **"D"** at the rear of the Vertical Column, the Head Unit may be raised or lowered by turning either of the Vertical Movement Control Knobs **"E".** When the required height is obtained, the Head Unit must be locked into position again by clamping the Locking Knob **"D".**

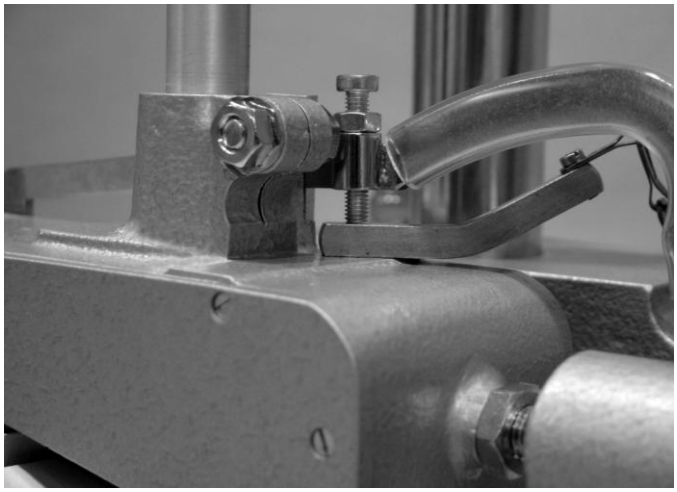


2.2 Check the zero setting. Raise the Pendulum Arm to the horizontal release position on the right hand side of the apparatus. In this position it is automatically locked in the Release Catch. The Pointer is then brought round to its stop in line with the Pendulum Arm. The Pendulum Arm is released by pressing button **"F"**. The Pointer is carried with the Pendulum Arm on the forward swing only. Catch the Pendulum Arm on its return swing and note the Pointer reading. Return the Pendulum Arm to the release position.

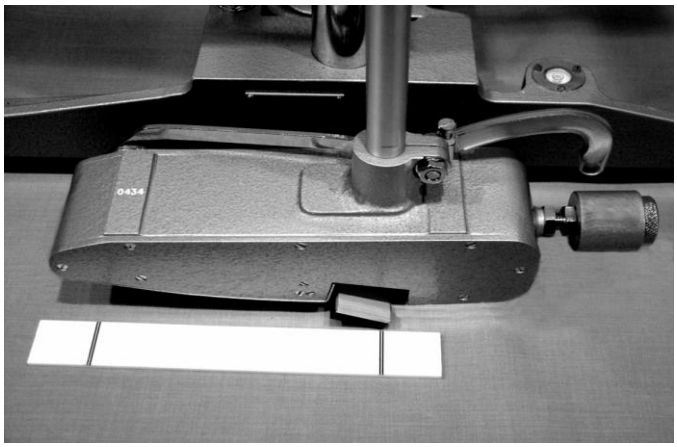


2.3 Correct the zero setting as necessary by adjustment of the Knurled Friction Rings **"G"**. If the Pointer has swung past the zero position, Friction Rings **"G"** are screwed up a little more tightly. If it has not reached zero the Knurled Friction Rings **"G"** should be unscrewed a little. Repeat this procedure until three consecutive zero readings are obtained. **Note**: There are two Knurled Friction Rings; the outer Friction Ring must be unlocked before the inner Friction Ring can be adjusted.

2.4. With the Pendulum Arm free and hanging vertically, place the Spacer, which will be found attached by a chain to the Base Rear Leg, under the Lifting Handle Setting-Screw to raise the Rubber Slider. Unclamp the Locking Knob **"D"** and lower the Head Unit of the Tester using Vertical Movement Control Knobs **"E"**, until the Rubber Slider just touches the test surface across its width, then clamp in position with Locking Knob **"D"**. Remove the Spacer. The approximate sliding length has now been set.



2.5. To accurately set the sliding length of the conditioned Rubber Slider over the surface under test, gently lower the Pendulum Arm until the Rubber Slider just touches the surface first on one side and then on the other side of the vertical. The sliding length is the distance between the two points where the working edge of the Rubber Slider touches the test surface. To prevent undue wear of the Rubber Slider when moving the Pendulum Arm through the arc of contact, the Rubber Slider should be raised off the test surface by means of the Lifting Handle. If necessary, adjust to the correct length by raising or lowering the Head Unit slightly. When the apparatus is set correctly, the sliding length, measured with the Perspex Setting Gauge provided, should be between **125 mm** and **127 mm** for a site test, and **76 mm** for a laboratory test. **Note** : The outer marks on the Perspex Setting Gauge are 127 mm apart and the inner marks indicate the 2 mm tolerance allowed.



2.6. Place the Pendulum Arm in its release position. The Tester is now set ready for operation.

3.0 Rubber Sliders

Two types of Rubber Slider are available for testing surfaces using the Main Graduated Scale. The **TRL** (Transport Research Laboratory) Rubber Slider is commonly used on surfaces where the general roughness is greater than that normally found with internal flooring situations. For testing most internal flooring materials, those with a roughness of less than 15µm Rz, then it is customary to use the **Four S** (Standard Simulated Shoe Sole) Rubber Slider. We strongly recommend that you consult the applicable standard before choosing a Rubber Slider.

3.1. TRL Large Rubber Slider

Mounted on a backing plate, this 76mm wide slider is used mainly on roadways or other surfaces where the general roughness is considered greater than normally found with internal flooring situations. Each Rubber Slider is provided with a certificate confirming the Hardness and Resilience.

Temperature °C	**0**	**10**	**20**	**30**	**40**
Lüpke resilience	43 - 49	58 - 65	66 - 73	71 - 77	74 - 79
IRHD hardness	55± 5	55± 5	55± 5	55± 5	55± 5

3.2 Four S Rubber Slider

Mounted on an aluminium backing plate, this 76mm wide slider is most commonly used for tests on internal flooring materials. Each Rubber Slider is provided with a certificate confirming the Hardness and Resilience.

Temperature °C	**5**	**23**	**40**
Lüpke resilience	21± 2	24± 2	28± 2
IRHD hardness	96± 2	96± 2	96± 2

3.3 TRL Small Slider

This 30mm wide slider is used for the Polished Stone Value (PSV) Test and is used in conjunction with the Detachable Scale and Laboratory Baseplate. Each Rubber Slider is provided with a certificate confirming the Hardness and Resilience.

Temperature °C	**0**	**10**	**20**	**30**	**40**
Lüpke resilience	43 - 49	58 - 65	66 - 73	71 - 77	74 - 79
IRHD hardness	55± 5	55± 5	55± 5	55± 5	55± 5

3.4 Slider Rubber Storage

Rubber Sliders are generally considered to have a shelf life of 12 months and should be stored in the dark with a constant environment, preferably below 15°C.

3.5 Slider Preparation

The Rubber Slider should always be clean and free from contamination, such as oil or abrasive. Preparation of the Rubber Slider is important and should be carried out in accordance with the standard being used. However, if no relevant standard exists, we suggest the following procedure to prepare new, or restore existing, Rubber Sliders.

3.6 TRL Rubber Sliders (New)

a) Fix a sheet of 400 grade silicon carbide resin bonded paper to the cleaned face of a piece of hard flat and robust material. The material must also be smooth, so glass or polished metals are ideal and should have a surface area measuring 150mm X 200mm.

b) Examine the Rubber Slider for damage or contamination.

c) Assemble and set the Tester as described in sections **1** and **2.**

d) This procedure may be carried out in either wet or dry conditions. Release the Pendulum Arm by pressing Button **"F"** allowing the Rubber Slider to swing over the 400 grade silicon carbide resin bonded paper. Repeat this procedure until ten swings have been completed. The Rubber Slider is now ready for use.

3.7 Four S Rubber Sliders (New)

a) Complete the procedure for TRL Rubber Sliders as described above.

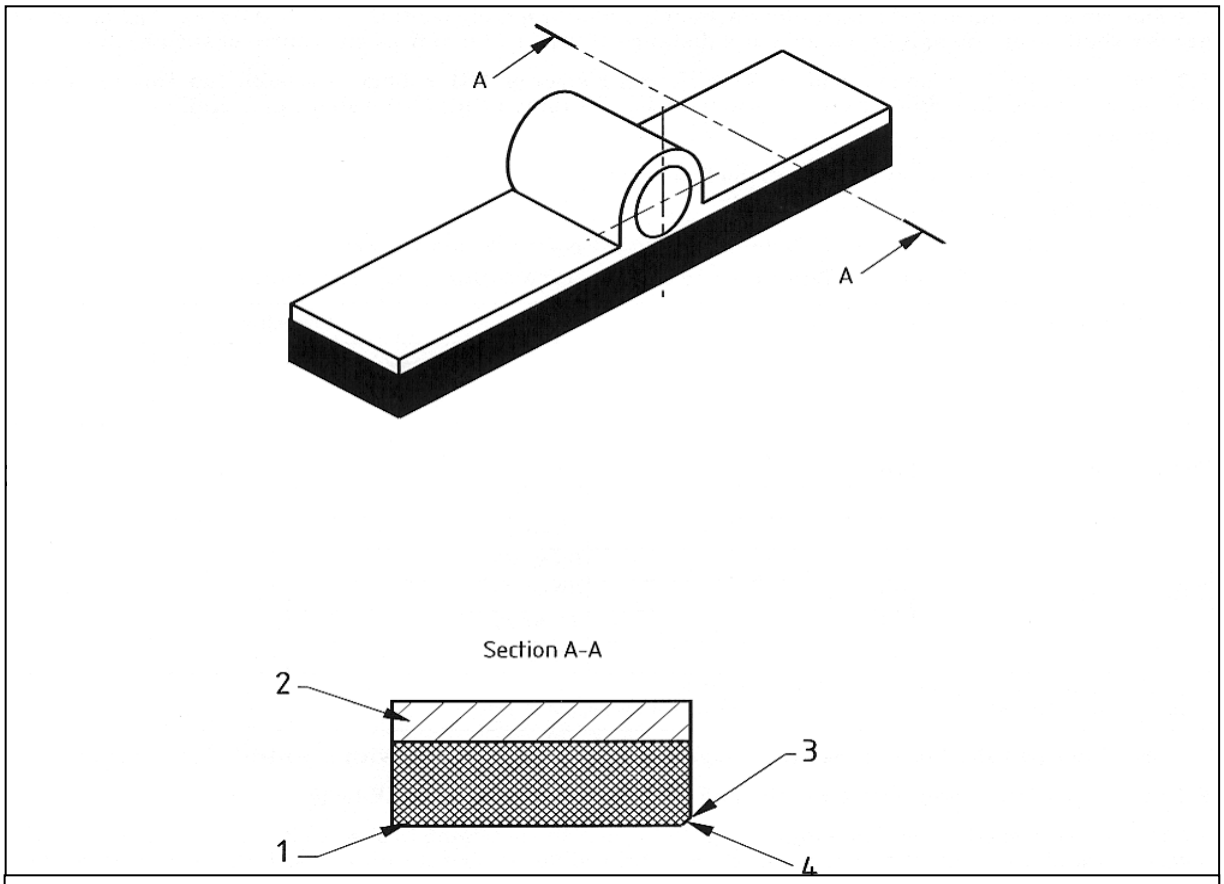
b) Fix a sheet of 3M 261X Imperial Lapping Film Grade 3MIC or an equivalent to the cleaned face of a piece of hard flat and robust material. The material must also be smooth, so glass or polished metals are ideal and should have a surface area measuring 150mm X 200mm. The sheet should be fixed to the plate across one edge only, enabling the rubber slider to make contact with at least 127 mm of the attached sheet.

c) **This part of procedure must be carried out in wet conditions**. Release the Pendulum Arm by pressing Button **"F"** allowing the Rubber Slider to swing over the 3M 261X Imperial Lapping Film Grade 3MIC. Repeat the procedure until twenty swings have been completed. The Rubber Slider is now ready for use.

3.8 Reconditioning of worn Rubber Sliders

The worn or damaged working edge of a Rubber Slider can be reconditioned by

following the procedure described in section **3.6.** Usually a minimum of three swings over the 400 grade silicon carbide resin bonded paper is sufficient to restore a **TRL Rubber Slider**, with a further twenty swings over the 3M 261X Imperial Lapping Film Grade 3MIC, described in section **3.7**, required to restore the **Four S Rubber Slider.**



Mounted Rubber Slider

(1) Rubber Slider Pad (2) Aluminium Mounting Plate

(3) Working Edge (4) Worn Width

Note : When the width of the working edge of the Rubber Slider exceeds 4mm, this edge shall no longer be used. The edge should be suitably disfigured to prevent its further use. Once both working edges have exceeded 4mm the Rubber Slider should be discarded.

4.0 Road Surface Tests

(Road Surface Testing is usually carried out in accordance with Road Note 27)

4.1 Inspect the road and choose the section to be tested.

4.2 Assemble and set the Tester as described in **1 & 2.**

4.3 Set the Tester on the road surface in the track to be tested so that the Rubber Slider swings in the direction of the traffic. Condition the slider by swinging it five times across the dry road surface. On surfaces bearing a regular pattern such as ridged or brushed concrete, tests should be made with the conditioned Rubber Slider operating at 80° to the ridges. Take the mean of five readings, as above, at each of five locations in the test track (usually the near side wheel-track) spaced at approximately 5 to 10 metre intervals along the length under test. The mean of these readings gives a representative value of the skidding resistance of the road.

4.4 The slipperiness of some roads varies considerably across the width of the road and sometimes the crown of the road is the most slippery part. Where this is suspected, tests should also be made on the crown of the road.

4.5 Gradients

The Tester is capable of performing tests on steep gradients and in the presence of crossfall. On gradients, the above procedure is followed and, although the sliding length is slightly displaced from the central position, there is no change in the load between Rubber Slider and test surface and no appreciable change in the speed of sliding. Therefore, the instrument operates correctly whether tests are performed uphill or downhill. Sufficient levelling adjustment is available for testing on gradients of up to I in 10 (5.7°). Inserting a spacer under one screw allows the Tester to be used on steeper gradients.

4.6 Factors affecting results

Like all skidding machines, the Portable Skid Resistance Tester can only be used to the best advantage with a full knowledge of the factors influencing skidding resistance, and results must be interpreted with due consideration for all conditions obtained at the time of the tests. The main factors influencing skid resistance are outlined below: -

a) The measurement obtained by the Portable Skid Resistance Tester has been termed 'Skid Resistance'. It is intended to correlate with the performance of a vehicle having patterned tyres, braking with locked wheels, on

a wet road at 50 Km/hr. The order of merit of road surfaces can change substantially between 50 and 130 Km/hr. Thus, Skid Resistance values, which represent the 50 Km/hr value, cannot alone be expected to give an indication of high-speed performance. The fall-off in Skidding Resistance with increased speed on wet roads depends on the roughness of surface macro-texture, and is considerably less on rough surfaces than on smooth ones.

If the tester is used on high-speed roads, an additional criterion indicating texture is required. Because the Portable Skid Resistance Tester indicates the performance of patterned tyres at relatively low speeds, it is important to record the surface texture or appearance of each road surface tested. On roads where speeds are low it is sufficient to classify the texture from visual inspection. Typical surface classifications are:-

Rough Textured Surfaces

Where tyre tread pattern would have a negligible effect. Smooth and patterned tyres would generally be equally effective on these surfaces.

Medium Textured Surfaces

Where some tread pattern effect would exist. Vehicles having smooth tyres would experience a skidding resistance slightly lower than the value indicated by the tester.

Smooth Textured Surfaces

Where the effect of tread pattern may be large.

On roads where speeds are high, a simple measure of surface texture, the 'texture depth', may be determined by the 'sand patch' method: A known volume of fine sand is poured in a heap on the road, and spread to form a circular patch so the small valleys on the road are filled to the level of the peaks. The 'texture depth' is the ratio of the volume of sand to the area of the patch (calculated from the measured radius).

Suggested Minimum Skid Resistance Values (Wet Conditions)

Category	Type of Site	Minimum "Skid Resistance" Value (Surface Wet)
A	Difficult sites such as:- (i) Roundabout (ii) Bends with radius less than 150 m on unrestricted roads (iii) Gradients, 1 in 20 or steeper, of lengths > 100 m (iv) Approaches to traffic lights on unrestricted roads	65

B	Motorways, trunk and class 1 roads and heavily trafficked roads in urban areas (carrying more than 2000 vehicles per day)	55
C	All other sites	45

b) In general the skidding resistance of wet roads is higher in winter than in summer. The magnitude of the variation depends on:-

I. Road layout and traffic conditions

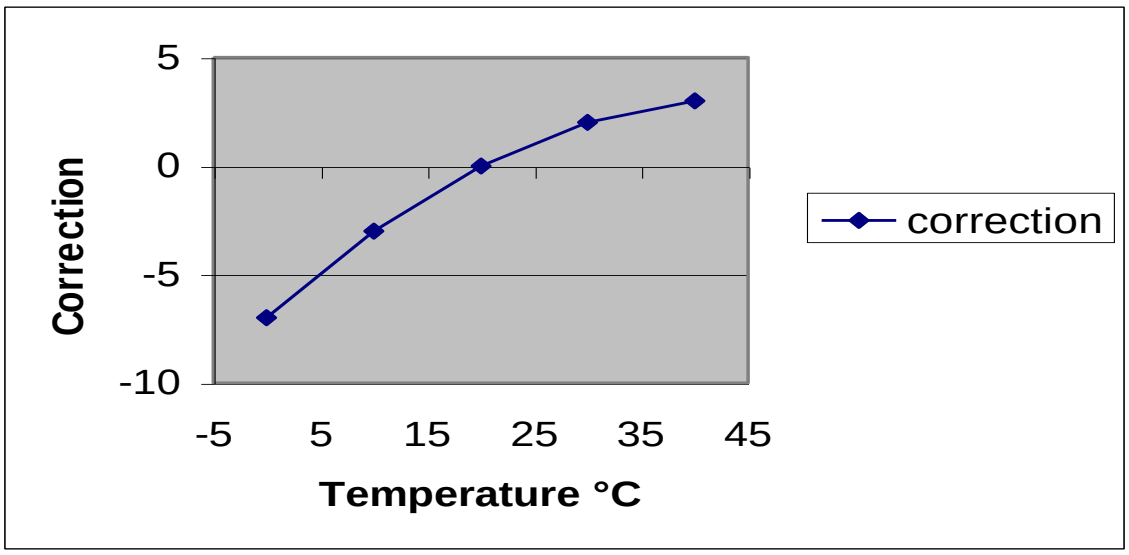
II. Road surface characteristics

III. The weather

It varies considerably from one road to another, so that it is not possible to predict the skidding resistance at one time of year from a single measurement made at another time. It is also important to note that roads with satisfactory values in winter (especially in December, January and February) may prove slippery during the summer. The date of the test should, therefore, always be recorded.

c) The effect of temperature on rubber resilience exerts a perceptible influence in all "Skidding Resistance" measurements; it shows itself as a fall on "Skidding Resistance" as the temperature rises. In addition, the magnitude of the variation of "Skidding Resistance" with temperature varies considerably from road to road, mainly because of the changes in road surface texture. The effect of temperature only becomes important for tests made at temperatures below 10°C, and then its main use is to give a more accurate assessment of the "Skidding Resistance" which the road is likely to offer to the tyres of vehicles, since they are likely to be running at temperatures rather higher than that of the slider rubber on the portable tester.

d) To help in interpreting results, therefore, the temperature of the water lying on the road immediately after the test should be recorded. It must be stressed, however, that the change in state of polish of road surfaces throughout the year is a much bigger factor determining changes in 'Skid Resistance' than is the change in temperature; the latter accounts for about 25% of the total change in 'Skid-Resistance', which is primarily due to real and reversible changes in the road surface.



e) Owing to variations in skidding resistance across the width of the road, care should be taken in choosing the track to be tested; the actual position should be recorded for future reference.

4.7 Texture Depth. Sand Patch Method

Apparatus and material

a) Dividers to measure 20 cm. Radius

b) Millimetre rule

c) Cylinder 8cm high, with an internal diameter of 2cm.

d) Flat wooden disk of 6.5cm diameter, with a hard rubber disc, of 1.5mm thickness, of the same diameter stuck to one face. A handle should be fixed to the wooden face.

e) A 250 cc plastic container to hold sand.

f) A soft hand brush.

g) Sand which will pass a No 52 BS sieve and be retained on a No.100 BS sieve. Natural sand with a round particle shape should be used.

Test procedure

The surface to be measured must be dry and should be first swept with a soft brush.

Fill the cylinder with sand. When full gently tap the base of the cylinder three times on the road surface, and then top up and level the top with a straight edge. Pour the sand in a heap on the surface to be tested.

In windy conditions use a tyre to surround the sand.

Spread the sand over the surface, using the disc in a circular motion, levelling the sand into a circular pattern.

Measure the radius of the patch (using dividers). Make a number of tests parallel to the kerb.

Calculation of Texture Depth

Formula $TD = \frac{V.}{\pi R^2}$

V = Volume of Cylinder

R = Radius of Patch

TD = Texture Depth

5.0. Testing Internal Floor Surfaces

As the tests on internal flooring surfaces normally deal with pedestrian traffic, accordingly, skid will be referred to as slip, throughout this section.

Testing should be carried out in accordance with the relevant standard or guidelines. However, where no standard or guidelines exist, we suggest the following procedure.

5.1 Scope

This section covers the procedure for the on site measurement of slip resistance of floors and flooring materials used by pedestrians. This procedure may not be appropriate for all sports surfaces, those used by vehicular traffic or surfaces with a gross profile comparable in dimensions with those of the Rubber Slider. The main parameters of consideration are the friction in wet or contaminated conditions between the Rubber Slider and the floor surface and the roughness of the flooring material. The methods described apply only to horizontal floors that are approximately flat, and are not recommended for ramps or steps. Allowance for surface texture or where there is a slight run-off in level is made by taking measurements in three different directions – see diagram. Profiled or uneven floors often present a problem and, in certain instances, an unrealistic slip resistance value may be recorded. In all cases it is imperative that proper contact between the working edge of the Rubber Slider and the test surface are maintained throughout the contact length.

5.2 Apparatus

Portable Slip Resistance Tester

Rank Taylor Hobson Surtronic 10 Roughness Meter

5.3 Selection of a Test Site

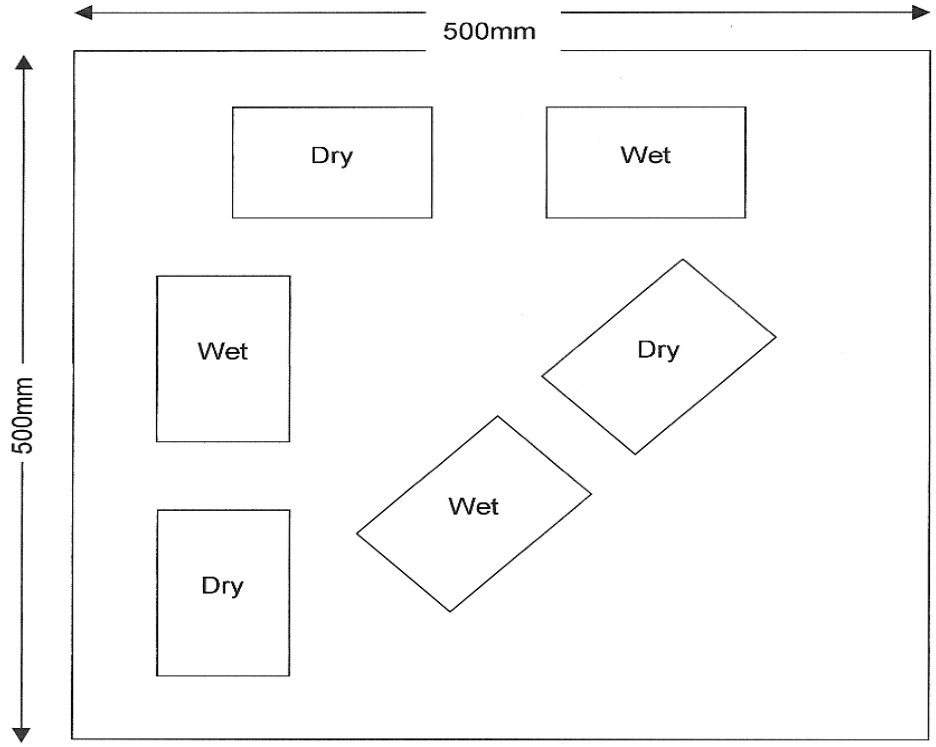
A wide variety of conditions of use should be included. For example, a doorway subjected to heavy traffic, an area close to a source of contamination, such as a vending machine, and finally, a little used area in a corner or behind a door.

If there has been an accident, then results relating to the accident site are best obtained within as short a time as possible, and preferably before any cleaning has been carried out. Where this is not possible, it must be clearly stated in the report that conditions at the test site may not be the same as those which existed at the time of the accident.

5.4 Test Areas

At least six test areas 150 mm x 100 mm or greater are required to accommodate wet and dry measurements.

Note : Each test area should be used only once.



5.5 Roughness Measurements

Surface roughness can bring about an improvement in slip resistance in wet conditions. Irregularities can break up a water film, establishing contact with the shoe sole or heel. In this regard peaks are more helpful than troughs. The measurement of the various aspects of surface roughness is complex, but it has been established empirically that a measure of peak to trough roughness, Rz, is itself a useful guide to slip resistance.

Research has suggested that hard floors need to have a higher Rz roughness than polymeric floors for the same degree of safety in wet conditions, but whatever flooring material is used an Rz roughness value of at least 10 µm is needed. In circumstances where wetness is normal or expected, this figure may need to be significantly increased. High Slip Resistance Tester and roughness readings generally indicate a satisfactory floor. Conversely, low Slip Resistance Tester and roughness readings, indicate an unsatisfactory floor when wet. To allow for surface texture, measurements are taken in three different directions.

5.6 Profiled Floors

Floor surfaces intended for installation in wet areas, such as swimming pool surrounds or floors intended for use in heavily contaminated areas are often profiled. The profiling serves two purposes, firstly it helps to drain water away and secondly, it enables soft shoe sole/heel materials or bare feet to deform and obtain a better grip.

While, in general, profiled floors in wet or contaminated conditions are safer than flat floors, this is not universally the case. Some profiled floors with rounded corners on the profiling and no degree of surface roughness can be very slippery in wet conditions. Direct measurement of friction on profiled surfaces is more difficult than on flat surfaces. Results depend on the size of the raised profile areas and the ratio of high to low areas (distance apart of raised blocks).

5.7 Sliders

Two types of Rubber Slider are available for testing surfaces using the Main Graduated Scale. The **TRL** (Transport Research Laboratory) Rubber Slider is commonly used on surfaces where the general roughness is greater than that normally found with internal flooring situations. For testing most internal flooring materials, those with a roughness of less than 15µm Rz, then it is customary to use the **Four S** (Standard Simulated Shoe Sole) Rubber Slider. We strongly recommend that you consult the applicable standard before choosing a Rubber Slider.

5.7.1 TRL Large Rubber Slider

Mounted on a backing plate, this 76mm wide slider is used mainly on roadways or other surfaces where the general roughness is considered greater than normally found with internal flooring situations. Each Rubber Slider is provided with a certificate confirming the Hardness and Lupke Resilience.

Temperature °C	**0**	**10**	**20**	**30**	**40**
Lüpke resilience	43 - 49	58 - 65	66 - 73	71 - 77	74 - 79
IRHD hardness	55± 5	55± 5	55± 5	55± 5	55± 5

5.7.2 Four S Rubber Slider

Mounted on an aluminium backing plate, this 76mm wide slider is most commonly used for tests on internal flooring materials. Each Rubber Slider is provided with a certificate confirming the Hardness and Lupke Resilience.

Temperature °C	**5**	**23**	**40**
Lüpke resilience	21± 2	24± 2	28± 2
IRHD hardness	96± 2	96± 2	96± 2

5.7.3 Slider Preparation

The Rubber Slider should always be clean and free from contamination, such as oil or abrasive. Preparation of the Rubber Slider is important and should be carried out in accordance with the standard being used. However, if no relevant standard exists, we recommend the following procedure to prepare new, or restore existing, Rubber Sliders.

5.7.4 TRL Rubber Sliders (New)

a) Fix a sheet of 400 grade silicon carbide resin bonded paper to the cleaned face of a piece of hard flat and robust material. The material must also be smooth, so glass or polished metals are ideal and should have a surface area measuring 150mm X 200mm.

b) Examine the Rubber Slider for damage or contamination.

c) Assemble and set the Tester as described in sections **1** and **2.**

d) This procedure may be carried out in either wet or dry conditions. Release the Pendulum Arm by pressing Button **"F"** allowing the Rubber Slider to swing over the 400 grade silicon carbide resin bonded paper. Repeat this procedure until ten swings have been completed. The Rubber Slider is now ready for use.

5.7.5 Four S Rubber Sliders (New)

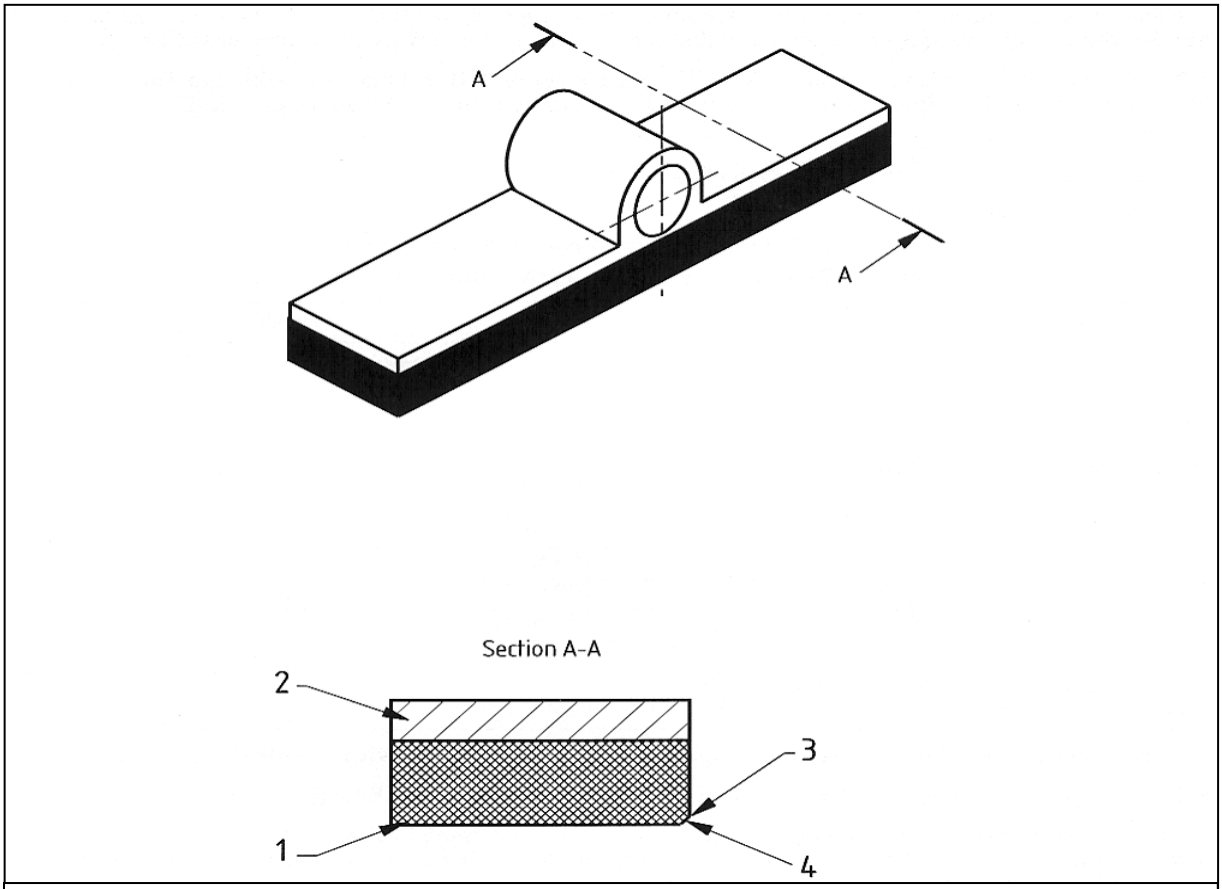
a) Complete the procedure for TRL Rubber Sliders as described above.

b) Fix a sheet of 3M 261X Imperial Lapping Film Grade 3MIC or an equivalent to the cleaned face of a piece of hard flat and robust material. The material must also be smooth, so glass or polished metals are ideal and should have a surface area measuring 150mm X 200mm. The sheet should be fixed to the plate across one edge only, enabling the rubber slider to make contact with at least 127 mm of the attached sheet.

c) **This part of procedure must be carried out in wet conditions**. Release the Pendulum Arm by pressing Button **"F"** allowing the Rubber Slider to swing over the 3M 261X Imperial Lapping Film Grade 3MIC. Repeat the procedure until twenty swings have been completed. The Rubber Slider is now ready for use.

5.7.6 Reconditioning of worn Rubber Sliders

The worn or damaged working edge of a Rubber Slider can be reconditioned by following the procedure described in section **3.6.** Usually a minimum of three swings over the 400 grade silicon carbide resin bonded paper is sufficient to restore a **TRL Rubber Slider**, with a further twenty swings over the 3M 261X Imperial Lapping Film Grade 3MIC, described in section **3.7** required to restore the **Four S Rubber Slider.**



Mounted Rubber Slider

(1) Rubber Slider Pad (2) Aluminium Mounting Plate

(3) Working Edge (4) Worn Width

Note : When the width of the working edge of the Rubber Slider exceeds 4mm, this edge shall no longer be used. The edge should be suitably disfigured to prevent its further use. Once both working edges have exceeded 4mm the Rubber Slider should be discarded.

5.8 Assemble and Set

Assemble and set the Tester as described in sections **1** and **2**

5.9 Testing - Dry Conditions

1. Using the Thermometer provided, measure and record to the nearest degree, the temperature of the test surface. Unless testing the “as-found” state, thoroughly clean and dry the test surface. **Note:** It is important that both the test surface and the Rubber Slider are completely dry for the test, as even a small amount of water can adversely affect the readings.

2. Place the Pendulum Arm in the release position so that it is held by the Release Catch. Bring Pointer round to its stop. Release the Pendulum Arm by pressing button **“F”** and catch it on its return swing, before the Rubber Slider strikes the test surface. Note the reading indicated by the Pointer.

3. Keeping the Slider clear of the test surface by means of the lifting handle, return the Pendulum Arm to the release position and bring the Pointer round to its stop. Repeat to give eight readings. Record all the readings obtained or as described by the appropriate standard.

4. After conducting the tests, raise the Head Unit of the Tester so that it swings clear of the test surface and check the zero setting for error. If the zero setting is incorrect, adjust as described in **2.3.** Repeat the test procedure and again check the zero setting. If the zero setting is again incorrect, the instrument must be taken out of service.

5.10 Wet Conditions

1. Using the Thermometer provided, measure and record to the nearest degree, the temperature of the test surface. Unless testing the “as-found” state, thoroughly clean the test surface.

2. Place the Pendulum Arm in the release position such that it is held by the Release Catch. Bring Pointer round to its stop.

3. Using distilled or potable water thoroughly wet the surface to be tested. Ensure that the entire area that will be in contact with the Rubber Slider is wetted.

4. Release the Pendulum Arm by pressing button **“F”** and catch it on its return swing, before the Rubber Slider strikes the test surface. Note the reading indicated by the Pointer.

5. Keeping the Rubber Slider clear of the test surface by means of the Lifting Handle, return the Pendulum Arm to the release position and bring the Pointer round to its stop. Repeat, wetting the test surface between each swing, to give eight readings. Record all the readings obtained or as described by the appropriate standard.

6. After conducting the tests, raise the Head Unit of the Tester so that it swings clear of the test surface and check the zero setting for error. If the zero setting is incorrect, adjust as described in **2.3.** Repeat the test procedure, wetting the test surface between each swing, and again check the zero setting. If the zero setting is again incorrect, the instrument must be taken out of service.

5.11 Calculations and Corrections

Ignore the first three recorded readings, the slip resistance is calculated as the mean of the last five recorded readings, giving the result to the nearest whole number.

When using the TRL Rubber Slider, temperature corrections, as illustrated in the table below, should be applied to the readings.

Note: No temperature correction is applicable for Four-S Rubber Sliders.

Surface temperature °C	**Correction**
8 to 11	**Subtract 3 units**
12 to 15	**Subtract 2 units**
16 to 18	**Subtract 1 units**
19 to 22	**No Correction**
23 to 28	**Add 1 unit**
29 to 35	**Add 2 units**

5.12 Test Reports

The Test Report should contain, as a minimum, the following information:-

a) Number, description and date of the applicable standard

b) Location of the site and a drawing showing the position of the test(s)

c) Description of the surface tested and its condition

d) Whether the test was performed under wet or dry conditions

e) Slider material used and the batch number

f) The Skid value obtained at each position tested

g) Recorded temperature of the test surface

h) Operators name and organisation

5.13 Interpretation of Results

No single measurement or piece of information can be used to assess a flooring surface. All information from instruments, conditions of use and environments should be taken into account before a categorisation is reached.

The Slip Resistance of the floor for able-bodied pedestrians, when tested with the Portable Slip Resistance Tester with a Four S Rubber Slider can be interpreted using the table below. However, as stated, surface roughness must also be considered. A high Slip Resistance reading in dry conditions will often be associated with a low reading in wet conditions. However, in extreme cases, a low reading in dry conditions can be lower than the corresponding result in wet conditions. Therefore, in borderline regions, Rz roughness is an important and perhaps a dominating factor.

Four S Rubber Slider

Potential for Slip	**Slip Resistance Tester Reading**
High	24 and below
Moderate	25 to 34
Low	35 to 64
Extremely Low	65 and above

Roughness values applicable for water wet low activity pedestrian areas.

Potential for Slip	**Rz Surface Roughness**
High	Below 10
Moderate	Between 10 and 20
Low	Between 21 and 30
Extremely Low	Above 31

The above tables refers to the “as found” conditions, to include dry and water wet conditions. The above tables should not be used as a stand-alone assessment guide.

TRL Rubber Slider

Potential for Slip	**Slip Resistance Tester Reading**
High	19 and below
Moderate	20 to 39
Low	40 to 74
Extremely Low	75 and above

The TRL Rubber Slider is more applicable on rough surfaces, such as rough concrete and coarse pavers and those with a roughness of above 30µm Rz. The readings can be interpreted according to the limits established by the GLC in Bulletin No.43.

6.0 Laboratory Testing of Flooring Materials

Testing should be carried out in accordance with the relevant standard or guidelines. However, where no standard or guidelines exist, we suggest the following procedure.

6.1 Scope

This section covers the procedures for the measurement of slip resistance of flooring materials in the laboratory. Allowance for surface texture is made by taking measurements in three different directions. This procedure may not be appropriate for materials, profiled or uneven flooring materials present a problem and in some cases quite unrealistic friction values may be recorded. In some instances, where the surface roughness of the flooring material is below 15µm Rz, a true reading of the wet slip resistance may not be obtained because the surface roughness of the Four S Rubber Slider is greater than that of the flooring material and inhibits the formation of a water film between the Rubber Slider and the flooring material. The main parameters of consideration are the friction in wet or contaminated conditions between the Rubber Slider and the floor surface and the roughness of the flooring material. A truer reading may be obtained by preparing the Four S Rubber Slider on 3µm pink lapping film as described later in this section. In all cases it is imperative that proper contact between the working edge of the Rubber Slider and the test surface is maintained throughout the contact length.

6.2 Apparatus

Portable Slip Resistance Tester

Rank Taylor Hobson Surtronic 10 Roughness meter

6.3 Sliders

Two types of Rubber Slider are available for Laboratory testing of flooring surfaces using the Main Graduated Scale. The **TRL** (Transport Research Laboratory), Rubber Slider is commonly used on surfaces where the general roughness is greater than that normally found with internal flooring situations. For testing most internal flooring materials, those with a roughness of less than 15µm Rz, then it is customary to use the **Four S** (Standard Simulated Shoe Sole) Rubber Slider.

6.3.1 TRL Large Rubber Slider

Mounted on a backing plate, this 76mm wide slider is used mainly on roadways or other surfaces where the general roughness is considered greater than normally found with internal flooring situations. Each Rubber Slider is provided with a certificate confirming the Hardness and Lupke Resilience.

Temperature °C	**0**	**10**	**20**	**30**	**40**
Lüpke resilience	43 - 49	58 - 65	66 - 73	71 - 77	74 - 79
IRHD hardness	55± 5	55± 5	55± 5	55± 5	55± 5

6.3.2 Four S Rubber Slider

Mounted on an aluminium backing plate, this 76mm wide slider is most commonly used for tests on internal flooring materials. Each Rubber Slider is provided with a certificate confirming the Hardness and Lupke Resilience.

Temperature °C	**5**	**23**	**40**
Lüpke resilience	21± 2	24± 2	28± 2
IRHD hardness	96± 2	96± 2	96± 2

6.3.3 Slider Preparation

The Rubber Slider should always be clean and free from contamination, such as oil or abrasive. Preparation of the Rubber Slider is important and should be carried out in accordance with the standard being used. However, if no relevant standard exists, we suggest the following procedure to prepare new, or restore existing, Rubber Sliders.

6.3.4 TRL Rubber Sliders (New)

a) Fix a sheet of 400 grade silicon carbide resin bonded paper to the cleaned face of a piece of hard flat and robust material. The material must also be smooth, so glass or polished metals are ideal and should have a surface area measuring 150mm X 200mm.

b) Examine the Rubber Slider for damage or contamination.

c) Assemble and set the Tester as described in sections **1** and **2.**

d) This procedure may be carried out in either wet or dry conditions. Release the Pendulum Arm by pressing Button **"F"** allowing the Rubber Slider to swing over the 400 grade silicon carbide resin bonded paper. Repeat this procedure until ten swings have been completed. The Rubber Slider is now ready for use.

6.3.5 Four S Rubber Sliders (New)

a) Complete the procedure for TRL Rubber Sliders as described above.

b) Fix a sheet of 3M 261X Imperial Lapping Film Grade 3MIC or an equivalent to the cleaned face of a piece of hard flat and robust material. The material must also be smooth, so glass or polished metals are ideal and should have a surface area measuring 150mm X 200mm. The sheet should be fixed to the plate across one edge only, enabling the rubber slider to make contact with at least 127 mm of the attached sheet.

c) **This part of procedure must be carried out in wet conditions**. Release the Pendulum Arm by pressing Button **"F"** allowing the Rubber Slider to swing over the 3M 261X Imperial Lapping Film Grade 3MIC. Repeat the procedure until twenty swings have been completed. The Rubber Slider is now ready for use.
Reconditioning of worn Rubber Sliders

The worn or damaged working edge of a Rubber Slider can be reconditioned by following the procedure described in section **3.6.** Usually, a minimum of three swings over the 400 grade silicon carbide resin bonded paper is sufficient to restore a **TRL Rubber Slider**, with a further twenty swings over the 3M 261X Imperial Lapping Film Grade 3MIC, described in section **3.7** required to restore the **Four S Rubber Slider.**

6.4. Preparing the Test Sample

Laboratory tests are usually carried out on new flooring products as supplied by the manufacturer or samples of flooring material previously removed from a site. All samples should be placed on a clean flat bench, covered with clean tissue and conditioned at 23±2°C and an ambient humidity for a minimum of 16 hours before testing. At the time of testing it is necessary for the sample to be flat. During testing, the flattened test sample should be securely restrained by the use of adhesive tape, clamps, weights or other means.

6.5 Test Conditions

Initial tests should be performed on the test sample in the "as received" condition. Once these tests are complete, it is then suggested that the surface of the test sample be wiped with a clean, dry industrial towel before proceeding to further tests. Other methods of cleaning the test sample, such as washing, may be used as appropriate to an investigation, or as agreed previously with the manufacturer of the test sample. However, cleaning of the test sample with a solvent should be avoided, unless as recommended by the sample manufacturer as a process for removing a layer of sealer or oil based contaminates.

6.6 Test Areas

At least six test areas 150 mm x 100 mm or larger, as detailed in section **5.4**, are required to accommodate wet and dry measurements in three directions. The required areas may form part of a larger tile or roll. Where six separate test areas are not available due to the size restraints of the test sample, this should be noted in the test report. Where the test sample is grained, it may be necessary to perform additional tests taking into account the direction of the grain. In this situation further test areas will be required.
Note : Each test area should be used only once.

6.7 Assembly and Setting the Tester

Assemble and set the Tester as described in sections **1** and **2.** On soft test samples, such as certain flooring materials, spreader pads should be installed

under the feet of the Tester. In all cases, any possible movement of the Tester should be overcome by placing a weight in excess of 6kg, across the rear foot.

6.8 Test Procedure - Dry

1. Using the Thermometer provided, measure and record to the nearest degree, the temperature of the test surface. Unless testing the “as received” state, clean the surface with a dry clean industrial towel. **Note: It is important that both the test surface and the Rubber Slider are completely dry for the test.**

2. Place the Pendulum Arm in the release position such that it is held by the Release Catch. Bring Pointer round to its stop. Release the Pendulum Arm by pressing button **“F”** and catch it on its return swing, before the Rubber Slider strikes the test surface. Note the reading indicated by the Pointer.

3. Keeping the slider clear of the test surface by means of the lifting handle, return the Pendulum Arm to the release position and bring the Pointer round to its stop. Repeat to give eight readings. Record all the readings obtained or as described by the appropriate standard.

4. After conducting the tests, raise the Head Unit of the Tester so that it swings clear of the test surface and check the zero setting for error. If the zero setting is incorrect, adjust as described in **2.3.** Repeat the test procedure and again check the zero setting. If the zero setting is again incorrect, the instrument must be taken out of service.

6.9 Test Procedure - Wet

1. Using the Thermometer provided, measure and record to the nearest degree, the temperature of the test surface. Unless testing the “as received” state, clean the test surface with a dry clean industrial towel.

2. Place the Pendulum Arm in the release position such that it is held by the Release Catch. Bring Pointer round to its stop.

3. Using distilled or potable water thoroughly wet the surface to be tested. Ensure that the entire area that will be in contact with the Rubber Slider is wetted.

4. Release the Pendulum Arm by pressing button **“F”** and catch it on its return swing, before the Rubber Slider strikes the test surface. Note the reading indicated by the Pointer.

5. Keeping the Rubber Slider clear of the test surface by means of the Lifting Handle, return the Pendulum Arm to the release position and bring the Pointer round to its stop. Repeat, wetting the test surface between each swing, to give eight readings. Record all the readings obtained or as described by the appropriate standard.

6. After conducting the tests, raise the Head Unit of the Tester so that it swings clear of the test surface and check the zero setting for error. If the zero setting is incorrect, adjust as described in **2.3.** Repeat the test procedure, wetting the test surface between each swing, and again check the zero setting. If the zero setting is again incorrect, the instrument must be taken out of service.

6.10. Calculation and Expression of Results

Ignore the first three recorded readings, the slip resistance is calculated as the mean of the last five recorded readings. Repeat this procedure for the other readings taken in each direction tested. Take the average of all the median results obtained relating to a given test condition and correct the result to the nearest whole number. Record this as the Slip Resistance value of the Test sample under the condition of test, (Dry). Repeat this procedure for the Wet Test.

6.11. Interpretation of Results

No single measurement or piece of information can be used to assess a flooring surface. All information from instruments, conditions of use and environments, should be taken into account before a categorisation is reached.

The Slip Resistance of the floor for able-bodied pedestrians, when tested with the Portable Slip Resistance Tester with a Four S Rubber Slider can be interpreted using the table below. However, as stated, surface roughness must also be considered. A high Slip Resistance reading in dry conditions will often be associated with a low reading in wet conditions. However, in extreme cases, a low reading in dry conditions can be lower than the corresponding result in wet conditions. Therefore, in borderline regions Rz roughness is an important and perhaps a dominating factor.

Four S Rubber Slider

Potential for Slip	**Slip Resistance Tester Reading**
High	24 and below
Moderate	25 to 34
Low	35 to 64
Extremely Low	65 and above

Roughness values applicable for water wet low activity pedestrian areas.

Potential for Slip	**Rz Surface Roughness**
High	Below 10
Moderate	Between 10 and 20
Low	Between 21 and 30
Extremely Low	Above 31

The above tables refers to the “as found” conditions, to include dry and water wet conditions. Surfaces contaminated with pure water require a surface roughness of at least 10µm Rz to provide a reasonable slip resistance, whilst more viscous contaminants, such as dirty water, oils etc. require a higher surface roughness. The above tables should not be used as a stand-alone assessment guide and it must be appreciated that when a laboratory evaluation is performed, consideration should be given to the site where the sample will be installed.

TRL Rubber Slider

Potential for Slip	**Slip Resistance Tester Reading**
High	19 and below
Moderate	20 to 39
Low	40 to 74
Extremely Low	75 and above

The TRL Rubber Slider is more applicable on rough surfaces, such as rough concrete and coarse pavers and those with a roughness of above 30µm Rz. The readings can be interpreted according to the limits established by the GLC in Bulletin No.43.

It must be appreciated that when a laboratory evaluation is performed, consideration should be given to the site where the sample will be installed. Any pedestrian surface that is to be installed on a slope requires a higher slip resistance value than that of an adjacent horizontal surface if consistent slip resistance is to be maintained.

7.0 Determination of Polished Stone Values

Testing should be carried out in accordance with the relevant standard, (BS812). However, where no standard or guidelines exist, we suggest the following procedure.

7.1 Scope

This section covers the procedures for determining the Polished Stone Value (PSV) of an aggregate prepared beforehand using an Accelerated Polishing Machine. Samples should be prepared as recommended by the appropriate standard or, as specified by the Accelerated Polishing Machine manufacturer. The Polished Stone Value gives a measure of the resistance of road-stone to the polishing action of vehicle tyres under conditions similar to those occurring on the surface of a road. Where the surface of a road consists largely of road-stone, the state of the polish of the sample will be one of the factors affecting the resistance of the surface to skidding. The actual relationship between PSV and skidding resistance will vary with traffic conditions, type of surfacing and other factors. All factors together with the reproducibility of the test should be taken into account when producing specifications for road works, which include test limits for PSV.

7.2 Apparatus

Laboratory Base-Plate and Detachable Scale

Portable Slip Resistance Tester

Small Mounted Rubber Slider

Accelerated Polishing Machine

7.3 Laboratory Base-Plate

Using the four fixing holes, secure the Laboratory Base-Plate to a sturdy, flat and level surface.

7.4 Assemble the Test

Assemble the Tester as described in sections **1.** Position the Tester on the Laboratory Base-Plate, lining up the three levelling screws on the Tester with the three location blocks on the Base-Plate. Attach the Detachable Scale to the main scale of the Tester such that the two zeros align and the maximum reading on the Detachable Scale aligns with the “60” on the main scale of the Tester. Ensure that the appropriate Slider is fitted and that the Slider swings parallel across the Test Specimen Holder. If necessary, adjust by repositioning the levelling feet location blocks. Ensuring that the Slider does not touch the surface of the Test Specimen Holder, adjust and check the calibration as described in section **2**. Adjust the height of arm so that the working edge of the Slider is in contact with the sample for a distance of 76mm horizontally. The Test Specimen Holder is marked with lines 76mm apart to assist.

7.5 Slider, TRL Small Slider

This 30mm wide slider is used for the Polished Stone Value (PSV) Test and is used in conjunction with the Detachable Scale and Laboratory Base-Plate. Each Rubber Slider is provided with a certificate confirming the Hardness and Resilience.

Temperature °C	**0**	**10**	**20**	**30**	**40**
Lüpke resilience	43 - 49	58 - 65	66 - 73	71 - 77	74 - 79
IRHD hardness	55± 5	55± 5	55± 5	55± 5	55± 5

7.6 Slider Rubber Storage

Rubber Sliders are generally considered to have a shelf life of 12 months and should be stored in the dark with a constant environment, preferably below 15°C.

7.7 Slider Preparation

The Rubber Slider should always be clean and free from contamination, such as oil or abrasive, and have square and clean-cut edges. Preparation of the Rubber Slider is important and should be carried out in accordance with the standard being used. However, if no relevant standard exists, we suggest the following procedure to prepare new Rubber Sliders.

Swing the Slider five times over the dry surface of a polished Criggion specimen, followed by twenty swings over the wetted surface. The Slider is now ready for use. To extend the life of the Slider, it is possible to reverse the Slider to make use of both working edges. However, any Slider that develops excessive burring or scoring should be discarded. Keep the Criggion specimen used for conditioning rubber sliders apart from the Criggion calibration specimens.

7.8 Preparing the Test Sample

The samples should be prepared as defined in the relevant standard and/or as recommended by the manufacturer of the Accelerated Polishing Machine.

7.9 Test Procedure

Tests should be performed as defined in the relevant standard and/or as recommended by the manufacturer of the Accelerated Polishing Machine.