BRITISH STANDARD

BS 7941-2:2000

Surface friction of pavements —

Part 2: Test method for measurement of surface skid resistance using the GripTester braked wheel fixed slip device

ICS 17.040.20; 93.080.20

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee B/510, Road materials, to Subcommittee B/510/5, Surface characteristics, upon which the following bodies were represented:

County Surveyors' Society
Department of the Environment, transport and the Regions
Institution of Civil Engineers
Quarry Products Association
Road Surface Dressing Association
Society of Chemical Industry

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Brick Development Association
Britpave
Department of the Environment, Transport and the Regions (Highways Agency)
Ministry of Defence

This British Standard, having been prepared under the direction of the Sector Committee for Building and Civil Engineering, was published under the authority of the Standards Committee and comes into effect on 15 September 2000

Amendments issued since publication

Amd. No.	Date	Comments

The following BSI references relate to the work on this standard:
Committee reference B/510/5
Draft for comment 97/108144 DC

ISBN 0 580 33210 1

Contents

Foreword

This British Standard has been prepared under the direction of the Building and Civil Engineering Sector Policy and Strategy Committee by Subcommittee B/510/5, Surface characteristics.

This standard is published in two parts. Part 1 is entitled *Method for measuring the surface friction of pavements using a sideway force coefficient routine investigation machine*.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

1 Scope

This British Standard describes a method for determining the skid resistance of a surface using the GripTester continuous reading braked wheel fixed slip device.

The method is applicable to the following:

— highways: surfacings;

— highways: horizontal signs;

— airport runways;

— flight decks;

— footways;

— pedestrian precincts;

— test panels of surfaces intended for any of the above.

The method is for measurement of skid resistance along a continuous surface on external paved surfaces or indoors. Test speeds can vary from 5 km/h to 130 km/h depending on the application. The measured values can be affected by the test speed.

2 Terms and definitions

For the purposes of this British Standard the following terms and definitions apply.

2.1

skid resistance

property of the trafficked surface which limits relative movement between a vehicle tyre contact patch and the road

2.2

slip resistance

property of the trafficked surface to maintain the adhesion of a pedestrian sole

2.3

frictional force

tangential force generated between the vehicle tyre/pedestrian sole and the trafficked surface

2.4

braked wheel friction tester

apparatus that can be moved over the test surface at a known, steady speed and that includes a test wheel, a system for braking the test wheel and instrumentation for measuring the resulting friction between the test tyre and test surface

2.5

fixed slip

a braking system that forces the test wheel to roll at a fixed reduction of its natural speed

2.6

GripTester

a braked wheel fixed slip device friction tester capable of being manually pushed or towed at up to 130 km/h

2.7

load

dynamic instantaneous vertical force acting on the test wheel

2.8

drag

dynamic instantaneous horizontal force acting on the test wheel

2.9

instantaneous friction reading

drag divided by load

2.10

GripNumber

mean of a number of instantaneous friction readings over a defined length

NOTE The range of the GripNumber is 0.00 to 1.20.

2.11

GripLength

defined length over which the GripNumber is produced

2.12

water deposition system

system for depositing a given amount of water in front of the test tyre so that it then passes between the tyre and the surface being measured

2.13

rate of water deposition

rate at which water is deposited on the surface to be measured in front of the test tyre

2.14

theoretical water film thickness

thickness of the water film that would exist between a test tyre with smooth tread and the surface being measured if this surface had zero texture depth

2.15

routine skid resistance testing

measurement of the skid resistance of a surface in standardized test conditions, which normally include a defined rate of water deposition

2.16

operational skid resistance testing

measurement of the skid resistance of a surface in response to an operational need and in whatever conditions exist at the time of the test, which may include contamination by ice, snow, slush or water

NOTE These tests do not include water deposition.

3 Equipment

3.1 Principle of operation

The GripTester has two drive wheels and a single test wheel and is capable of being towed or manually pushed at speeds between 5 km/h and 130 km/h. It is illustrated in Figure 1. The test wheel is mounted on a stub axle and is mechanically braked by a fixed gear system with a ratio of 27:32 in relation to the drive wheels so that there is a relative slip speed between the drive wheels and the test wheel of just over 15 %. The drive wheel tyres have a patterned tread and carry just over three quarters of the weight of the instrument: the test wheel tyre has a smooth tread.

The two drive wheels are mounted on the main axle, which also carries a toothed wheel. A proximity sensor is mounted adjacent to this toothed wheel in such a way that signals from this sensor can be transmitted to a signal processing unit (SPU) for the calculation of distance.

Two strain gauge bridges on the stub axle continuously measure drag and load and transmit these signals to the SPU, which calculates the instantaneous friction readings. These readings are sent in ASCII form to a data capture device where the GripNumber is computed and stored.

If the GripTester is to be used for routine testing it shall be connected to a water tank fitted with a control valve. In towing mode, water deposition is further controlled by a pump and may be monitored with a flowmeter.

3.2 Physical characteristics

Overall length (excluding removable tow-bar)	1 010 mm
Overall width	790 mm
Overall height	510 mm
Test tyre × 1	10" diameter smooth tread as approved by the manufacturer
Drive tyres × 2	10" diameter patterned tread as approved by the manufacturer
Static load on test wheel under normal operating conditions	Between 22 kg and 28 kg
Data capture software	As provided by the manufacturer
Data capture device	Various non-proprietary portable computers may be used

4 Calibration and maintenance

4.1 General principles

The time-based schedule of inspection, calibration and maintenance set out in the manufacturer's current manual shall be adhered to.

4.2 Routine procedures

4.2.1 A pre-survey check shall be carried out in accordance with the manufacturer's current manual before and after testing on each day of the survey.

4.2.2 The monthly maintenance procedure shall be carried out in accordance with the manufacturer's manual not more than one month prior to the survey.

4.2.3 The annual maintenance procedure shall be carried out in accordance with the manufacturer's manual not more than one year prior to the survey.

4.2.4 Full records shall be kept of the dates and details of all inspections and calibrations.

4.3 Special procedures

When required, the accuracy of distance measurement shall be checked and calibrated in accordance with the manufacturer's instructions.

NOTE Since speed measurements are derived from distance measurements, regular calibration of distance measurement is recommended.

5 Test procedures

5.1 Safety

When carrying out a friction survey on trafficked roads, the GripTester can operate at speeds different from normal road speed and as a result can create a hazard to other road users. It is essential that attention is paid to working in accordance with all current safety measures and those required by current legislation.

When carrying out a friction survey at an airport, ensure that all activities are under the control of the airport operators.

Avoid carrying out tests involving water deposition if there is a risk of water freezing on the pavement.

5.2 Routine testing

5.2.1 *General*

Wherever possible, the surface to be measured should be free from standing water, frost, grease, debris or other contamination.

The water deposition system shall be set up to provide the required water deposition rate.

NOTE Suggested guidelines for water deposition rates are given in annex A.

The temperature of water applied shall be not less than 5 °C and not greater than 25 °C.

5.2.2 *Towing mode*

Prior to the first test, check that the measuring system has reached the appropriate stable state. This shall be done by switching on the SPU for at least 5 min and towing the GripTester over at least 500 m with the water deposition system in operation. If possible, the surface used should be representative of that initially to be tested.

With the water deposition system in operation, tow the GripTester smoothly and at a standard speed, operating the data capture device in accordance with the manufacturer's instructions. Examples of standard speeds are: (20 ± 5), (50 ± 5), (65 ± 5), (95 ± 5) km/h.

5.2.3 *Pushing mode*

Prior to the first test, check that the measuring system has reached the appropriate stable state. This shall be done by switching on the SPU for at least 5 min and pushing the GripTester over at least 20 m with the water deposition system in operation. The surface used shall be representative of that initially to be tested.

With the water deposition system in operation, push the GripTester smoothly and at the standard speed of (6 ± 1) km/h, operating the data capture device in accordance with the manufacturer's instructions.

5.3 Operational testing

5.3.1 *Towing mode*

Prior to the first test check that the measuring system has reached the appropriate stable state. This shall be done by switching on the SPU for at least 5 min and towing the GripTester over at least 500 m. If possible, the surface used should be representative of that initially to be tested.

Tow the GripTester smoothly and at a standard speed, operating the data capture device in accordance with the manufacturer's instructions. Standard speeds are: (20 ± 5), (50 ± 5), (65 ± 5), (95 ± 5) km/h.

5.3.2 *Pushing mode*

Prior to the first test, ensure that the measuring system has reached the appropriate stable state. This shall be done by switching on the SPU for at least 5 min and pushing the GripTester over at least 20 m.

NOTE If possible, the surface used should be representative of that initially to be tested.

Push the GripTester smoothly and at the standard speed of (6 ± 1) km/h, operating the data capture device in accordance with the manufacturer's instructions.

6 Sampling

The GripTester shall be set to a sampling rate of 40 mm, 160 mm, 400 mm or 800 mm. The data capture device shall be set to give a GripLength of between 40 mm and 10 m.

The sampling rate and the GripLength shall be as specified by the client.

7 Precision

Trials at the Transport Research Laboratory in May 1993 showed that for routine testing at 50 km/h with a water deposition rate of 18 l/min the repeatability of the GripTester was $r = 0.02$ and its reproducibility was $R = 0.08$.

8 Test results

If the data capture device is used in accordance with the manufacturer's instructions, the data file and the printed report will both contain all significant conditions under which the test was carried out as well as the actual test results. The structure of the ASCII data files is defined in the manufacturer's manual.

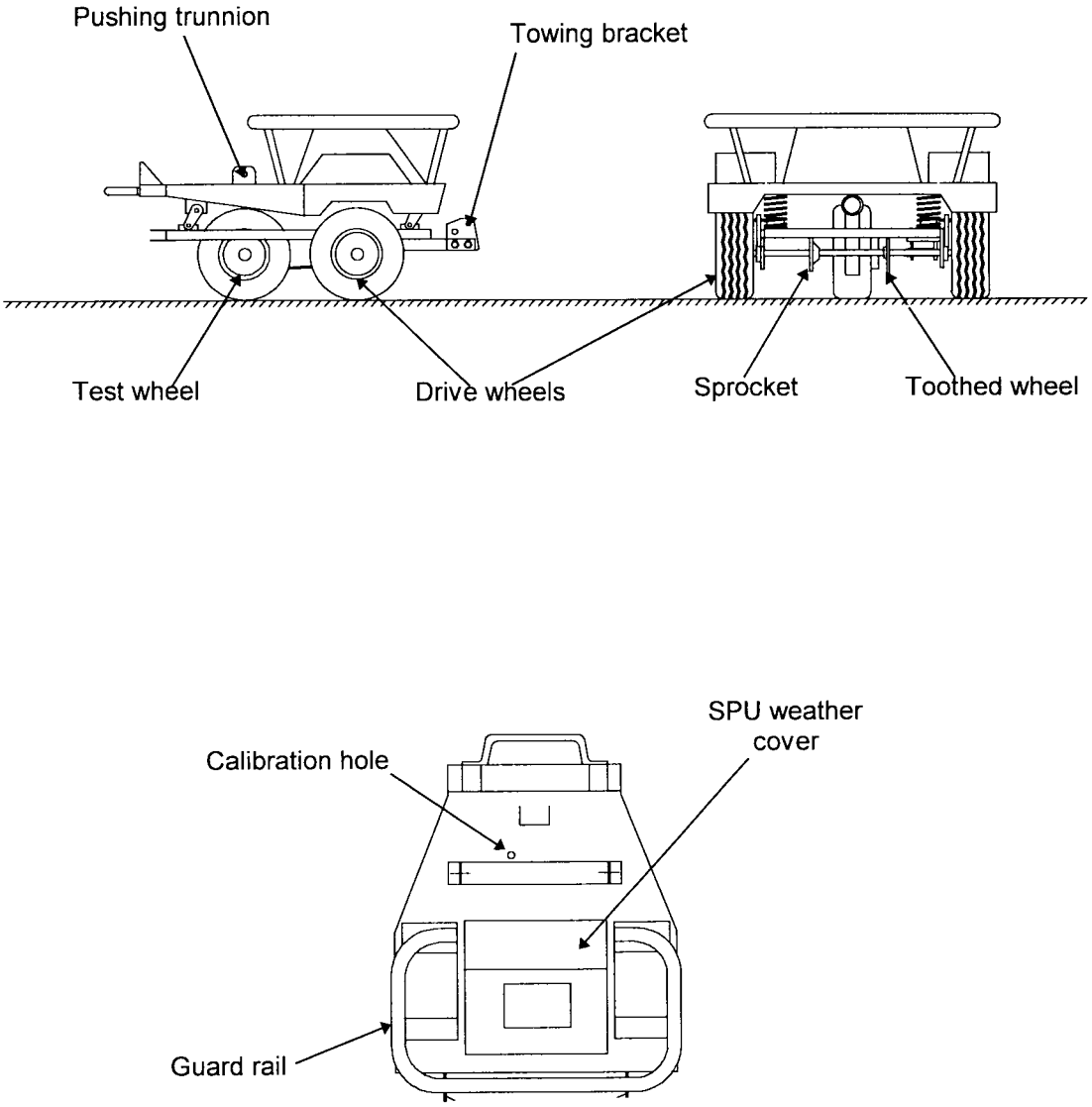

Figure 1 — GripTester: General arrangement

Record no.	Record name	Comments/ details
0	File format identifier	Data file in format: ROADS VERSION 3.1, units
1	Authority	*Keyed in by operator: optional*
2	Date	*Supplied by system*
3	Time	*Supplied by system*
4	GripTester	*Keyed in by operator: mandatory*
5	Test tyre	*Keyed in by operator: mandatory*
6	Site	*Keyed in by operator: optional*
7	Surface	*Keyed in by operator: optional*
8	Direction	*Keyed in by operator: optional*
9	Lane/track	*Keyed in by operator: optional*
10	Speed(km/h)	*Keyed in by operator: mandatory*
11	Water flow(l/m)	*Keyed in by operator: mandatory*
12	Operator/s	*Keyed in by operator: optional*
13	Weather	*Keyed in by operator: optional*
14	Ambient temp (C)	*Keyed in by operator: optional*
15	Surface temp (C)	*Keyed in by operator: optional*
16	Tyre temp (C)	*Keyed in by operator: optional*
17	Run number	*Keyed in by operator: mandatory*
18	Data gathering computer type	*Supplied by system*
19	Distance calibration data	*Supplied by system*
20	Remarks (before survey)	*Keyed in by operator: optional*
21	Remarks (after survey)	*Keyed in by operator: optional*
22	Marker	*Supplied and used by the DC software*

Figure 2 — GripTester header file layout: ROADS VERSION 3.1

Record no.	Record name	Comments/ details
0	File format identifier	Data file in format: AIRFIELDS VERSION 3.3, units
1	Airfield	*Stored in system*
2	Date	*Supplied by system*
3	Time	*Supplied by system*
4	Subject	*Supplied by operator: mandatory*
5	Side of c/l	*Supplied by operator: mandatory*
6	Distance from c/l	*Supplied by operator: mandatory*
7	Distance of keyed start from t/h 1	*Stored in system*
8	Distance of keyed start from survey speed 1	*Stored in system*
9	Distance of keyed start from t/h 2	*Stored in system*
10	Distance of keyed start from survey speed 2	*Stored in system*
11	Runway length (threshold - threshold)	*Stored in system*
12	Target test speed	*Supplied by operator: mandatory*
13	Actual test speed	*Supplied by system*
14	Theoretical water film thickness	*Supplied by operator: mandatory*
15	Surface condition (before self-wetting)	*Supplied by operator: mandatory*
16	Weather	*Supplied by operator: mandatory*
17	Ambient temp (C)	*Supplied by operator: optional*
18	Surface temperature (C)	*Supplied by operator: optional*
19	Operator(s)	*Supplied by operator: mandatory*
20	GripTester serial number	*Supplied by operator: mandatory*
21	Test tyre	*Supplied by operator: type is mandatory, tyre no. is optional*
22	Data acquisition computer type	*Supplied by system*
23	Distance calibration data	*Supplied by system*
24	Remarks	*Supplied by operator: optional*

Figure 3 — GripTester header file layout: AIRFIELDS VERSION 3.3

Annex A (informative)

Water flow rates

The effect of depositing water in front of the test tyre of any friction tester is two-fold. The primary effect is to provide a water film between the test tyre and the surface being tested. The secondary effect of the water deposition is the cleaning of the surface.

On a clean surface, the effect of passing a given quantity of water under the test tyre is quite precise and its effects are repeatable. Table A.1 below gives the relationship between water flow, GripTester survey speed and theoretical water film thickness for a test tyre of width 50 mm. It should be borne in mind that the actual (as opposed to theoretical) thickness of this water film will vary with the draining characteristics of the surface concerned.

If the surface is contaminated, deposition of water and the passage of the test tyre will alter the friction characteristics of the surface, so that subsequent tests will give different results.

Table A.1 Water deposition rates (in/min)

Survey speed (km/h)	Theoretical water film thickness (mm)				
	0.20	0.25	0.30	0.50	1.00
6	1.0	1.2	1.5	2.5	5.0
20	3.3	4.2	5.0	8.3	16.7
50	8.3	10.4	12.5	20.8	41.7
65	10.8	13.5	16.3	27.1	54.2
95	15.8	19.8	23.8	39.6	79.2

blank

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL