BRITISH STANDARD

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Methods of measuring irregularities on surfaces of roads, footways and other paved areas using straightedges and wedges

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Committee responsible for this British Standard

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Brick Development Association

Britpave

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Ministry of Defence — UK Defence Standardization

Quarry Products Association

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The following BSI references relate to the work on this British Standard:
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Contents

Foreword

This British Standard has been prepared by Subcommittee B/510/5, under the direction of Technical Committee B/510. It supersedes DD 227:1996, which is withdrawn.

This British Standard describes three methods of measuring surface irregularities, using three different types of straightedge. A fourth method, using a fourth type of straightedge, is described in BS EN 13036-7. Type 1 and Type 3 straightedges enable positive irregularities to be measured equal to or less than the height of the support feet or adjustable blocks, as well as negative irregularities. The methods described in this British Standard allow the use of both longer and shorter straightedges than the type used in BS EN 13036-7, and therefore the measurement values obtained might differ. Guidance on the use of each type of straightedge, explaining when each type is generally used and giving additional background information, is given in Annex A.

Attention is drawn to advisory traffic management procedures for measurements on in-service roads. For further information, refer to Chapter 8 of the *Traffic signs manual* [1].

It has been assumed in the drafting of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and competent people.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its 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 9 and a back cover.

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1 Scope

This British Standard describes methods of measuring irregularities on surfaces of roads, footways and other paved and trafficked areas using straightedges and wedges other than those described in BS EN 13036-7. It describes apparatus and procedures for measuring:

a) single irregularities that are attributable to quality defects in new surface course(s) as well as in-service surfaces;

b) rut depths and trench reinstatements of in-service roads;

c) any other single irregularities less than the length of the straightedge(s) being used.

This British Standard does not give methods for measuring profile or general unevenness of surfaces.

2 Terms and definitions

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

2.1
detritus
loose surface matter

2.2
irregularity
maximum variation of a surface from the measurement edge of a straightedge between two contact points of the straightedge when placed perpendicular to the surface

2.3
layer
structural element of a pavement (**2.4**) laid in a single operation

2.4
pavement
structure composed of one or more courses, to assist the passage of wheeled traffic over terrain

2.5
surface
surface of an individual layer (**2.3**)

2.6
surface course
upper layer (**2.3**) of a pavement (**2.4**), which is in contact with traffic

3 Measurement using type 1 straightedge

NOTE Guidance on the use of type 1 straightedges is given in **A.1**.

3.1 Apparatus

NOTE All equipment should be calibrated in accordance with Annex B.

3.1.1 *Type 1 straightedge with fixed support feet*, between 1 m and 4 m (in whole or half metres) long. It shall be of rigid construction such that its measurement edge does not deviate from a true plane by more than ±0.2 mm at any point in its operating position. The straightedge shall not deviate from straight along its length by more than 1 mm/m. The horizontal width of the measurement edge shall be not less than 3 mm. The measurement edge shall be identifiable. The support feet shall be of equal dimensions and the contact edge of the support feet shall not deviate from a true plane by more than ±0.2 mm at any point.

NOTE A typical type 1 straightedge and typical support feet are shown in Figure 1.

3.1.2 *Wedge A*, not less than 300 mm in length and not less than 25 mm in width. It shall be permanently marked on the slope plane in increments of 1 mm and its true height shall be accurate at each marked increment to ±0.2 mm. At the zero (0) point on the measurement wedge, the height shall be the same as the height of the support feet of the straightedge ±0.2 mm.

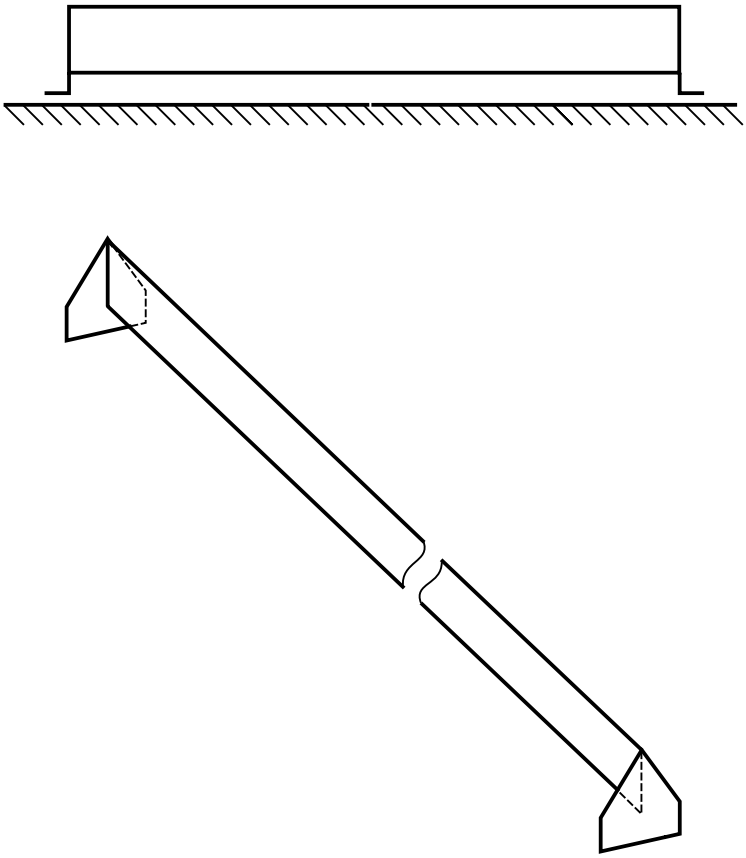


Figure 1 — Typical type 1 straightedge with fixed support feet

3.2 Test method

3.2.1 The type 1 straightedge (**3.1.1**) shall be used only in conjunction with wedge A (**3.1.2**) and they shall be permanently marked with the same unique reference.

3.2.2 Ensure that the surface to be measured is free from detritus.

3.2.3 Place the straightedge on the surface perpendicular to it. For longitudinal measurement, place the straightedge parallel to the centreline of the road. For transverse measurement, place it perpendicular to the centreline of the road.

NOTE The straightedge may be moved across the lane width and construction joints to determine the greatest irregularity. It may be placed at any place, in any direction unless a specific direction of measurement is required.

3.2.4 Place the wedge on the surface so that full contact with the surface is obtained. Ensure that the wedge is perpendicular to the measurement edge of the straightedge.

3.2.5 Measure the distance between the measurement edge of the straightedge and the surface of the irregularity by inserting the wedge in the gap to refusal and then reading off the marked increments on the slope of the wedge.

3.2.6 Record the measurements to the nearest 1 mm.

3.2.7 For new surfaces, check conformity to irregularity criteria as soon as practicable after the surface has been laid.

NOTE 1 An example of irregularity criteria is SHW Cl 702; refer to Volume 1 of the Highways Agency publication *Manual of contract documents for highway works* [2].

NOTE 2 On occasions it will not be possible to check compliance before trafficking so on these occasions record and report that trafficking had occurred prior to test.

3.3 Test report

The test report shall contain at least the following information:

a) test date;

b) serial number of the report;

c) reference number of the straightedge and wedge (see **3.2.1**);

d) test location, e.g. road number, lane, chainage reference;

e) type of measurement, e.g. transverse;

f) transverse location of left-hand end of straightedge, e.g. 500 mm from kerb;

g) length of the straightedge used in the test;

h) greatest measurement to the nearest 1 mm;

i) whether the test surface has been trafficked;

j) signature of the person accepting the technical responsibility for the report.

NOTE For repeatability and reproducibility, the location of each measurement position should be recorded as accurately as possible.

4 Measurement using type 2 straightedge

NOTE Guidance on the use of type 2 straightedges is given in **A.2**.

4.1 Apparatus

NOTE All equipment should be calibrated in accordance with Annex B.

4.1.1 *Type 2 plain straightedge*, between 1 m and 4 m (in whole or half metres) long. It shall be of rigid construction such that its measurement edge does not deviate from a true plane by more than ±0.2 mm at any point in its operating position. The straightedge shall not deviate from straight along its length by more than 1 mm/m. The horizontal width of the measurement edge shall be not less than 3 mm. The measurement edge shall be identifiable.

NOTE A typical type 2 straightedge is shown in Figure 2.

4.1.2 *Wedge B*, not less than 200 mm in length and not less than 20 mm in width. It shall be permanently marked on the slope plane in increments of 1 mm and its true height shall be accurate at each marked increment to ±0.5 mm.

4.2 Test method

4.2.1 The type 2 straightedge (**4.1.1**) shall be used only in conjunction with wedge B (**4.1.2**) and they shall be permanently marked with the same unique reference.

4.2.2 Ensure that the surface is free from detritus. Place the straightedge on the surface, perpendicular to the centreline of the road and bridging the rut to be measured.

4.2.3 Place the wedge on the surface so that full contact with the surface is obtained. Ensure that the wedge is perpendicular to the measurement edge of the straightedge.

NOTE Measurements may be taken from either side of the straightedge.

4.2.4 Measure the distance between the measurement edge of the straightedge and the surface of the rut by inserting the wedge in the gap to refusal to ascertain the greatest deviation and then reading the marked increments on the slope of the wedge.

4.2.5 Record the measurements to the nearest 1 mm.

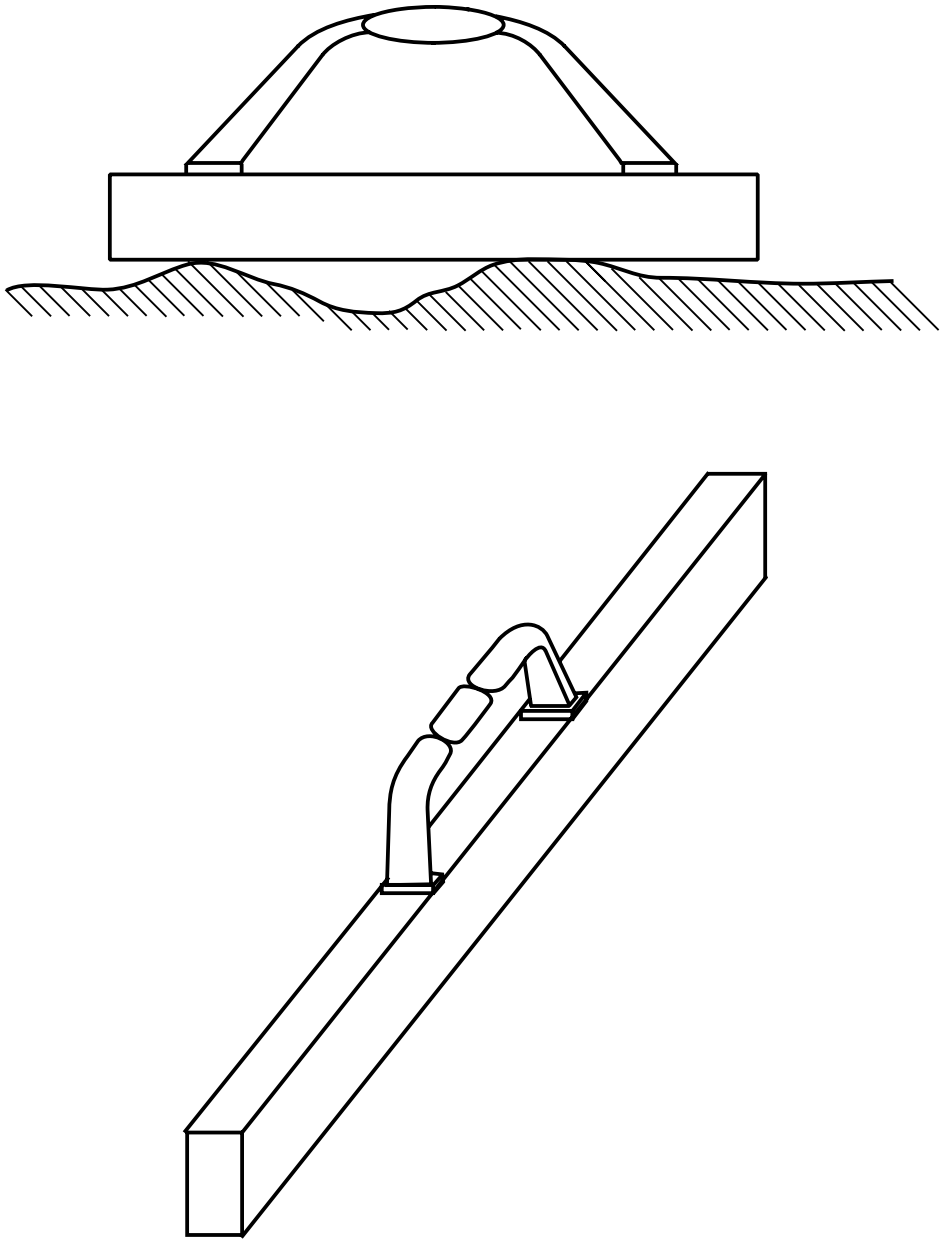


Figure 2 — Typical type 2 plain straightedges for use in measurement of rut depth

4.3 Test report

The test report shall contain the following information:

a) test date;

b) serial number of the report;

c) reference number of the straightedge and wedge (see **4.2.1**);

d) test location, e.g. road number, lane, chainage reference;

e) type of measurement, e.g. longitudinal, diagonal, transverse;

f) length of the straightedge used in the test;

g) whether the surface has been trafficked;

h) signature of the person accepting the technical responsibility for the report.

NOTE For repeatability and reproducibility, the location of each measurement position should be recorded as accurately as possible.

5 Measurement using type 3 straightedge

NOTE Guidance on the use of type 3 straightedges is given in **A.3**.

5.1 Apparatus

NOTE All equipment should be calibrated in accordance with Annex B.

5.1.1 *Type 3 straightedge with adjustable blocks*, between 1 m and 4 m (in whole or half metres) long. It shall be of rigid construction such that its measurement edge does not deviate from a true plane by more than ±0.2 mm at any point in its operating position. The straightedge shall not deviate from straight along its length by more than 1 mm/m. The horizontal width of the measurement edge shall be not less than 3 mm. The measurement edge shall be identifiable. The blocks shall be of equal dimensions and adjustable along the length of the straightedge and they shall not deviate from a true plane by more than ±0.2 mm.

NOTE A typical type 3 straightedge and typical adjustable blocks are shown in Figure 3.

5.1.2 *Wedge A*, in accordance with **3.1.2**.

5.2 Test method

5.2.1 The type 3 straightedge (**5.1.1**) shall be used only in conjunction with wedge A (**5.1.2**) and they shall be permanently marked with the same unique reference.

5.2.2 Ensure that the surface is free from detritus. Place the straightedge on the surface and adjust the blocks so that they can sit on each edge of the old road surface and the straightedge is perpendicular to the line of the trench.

5.2.3 Measure the distance between the measurement edge of the straightedge and the surface of the trench reinstatement by inserting the wedge in the gap to refusal to ascertain the greatest or least deviation and then reading off the marked increments on the slope of the wedge.

5.2.4 Record the measurements to the nearest 1 mm.

5.3 Test report

The test report shall contain at least the following information:

a) test date;

b) serial number of the report;

c) reference number of the straightedge and wedge (see **5.2.1**);

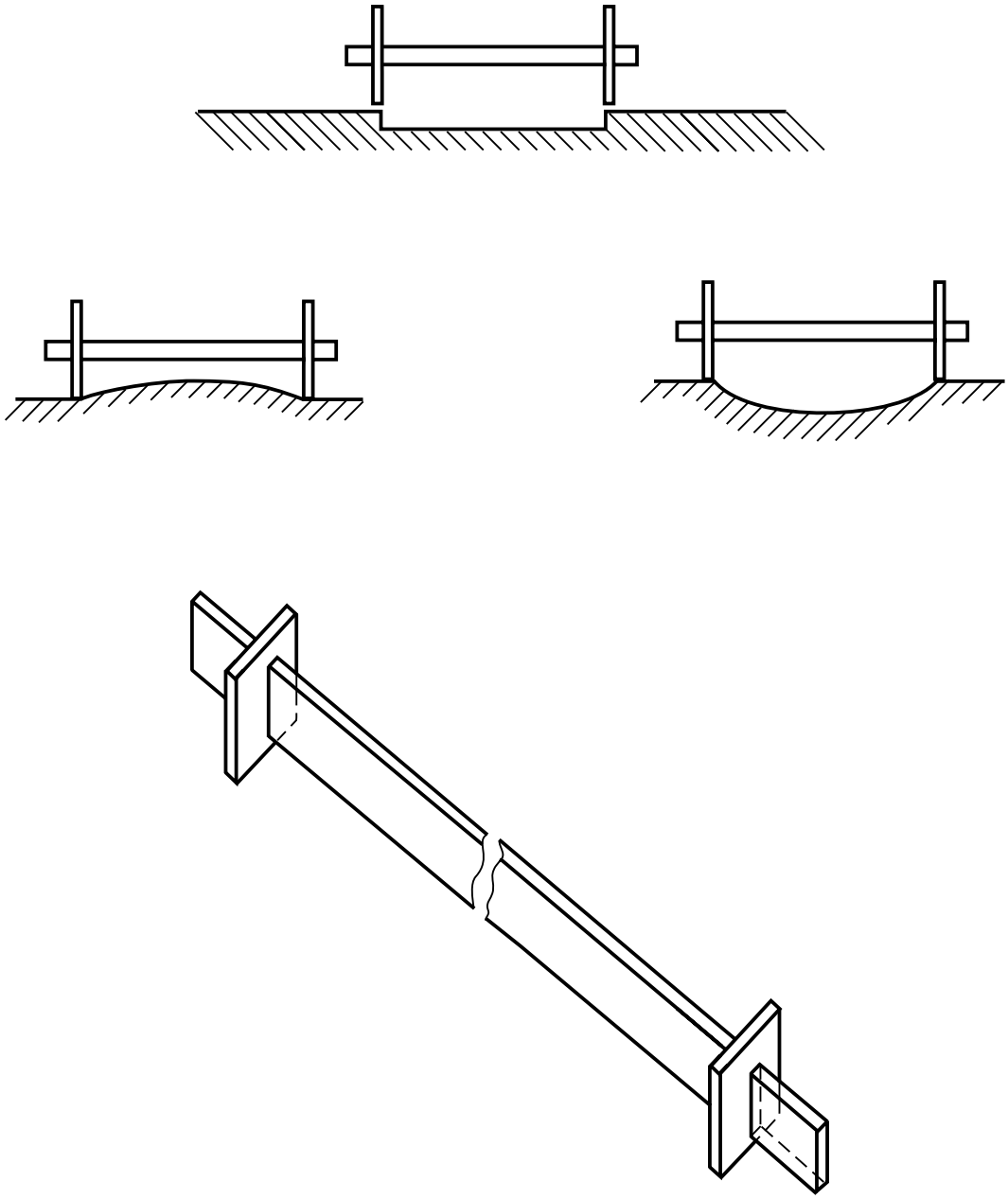
d) test location, e.g. road number, lane, chainage reference;

e) length of the straightedge used in the test;

f) greatest measurement to the nearest 1 mm;

g) signature of the person accepting the technical responsibility for the report.

NOTE For repeatability and reproducibility, the location of each measurement position should be recorded as accurately as possible.



See Annex A, Note to **A.3**

Figure 3 — Typical type 3 straightedge for HAUC use

Annex A (informative)
Guidance on usage

A.1 Type 1 straightedge

The type 1 straightedge is generally used in the initial construction or maintenance of highways, footways and airfields. Irregularities in the finished surface can impede surface water drainage to the detriment of safety and durability, and can adversely affect vehicle handling, safety and comfort.

NOTE An appropriate size for measuring irregularities on highway and airfield surfaces is 3 m in length with 15 mm high support feet whilst for footway surfaces 1 m length with 40 mm high support feet would be appropriate.

Conformity to specified requirements of surface regularity is a prime determinant of quality in new construction.

The values of irregularities measured by this method can change with the length of the individual apparatus used and therefore might not correspond to values obtained by other methods and procedures.

A.2 Type 2 straightedge

The type 2 straightedge is generally used in measuring rut depth as part of a computerized highway management survey system.

Rutting of in-service pavements indicates a deterioration of the pavement caused by deformation in the surface course(s) and/or a more general failure of bearing capacity of the pavement.

Rutting adversely affects vehicle handling, safety and comfort, and by impeding surface water drainage can reduce skid resistance and contribute to aquaplaning.

Rut depth measured by this apparatus and procedure might not correspond to values obtained by other methods and procedures.

NOTE It can be an advantage if the width of the measurement edge is great enough so that the straightedge will stand on the surface unaided, while the rut depth is being measured.

A.3 Type 3 straightedge

The type 3 straightedge is generally used in assessing of trench reinstatements as detailed in the Highways Authorities Utilities Committee (HAUC) specification [3].

NOTE Any of the conditions shown in Figure 3, or a combination of some or all of these conditions, can be present, so in some circumstances it can be advisable to produce a sketch to accompany the test report.

Annex B (informative)
Guidance on calibration

B.1 Straightedges

The measurement edge of the straightedge should be checked on a plane and the deviation of the distance between the measurement edge of the plane should be equal to or less than the tolerances detailed in **3.1.1**, **4.1.1** or **5.1.1** as appropriate to the type of straightedge.

NOTE The plane may be plate glass, metal, or liquid in a tank or provided by suitable light/laser beams or strained wires.

B.2 Wedges

The measurement wedge should be checked by a suitable method, e.g. calliper or dial gauge at the marked increments; the true height at the marked intervals should be equal to or less than the tolerances detailed in **3.1.2**, **4.1.2** or **5.1.2** as appropriate to the type of wedge.

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[1] DEPARTMENT OF TRANSPORT. *Traffic signs manual — Chapter 8: Traffic safety measures and signs for road works and temporary situations*. London, The Stationery Office, 1991.

[2] HIGHWAYS AGENCY. *Manual of contract documents for highway works — Volume 1: Specification for highway works*. London: The Stationery Office, 2002.

[3] DEPARTMENT OF TRANSPORT, *Specification for the reinstatement of openings in the highways — A code of practice*. London: The Stationery Office, 2002.

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