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EAST AFRICAN STANDARD

**Retro-reflective and fluorescent warning signs for road vehicles —
Specification — Part 1: Triangles**

EAST AFRICAN COMMUNITY

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Draft for comments only — Not to be cited as East African Standard

Retro-reflective and fluorescent warning signs for road vehicles — Specification — Part 1: Triangles

1 Scope

This part of the specification covers requirements for two types of triangles that are retro-reflective and fluorescent and are intended to be carried in motor vehicles operating on public roads.

NOTE

- a) The triangles covered by this part of the specification may be used to give advance warning to approaching traffic¹⁾ of
 - 1) a vehicle that is stationary, in the case of type A triangles (see Figure 4(a)), and
 - 2) a vehicle that is slow moving, in the case of type B triangles fixed to the rear of a vehicle (see Figure 4(b) and CD/K/028-2:2008).
- b) The standards referred to in this part of the specification are listed in Clause 2.
- c) Requirements that must be specified by the purchaser are listed in Annex A.
- d) Methods for the determination of the coefficient of friction and the geometric roughness of a road surface are given in Annex B.
- e) Suggested coatings for mild steel surfaces are given in Annex C.
- f) Guidance on the verification of the quality of triangles produced to this part of the specification is given in Annex D.

2 Normative references

The following referenced documents are indispensable for the application of this East African Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EAS 293-1, *Road marking materials — Part 1: Physical properties*

EAS 293-2, *Road marking materials — Part 2: Road marking performance for road users*

CIE 72, *Guide to the properties and uses of retroreflectors at night*

CIE 144, *Road surface and road marking reflection characteristics*

ISO 2813, *Paints and varnishes — Determination of specular gloss of non-metallic paint films at 20 degrees, 60 degrees and 85 degrees*

ISO 8781-3, *Pigments and extenders — Methods of assessment of dispersion characteristics — Part 3: Assessment from the change in gloss*

ISO 7724, *Paints and varnishes — Colorimetry*

ISO 10308, *Metallic coatings — Review of porosity tests*

ISO 6745, *Zinc phosphate pigments for paints — Specifications and methods of test*

CD/K/028-2:2008, *Retro-reflective and fluorescent warning signs for road vehicles — Part 2: Abnormal load vehicle signs*

ISO 7010:2003, *Graphical symbols — Safety colours and safety signs — Safety signs used in workplaces and public areas*

¹⁾ To ensure correct use of these triangles, the user should consult the relevant road traffic regulations.

ISO 105-A02, *Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 3668, *Paints and varnishes — Visual comparison of the colour of paints*

ISO 9001, *Quality management systems — Requirements*

ISO 1518, *Paints and varnishes — Scratch test*

ISO 7253, *Paints and varnishes — Determination of resistance to neutral salt spray (fog)*

3 Definitions

For the purposes of this part of the specification the following definitions shall apply:

3.1

Fluorescence

The phenomenon that occurs when light of a certain wavelength is absorbed by a chemical substance in the surface of a material and part of the light energy is re-radiated as light of a longer wavelength.

3.2

Retro-reflective surface

A surface from which light is reflected in directions close to the direction of incidence within a wide range of angles of incidence at the reflecting surface.

3.3

Triangle

A warning sign in the shape of a triangle and intended to be used in accordance with road traffic regulations to indicate a hazard.

3.4

Warning face

A surface of a warning sign that is intended to be displayed when the sign is in use.

4 Requirements

4.1 Type

A triangle shall be of type A (i.e. portable) or of type B (i.e. intended to be attached to a road vehicle).

4.2 Materials

4.2.1 Substrate materials

The substrate material used for a triangle shall be a metal or a plastics material, as required, and shall be such that the completed triangle complies with the performance requirements of 4.6. In addition, the substrate material shall comply with the appropriate of the following requirements:

- a) **Metal** — A substrate of metal shall be such that when, at an ambient temperature of $20\text{ °C} \pm 1\text{ °C}$, a specimen of the substrate of length and width approximately 150 mm and 40 mm respectively is placed on two parallel knife-edge supports that are each not more than 10 mm from an end of the specimen, and a force of $11\text{ }_{-0}^{+1}\text{ N}$ is applied vertically downwards at the centre of the specimen and maintained for a period of at least 5 s,

- 1) the deflection does not exceed 3.0 mm; and
- 2) there is no permanent deflection after the force has been removed.

- b) **Plastics material**²⁾ — A substrate of plastics shall be such that
- 1) it is of the thermoplastic type, has a high impact resistance, is water resistant and fuel resistant, contains ultraviolet light absorbers and anti-oxidants and, if required, contains a red fluorescent colorant; and
 - 2) it complies with the requirements given in (a) above.

NOTE When it is not practicable to obtain a specimen of the width given in (a) above, a specimen having the width of a leg of the triangle may be used and the applied test force shall then be that given by the equation

$$F = \left(\frac{x}{40} + 11 \right) N$$

where

F = required test force, N
x = width of leg of triangle, mm

4.2.2 Retro-reflective materials

Retro-reflective material shall be red and shall comply with the requirements for

- a) reflected luminous intensity given in 4.6.3; and
- b) the chromaticity co-ordinates given in 4.6.4;

and, in the case of a pressure-sensitive adhesive material, with the requirement for strength of adhesion given in EAS 293-1.

4.2.3 Retro-reflector units

The colour of the retro-reflective part of a retro-reflector unit shall be red and each retro-reflector shall comply with the relevant requirements for a retro-reflector given in CIE 72 for

- a) general construction;
- b) shape;
- c) colour;
- d) resistance to penetration by water, except that the CIL value of the retro-reflector shall be at least 90 % of the initial value or at least equal to the appropriate value given in CIE 72;
- e) adhesion of mirror coating;
- f) resistance to heat;
- g) resistance to motor fuel; and
- h) resistance to lubricating oil.

4.2.4 Fluorescent materials

Fluorescent material shall comply with the requirements for colour and for luminance factor given in 4.6.4. Fluorescent material shall be in the form of

²⁾ In the case of a triangle that has retro-reflective material on the warning face(s), before specifying a plastics material for the substrate material the purchaser should consult with the manufacturer or the supplier of the retro-reflective material regarding the compatibility of the retro-reflective material and the plastics material.

- a) sheeting having a pre-coated adhesive backing and complying with the requirement for strength of adhesion given in EAS 293-1; or
- b) fluorescent paint;³⁾ or
- c) in the case of a plastics substrate material, a fluorescent colorant incorporated in the substrate material.

4.3 Construction

4.3.1 General

A triangle shall be equilateral and generally in accordance with Figure 1. A triangle shall be so constructed that, in the case of a type A sign, it is portable or, in the case of a type B sign, it is suitable to be attached to the rear of a vehicle (see Figure 4).

4.3.2 Dimensions

The length of the sides of a triangle measured, when relevant, from the points of intersection of the sides, shall be in the range 450-550 mm. The width of the surface of the warning face(s) onto which the retro-reflective material or retro-reflectors (or both) are to be placed, shall be in the range 25-85 mm and the area of this surface shall be not less than 0.031 m² and not more than 0.102 m². The area of the fluorescent surface shall be at least 0.025 m². The corners of a type A triangle shall be rounded, the corners of a type B triangle may be rounded⁴⁾ and the radius of a rounded corner shall be half the width of the retro-reflective surface shown in Figure 1 (a).

4.3.3 Tolerances

The dimensions shall, when relevant, be subject to the appropriate of the following tolerances:

Range of dimensions			Tolerance, ±
mm			mm
0	–	50	0.5
51	–	200	1
201	–	500	2
>500			3

4.3.4 Type A triangles

A type A triangle

- a) may be collapsible and shall be provided with a folding support so constructed that, when the support is in use, there is a gap of height at least 25 mm between the bottom edge of the triangle and the ground (see Figure 1(a) and Figure 2);
- b) shall be provided with a protective cover that completely encloses the triangle when not in use.

NOTE In the case of triangles supplied as original equipment with a road vehicle, the triangles may, provided that the vehicle has a compartment intended only for storing the triangles, be supplied without a protective cover and the triangles shall still comply with the requirements for resistance to heat given in 4.6.2(b).

4.3.5 Warning face

At least one face of a type A triangle and only one face of a type B triangle shall be a warning face. A warning face shall consist of an outer triangular area that is retro-reflective and an inner triangular

³⁾ A suitability prepared surface shall have a final coat of fluorescent paint that complies with the relevant requirements of ISO 2813.

⁴⁾ Rounded corners should be specified when a triangle is to be clamped against a background that does not extend to the corners of the triangle.

area that is fluorescent, generally as shown in Figure 1. Provided that the fluorescent area is large enough (see 4.3.2), there may be a central triangular area that has a matt black coating or, in the case of a type A triangle, is hollow.

Retro-reflection shall be provided by retro-reflective material or retro-reflectors, or both, and fluorescence shall be provided by fluorescent sheeting, fluorescent paint or an incorporated fluorescent colorant (see 4.2.4), or any appropriate combination of these. Where retro-reflectors are used to provide retro-reflectivity and the retro-reflector units cover less than 30 % of the surface shown in figure 1(a) as retro-reflective surface, the rest of the said surface shall, to maintain the integrity of the triangle, be covered with red retro-reflective material or a matt red coating of a shade that is a practical match to colour No. A11 "Signal red" of ISO 7724. The warning face shall be applied symmetrically to the surface of a triangle.

4.4 Application of material and of protective coatings to warning faces

Before the application of any material to the warning face(s) and, when relevant, to the reverse face, both surfaces of a triangle shall have been cleaned of all grease, oil, corrosion products and other foreign matter and dried. A triangle having a substrate of mild steel shall, before the application of the warning face(s), have been so coated as to provide protection from corrosion.⁵⁾ The edges of a triangle shall be adequately protected from weathering.

4.5 Workmanship

The boundaries between the different areas of a triangle shall be clearly defined. Surfaces covered with fluorescent and retro-reflective material and protective and other coatings shall be free from creases, cracks, blisters, discoloration and lack of adhesion. A triangle shall be free from sharp and jagged edges and the edges of a triangle that has a metal substrate shall be free from corrosion.

4.6 Performance

4.6.1 Strength and stability (type A triangles)

- a) When a type A triangle is tested in accordance with 6.3, its strength shall be such that the applied force does not cause the apex of the triangle to be deflected by more than 50 mm and, after the force is removed, any residual deflection does not exceed 5 mm.
- b) When a type A triangle is tested in accordance with 6.4, the triangle shall not
 - 1) overturn;
 - 2) slide more than 75 mm away from its original position; or
 - 3) swivel through a horizontal angle of more than 10° (in either direction) from its original position.

4.6.2 Resistance to heat (type A triangles)

When a type A triangle together with, when relevant, its protective cover (see note to 4.3.4(b)) is tested in accordance with 6.5,

- a) the protective cover shall not become difficult to open, and shall show no sign of cracking or of adhering to the triangle; and
- b) the triangle shall show no appreciable distortion, shall still be capable of being erected and its warning faces shall show no sign of cracking or loss of adhesion.

4.6.3 Reflected luminous intensity

The reflected luminous intensity of each warning face of a triangle, determined in accordance with 6.6 for each observation angle and each angle of incidence given in Table 1, shall be at least equal to the appropriate value given in Table 1.

⁵⁾ Suggested coatings for mild steel surfaces are given in Annex C. It is recommended that, in the case of triangles made of metals other than mild steel and that are to be used in corrosive atmospheres, the purchaser discuss the relevance of added protection with the triangle manufacturer or the paint supplier or both.

Table 1 — Reflected luminous intensities of the warning face of a triangle

1	2	3	4	5
	Reflected luminous intensity, min. cd per incident lux			
	Angle of incidence degrees			
Vertical.....	0	±20	0	0
Horizontal.....	0	0	±30	±40
Observation angle:				
20'	8.00	4.00	1.75	0.60
1°30'	0.60	0.20	0.10	0.05
* ±5° in the case of retro-reflective material (see 4.2.2)				

4.6.4 Colour and luminance factor of fluorescent surfaces

When the fluorescent surface of a warning face of a triangle is tested in accordance with 6.7,

- the chromaticity co-ordinates of the surface shall, before artificial weathering, be within the area on the chromaticity diagram bounded by the limits given in Table 2; and
- the luminance factor shall, before artificial weathering, be not less than 30 % and, after weathering, not more than 60 %.

Table 2 — Chromaticity co-ordinates of the points of intersection of the boundary lines of the limiting area on the chromaticity diagram — Before weathering

1	2	3	4	5
Co-ordinate	Value of co-ordinate			
x	0.690	0.595	0.569	0.655
y	0.310	0.315	0.341	0.345

4.6.5 Resistance to artificial weathering

When a triangle is tested in accordance with 6.8,

- retro-reflective and fluorescent surfaces shall show no sign of cracking, blistering or lack of adhesion;
- each value of reflected luminous intensity of each retro-reflective surface shall be at least 50 % of the corresponding value given in 4.6.3 and the chromaticity co-ordinates of the retro-reflective surface shall comply with the requirements for the chromaticity co-ordinates after weathering given in EAS 293-1;
- the chromaticity co-ordinates of the fluorescent surface shall be within the area on the chromaticity diagram bounded by the limits given in Table 3 and the luminance factor shall comply with the applicable requirement of 4.6.4(b);
- protective and other coated surfaces, when relevant, shall show no sign of chalking, checking or a visual colour change rating lower than 4 (based on a figure of 5 for no colour change); and
- uncoated surfaces, when relevant, shall show no sign of deterioration.

Table 3 — Chromaticity co-ordinates of the points of intersection of the boundary lines of the limiting area on the chromaticity diagram — After weathering

1	2	3	4	5
Co-ordinate	Value of co-ordinate			
x	0.690	0.595	0.535	0.610
y	0.310	0.315	0.375	0.390

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4.6.6 Resistance to impact

When a triangle is tested in accordance with 6.9, coatings on surfaces, including fluorescent coatings and coverings of retro-reflective material, shall show no evidence of cracking or loss of adhesion.

4.6.7 Resistance of coatings to flaking

When the warning face(s) and other coated surfaces of a triangle having a plastics substrate are tested in accordance with 5.10, coatings shall show no sign of flaking.

4.6.8 Resistance of coatings to scratching

When the warning face(s) and other coated surfaces of a triangle are tested in accordance with 6.11, the scratch produced shall be free from jagged edges and shall not have penetrated to the substrate.

4.6.9 Resistance to salt fog

When a triangle including, when relevant, its support, is tested in accordance with 6.12,

- a) there shall be no sign of cracking, blistering or loss of adhesion on any fluorescent coating, or, when relevant, on retro-reflective material;
- b) there shall be no sign of corrosion or lack of adhesion on any retro-reflector or its fastener(s);
- c) in the case of a triangle (and, when relevant, its support) having a protective coating, there shall be no sign of corrosion of the substrate, except at the scribe mark where corrosion, creep or blisters (or any combination of these) shall not extend further than 2 mm on each side of the mark; and
- d) there shall be no sign of deterioration of surfaces or of edges.

5 Packing, marking and labelling**5.1 Packing**

Triangles shall be so packed that they are protected from damage during normal transportation and storage.

5.2 Marking

Each triangle shall bear, in legible and indelible marking on a warning face, the manufacturer's name, trade name or trade mark. The space occupied by the marking shall be of height and length approximately 5 mm and 25 mm, respectively.

The quality of the marking shall be such that, when the triangle is tested in accordance with 6.8 and 6.12, there is no loss of integrity of the marking.

5.3 Labelling**5.3.1 Type A triangles**

Instructions, in legible and indelible printing, regarding the erection of the triangle and its location relative to a stationary vehicle⁶⁾ shall be printed on the protective cover of each type A triangle or printed on a label permanently attached to the protective cover or firmly attached to the triangle (see also Figure 4).

5.3.2 Type B triangles

Each type B triangle shall bear, on the reverse face, a securely attached label that provides, in legible and indelible printing, at least the following information:

⁶⁾ The manufacturer should ascertain, from the relevant road traffic regulations, the requirements for the location of the triangle.

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- a) a warning that the triangle should not be fastened by any means that interferes with or diminishes its visibility;
- b) in the case of a triangle that has an aluminium alloy substrate, a warning that fasteners used for attaching the triangle to a vehicle must on no account be made from copper, brass, bronze or unprotected mild steel;
- c) in the case of a triangle that has a mild steel substrate, a warning of the danger that steel surfaces that become exposed during the fitting of the triangle will corrode unless they are adequately protected from corrosion, e.g. by being coated with a zinc phosphate primer.

6 Inspection and methods of test

6.1 Inspection

Visually examine and measure each triangle in the sample for compliance with all the relevant requirements of this part of the specification for which tests to assess compliance are not given in 6.3 — 6.13 (inclusive).

The manufacturer should ascertain, from the relevant road traffic regulations, the requirements for the location of the triangle.

6.2 Test specimens

From the triangles in the sample prepare the following test specimens:

- a) **Reflected luminous intensity.** — An erected triangle.
- b) **Colour and luminance factor of fluorescent surface** — Three test specimens of size approximately 70 mm × 150 mm, the faces of which are entirely covered by the fluorescent material.
- c) **Resistance to weathering** — Three test specimens of size approximately 70 mm × 150 mm that include as much of the fluorescent and, when relevant, the retro-reflective surfaces, edges, marking (see 5.2) and, when relevant, holes (for attachment) and any other coating, as is practicable. In the case of triangles that have a mild steel substrate, seal the newly cut edges.
- d) **Resistance to impact** — A test specimen of any convenient size that, when relevant, includes no retro-reflector.
- e) **Resistance of coatings to flaking** — In the case of a triangle that has a plastics substrate, a test specimen of size approximately 50 mm x 50 mm that includes as much of the fluorescent material and, when applicable, retro-reflective material and protective coating as is practicable.
- f) **Resistance to scratching** — A test specimen of size approximately 55 mm x 100 mm that includes as much of the fluorescent material and, when applicable, retro-reflective material and protective coating as is practicable.
- g) **Resistance to salt fog** — One test specimen in the case of a triangle without any protective coating, and two specimens in other cases, each specimen being similar to the specimens described in (c) above but of size approximately 100 mm x 150 mm.

6.3 Strength test (type A triangles)

So clamp the bottom edge of the triangle (if necessary, after removing its support) that the width of material held in the clamp is approximately 15 mm.

Apply a force of 2 N to the apex of the triangle in a direction that is normal to the face of the triangle and measure the deflection of the apex from its initial position. Then remove the applied force and measure the residual deflection of the apex from the face of the triangle. Check for compliance with

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6.4 Stability test (type A triangles)

Erect the triangle on a horizontal base of size at least 2 m x 1.5 m located in a wind tunnel and so formed of bituminous or concrete road surfacing that it has a medium surface texture with a geometric roughness of 0.50 ± 0.05 mm and a coefficient of friction with respect to rubber of 0.60 ± 0.5 .⁷⁾ Then subject the triangle for three consecutive periods, each period of duration at least 3 min, to a horizontal wind of speed 60 km/h and applied in a direction most likely to cause the triangle to fail to comply with the requirements for stability. Check for compliance with 4.6.1(b).

6.5 Test for resistance to heat (type A triangles)



Place the triangle in its protective cover, when applicable, and store the assembly for 12 ± 0.5 h in an atmosphere that is dry and maintained at a temperature of 60 ± 2 °C. After this period has elapsed, check for compliance with the requirements of 4.6.2.

6.6 Reflected luminous intensity test



Using the method given for the photometric test in EAS 293-1, determine the reflected luminous intensity of the specimen in accordance with the procedures in 6.6.1 and 6.6.2.

6.6.1 Single side approach

With any one of the three sides of the triangle (see 6.2(a)) in a horizontal position take, for one of the observation angles and one of the angles of incidence given in Table 1, three readings of the reflected luminous intensity along the longitudinal axis of the horizontal side, one reading being taken at the middle and one reading near each end. Use the average of the three readings and calculate the reflected luminous intensity of the warning face of the triangle.

Note Where the warning face comprises non-continuous retro-reflector units, only whole units shall be included in the test section.

Repeat the procedure for every other combination of observation angle and angle of incidence and check for compliance with 4.6.3. Repeat the test after the specimen has been weathered in accordance with 6.8 and check for compliance with 4.6.5(b).

6.6.2 Assembly approach

With the complete erected triangle mounted symmetrically (in its normal operating position) in the goniometer take, for one of the observation angles and one of the angles of incidence given in Table 1, a reading of the reflected luminous intensity of the warning face of the triangle.

Repeat the procedure for every other combination of observation angle and angle of incidence and check for compliance with 4.6.3.

6.7 Colour and luminance factor test for fluorescent surfaces

Use a suitable colorimeter with illumination and viewing conditions as recommended by the International Commission of Illumination, i.e. angles of incidence and observation of 45° and 0° respectively. Illuminate the specimen (see 6.2(b)) with illuminant C and determine the chromaticity coordinates and the luminance factor of the light diffusely reflected from the surface. Check for compliance with the applicable requirements of 4.6.4.

Note If the colorimetric characteristics have been calculated in the XYZ system, determine the luminance factor by applying the ratio $Y:Y_0$ where Y is the tristimulus value of the sample and Y_0 is that of a perfect diffuser observed under the same conditions. The test report shall contain at least the following information:

- the type of instrument (spectrophotometer, tristimulus colorimeter, etc.),

⁷⁾ Methods for determining the coefficient of friction and the geometric roughness are given in Annex B.

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- its designation (manufacturer and type),
- identification of the illuminant used, and
- lighting and viewing angles.

6.7.1 After weathering

Repeat the test after the specimen has been weathered in accordance with 6.8 and check for compliance with 4.6.5(c).

6.7.2 Painted surfaces

Test as described in 6.7 and check for compliance with the applicable requirements of 4.6.4 before weathering.

After the specimen has been weathered in accordance with 6.8, check for compliance with the applicable requirements of 4.6.5(d).

Note Rating of the change in colour according to the grey scale described in ISO 105-A02 shall be detailed according to the method for visual comparison contained in ISO 3668.

6.8 Test for resistance to artificial weathering



6.8.1 Apparatus

A weathering unit consisting of a test chamber constructed of corrosion-resistant materials and enclosing eight fluorescent UV lamps, a heated water pan and test specimen racks, and providing means for controlling and recording operating times and temperatures. The essential features of the unit are as follows:

- a) **Lamps** — The lamps are of type FS 40 fluorescent UV lamps or equivalent, the spectral energy distribution curve having a maximum at a wavelength of 313 nm with less than 1 % of the peak intensity at 280 nm. The lamps have a length of 1 220 mm and a nominal rating of 40 W when operated from a ballast providing a controlled current of 430 mA at 102 V.

The lamps are so mounted in two banks of four lamps each as to provide a uniform distribution of irradiance. The lamps in each bank are parallel and spaced at 70 mm centres.

- b) **Racks for test specimens** — Two racks for mounting the test specimens (see 6.2(c)) are provided in the chamber, each rack being of height 300 mm and width 1154 mm and so positioned that a surface of each test specimen is parallel to the plane of one bank of lamps and at a distance of 50 mm from the nearest surface of the lamps. The specimen racks and the test specimens themselves constitute the side walls of the chamber. The back surface of each test specimen is thus exposed to the ambient air.

The test specimens are so arranged that condensate forming on each test surface is caused by gravity to run off the test surface and is replaced by fresh condensate in a continuous process. Vents provided along the bottom of the test chamber admit ambient air and so prevent oxygen depletion of the condensate.

- c) **Water pan** — Water vapour is generated by the heating of water in a water pan extending under the entire specimen area and containing water to a depth of at least 25 mm.
- d) **Water supply** — The water supply has an automatic control to regulate the level in the water pan. (Distilled, de-ionized or potable tap water may be used.)
- e) **Cycle timer** — The test chamber has a continuously operating cycle timer and a controller that controls the UV radiation periods and the condensation periods as selected. An hour meter records the total time of operation and the total time of UV exposure.

- f) **Thermometer** — The temperature in the test chamber is measured by means of a thermocouple, the junction of which is inserted in a black aluminium panel of size 75 mm x 100 mm x 2.5 mm. The thermometer measures a range of 30-80 °C and is accurate to within 1 °C. The indicator dial of the thermometer is located outside the test chamber. The aluminium panel and thermocouple junction are so positioned in the centre of the exposure rack that they are subjected to the same conditions as the specimens.
- g) **Temperature control**
- 1) During UV exposure, the selected equilibrium temperature is maintained to within 3 °C by the supply of heated air to the test chamber.
 - 2) During condensation exposure, the selected equilibrium temperature is maintained to within 3 °C by the heating of the water in the pan.
 - 3) The UV temperature and condensation temperature are controlled independently of each other.
 - 4) Doors are located on the ambient air side of the specimen rack to act as insulation during the UV exposure and to minimize draughts. The doors are so arranged that they do not interfere with the ambient air cooling of the specimens during the condensation exposure.

6.8.2 Procedure

- a) Seal the cut edge of each specimen, when relevant (see 6.2(c)).
- b) Mount the test specimens in the specimen racks with the test surfaces facing the lamps.
- c) Select the following cycle conditions;
 - 1) 4 h of UV exposure at 60 °C;
 - 2) 4 h of condensation exposure at 50 °C.
- d) Except for servicing the apparatus and inspecting the specimens, repeat the cycle continuously over a period of 240 h for fluorescent material and 800 h for retro-reflective material.
- e) At the end of the specified exposure period, examine the specimens under 10x magnification.
- f) Check for compliance with the applicable requirements of 4.6.5 and 5.2.

6.9 Test for resistance to impact

Use the apparatus and procedure described in ISO 1518 to subject each coating and covering (see 3.6.6) of each specimen (see 6.2(d)) to an impact energy of 2.25 J in the case of a triangle having a steel substrate, 1.15 J in the case of a triangle having an aluminium alloy substrate and an impact energy of a suitable value in the case of a triangle having a substrate of another material.⁸⁾ Check for compliance with the requirements of 4.6.6.

6.10 Test for resistance of coatings to flaking (triangles having a plastics substrate)

On the specimen (see 6.2(e)) make, with a razor blade, a series of parallel cuts 2 mm apart through the coating to the plastics substrate, then make a second similar series of cuts at right angles to the first, and check for compliance with 4.6.7. When relevant, repeat the test on the other coating(s) on the specimen.

⁸⁾ In the case of a triangle having a substance of a material other than steel or aluminium alloy, the value of the impact energy to be applied should be obtained from a recognized testing authority.

6.11 Test for resistance of coatings to scratching

Use the apparatus and procedure described in ISO 1518, with the needle loaded with masspieces of total mass 2 000 g, to test the coating on each specimen (see 6.2(f)). Check for compliance with 4.6.8.

6.12 Test for resistance to salt fog

In the case of specimens that have one or more coated surfaces, make on each such surface (with the cutting edge of the cutting tool held at an angle of about 30° to the surface and the plane of the blade perpendicular to the surface), a scribe mark of length about 75 mm and that penetrates through the coating to the substrate. Then, using the apparatus and method described in ISO 7253, subject the specimen(s) (see 6.2(g)) to the test for a period of 240 h. After a 24 h recovery period, examine for compliance with the applicable requirements of 4.6.9 and 5.2.

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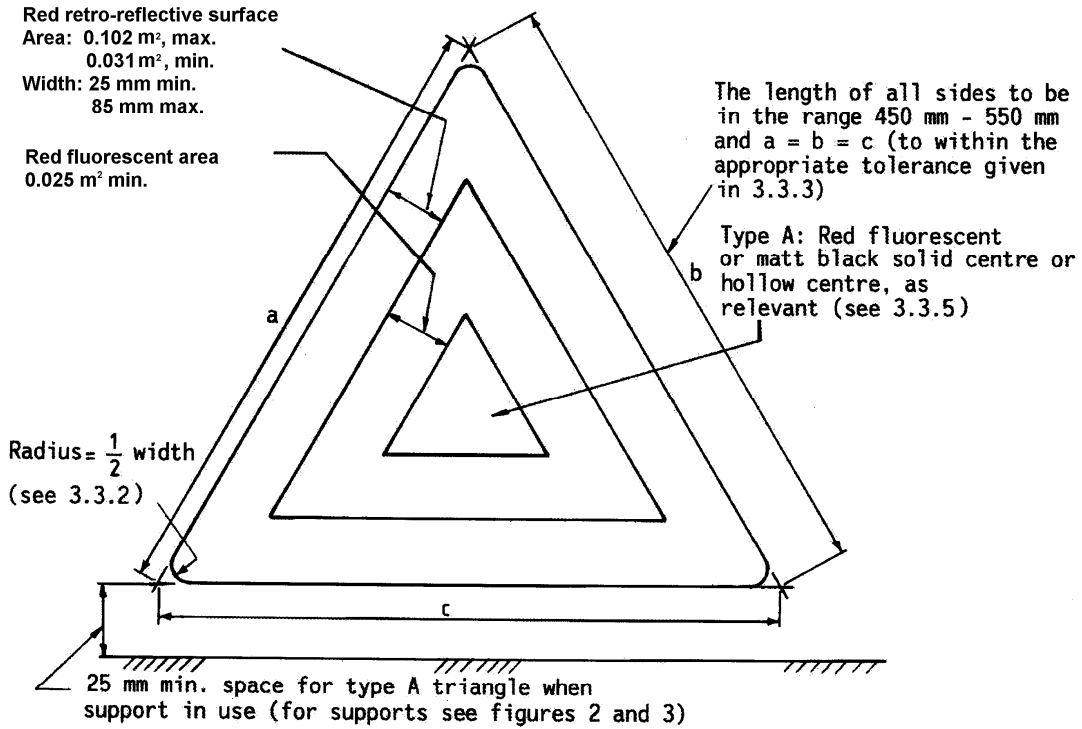
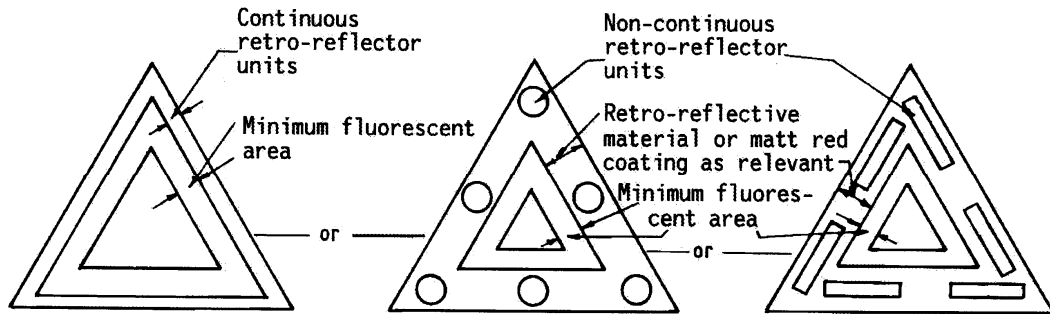


Figure 1(a) — Dimensions



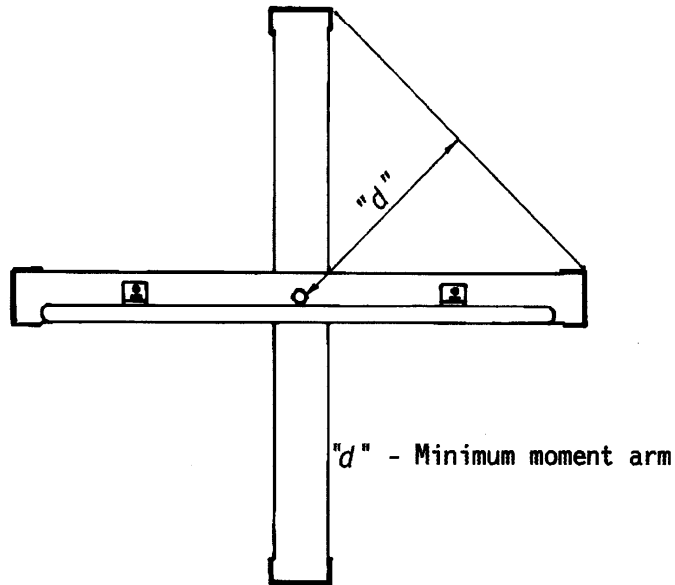
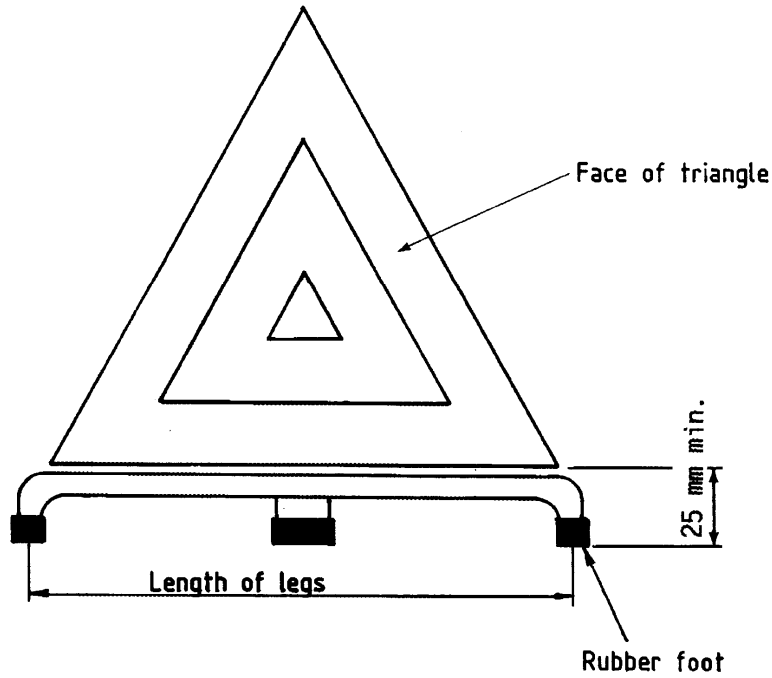
Not to scale

Figure 1(b) — Layouts of retro-reflective surfaces incorporating retro-reflector units

NOTE The drawings given in figures 1-3 are purely to identify parts and to specify dimensions. They are not intended as design guides.

Figure 1 — Triangle

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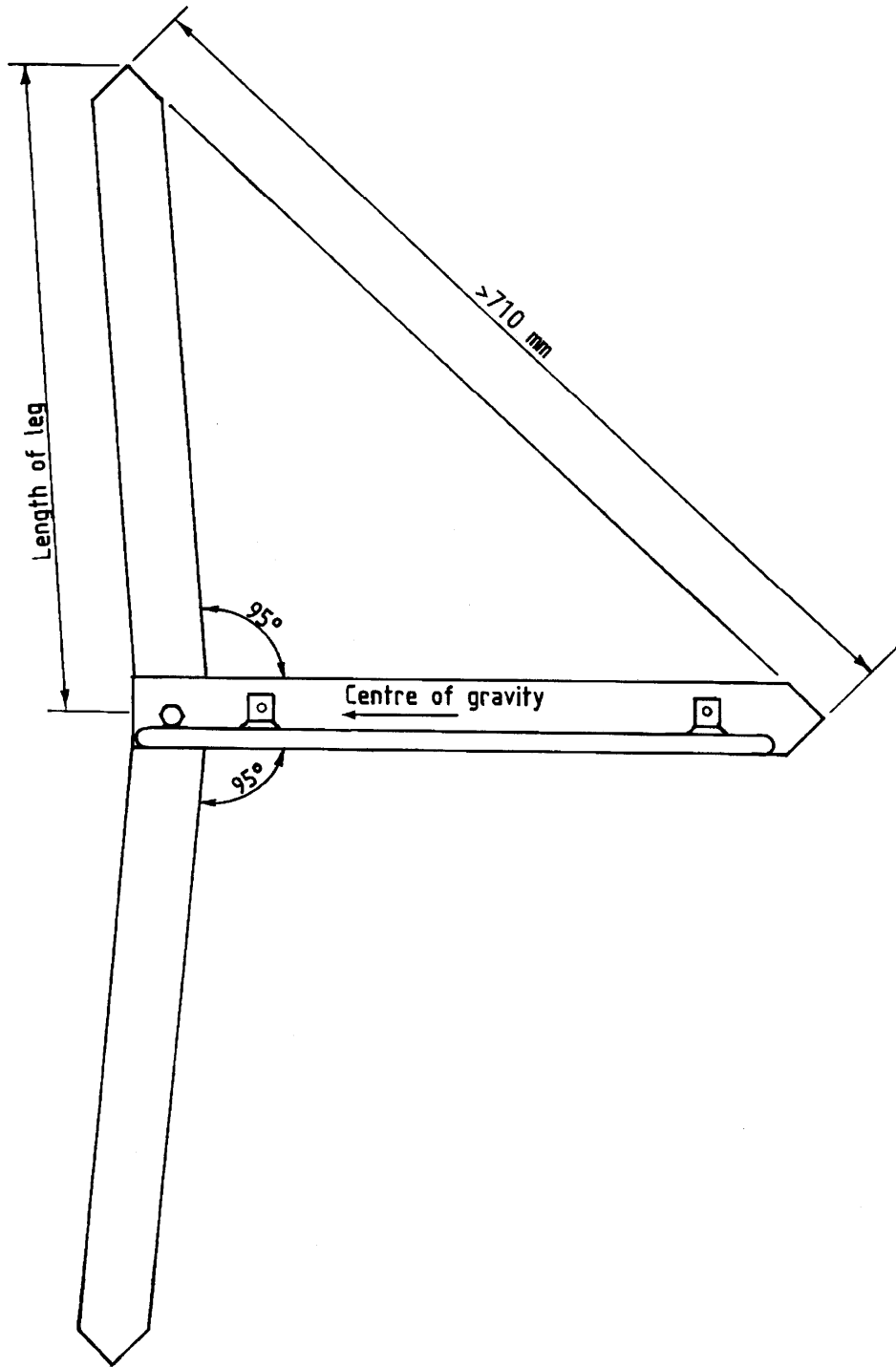


NOTE Recommended mass for stability:
2 kg for triangle with sides of length 450 mm
2.5 kg for triangle with sides of length 550 mm

Not to scale

Figure 2 — Typical support for type A triangle

ward



NOTE Recommended mass for stability:
2 kg for triangle with sides of length 450 mm
2.5 kg for triangle with sides of length 550 mm.

Not to scale

Figure 3 — Typical support for type A triangle

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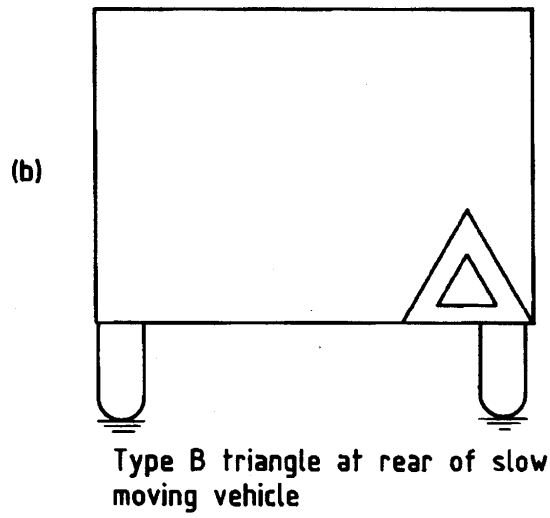
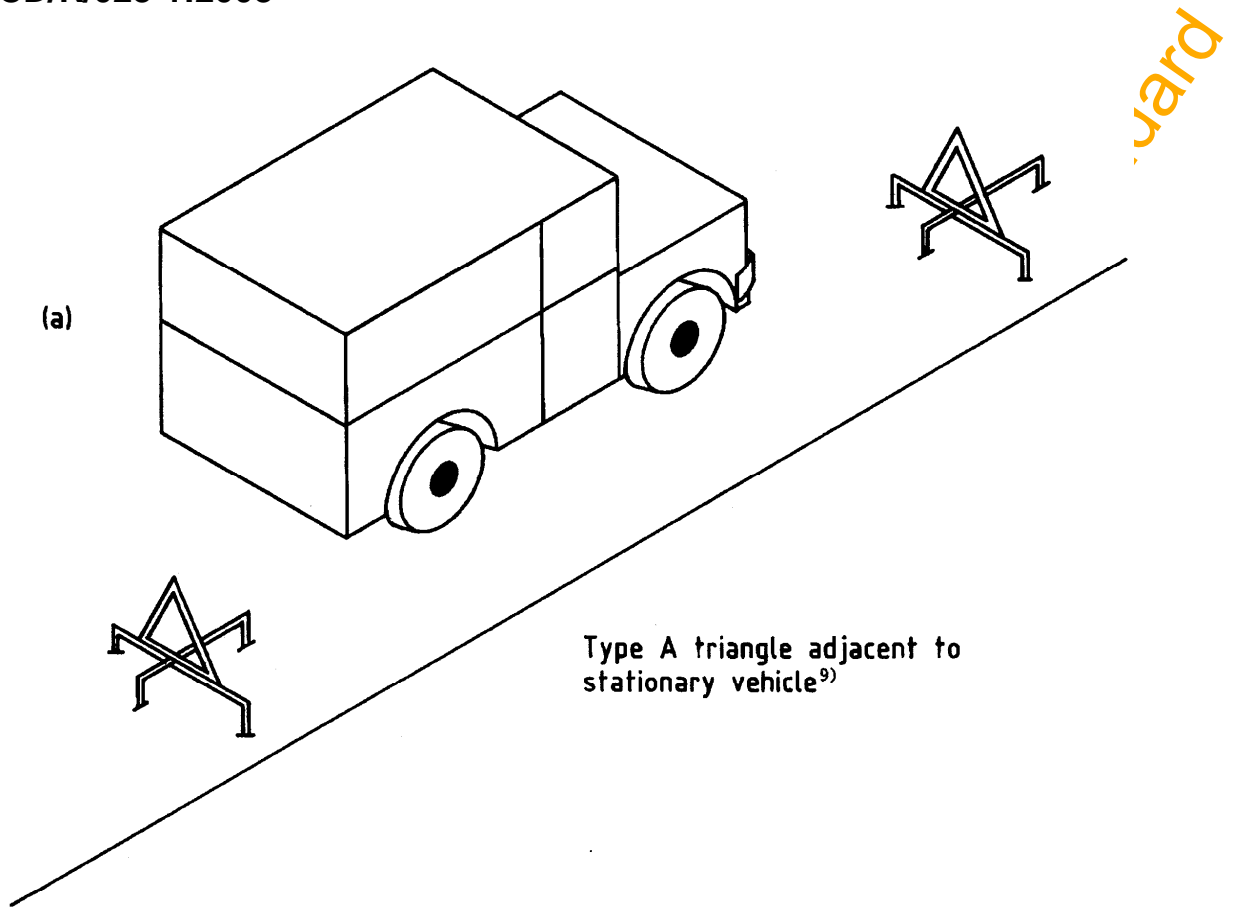


Figure 4 — Typical locations of triangles

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Annex A
(informative)

Notes to purchasers

Standard

The following requirements must be specified in tender invitations and in each order or contract:

- a) the type of sign (see 4.1);
- b) the substrate material and, in the case of a plastics material, whether it is to contain a red fluorescent colorant (see 4.2.1 and 4.2.1(b));
- c) the length of the sides and, in the case of a type B triangle, whether the corners are to be rounded (see 4.3.2);
- d) whether warning faces are to consist of retro-reflective material or retro-reflectors or both (see 4.3.5); and
- e) in the case of triangles having a substrate of material other than mild steel, whether the warning face(s) and, when relevant, the reverse face are to be given a protective coating (see 4.4).

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Annex B
(informative)

Determination of the coefficient of friction and the geometric roughness of a road surface

Standard

B.1 Coefficient of friction

B.1.1 Apparatus

A machine, the design of which is based on the principle of Charpy's pendulum and that measures the energy lost when a rubber foot is rubbed against the test surface. The machine consists basically of the following (see Figure B.1):

- a) rubber foot pressed downwards by a spring and so fixed to a pendulum that the rubbing surface is 500 mm from the axis of rotation;
- b) device for ensuring that the supporting column of the instrument is vertical;
- c) device for raising and lowering the axis of the pendulum;
- d) device for so lifting and releasing the arm of the pendulum that it drops from a horizontal position;
- e) needle fixed to the pendulum's axis of rotation and carried along by the pendulum in its forward motion; and
- f) dial calibrated to read the loss of energy of the pendulum.

B.1.2 Procedure

Wet the test area of the road surface and adjust the length of rub L of the machine (see Figure B.1) in accordance with the manufacturer's instructions.

Place the machine in position on the area to be tested and raise and release the pendulum at least three times, noting and recording each time the figure for the loss of energy shown on the calibrated dial.

Repeat the above procedure on at least three other points on the road surface. Record the mean value of the results and calculate the coefficient of friction of the road surface with respect to rubber (see 6.4).

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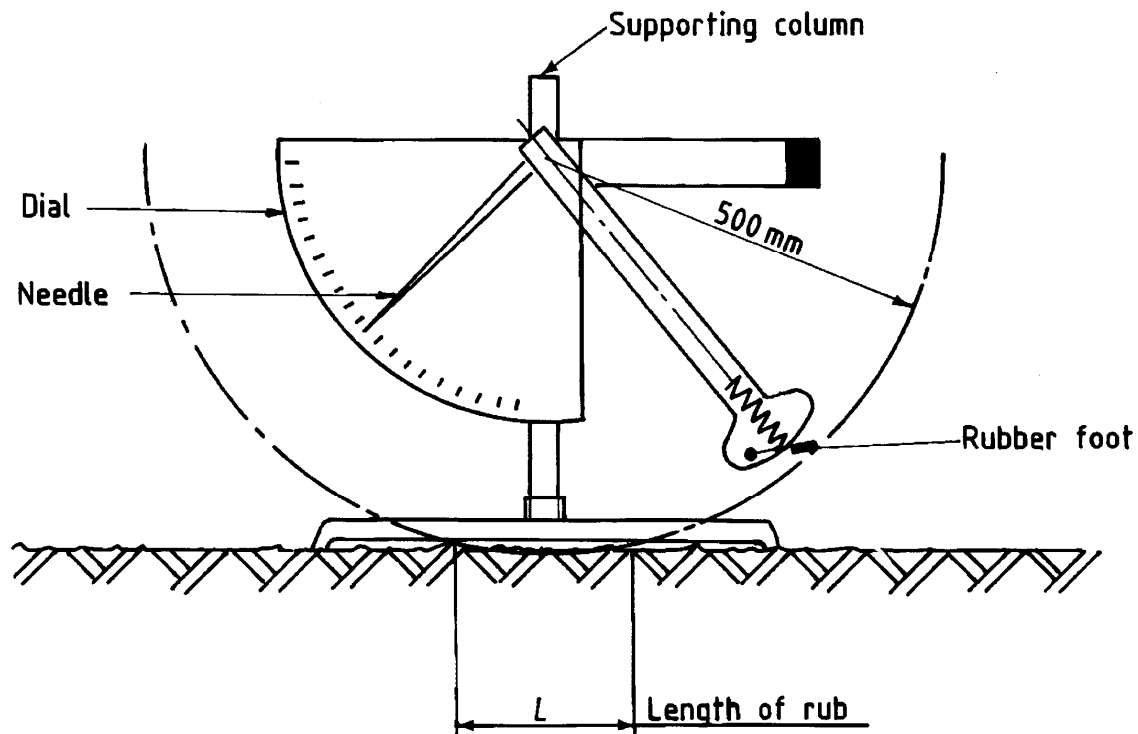


Figure B.1 — Typical machine for measuring coefficient of friction of road surface

B.2 Geometric roughness

B.2.1 Apparatus and materials

- a) **Cylinder** — A cylinder of any suitable material, of internal diameter 20 mm and length 80 mm, closed at one end, and having a capacity of $25 \pm 0.15 \text{ cm}^3$
- b) **Disc** — A flat disc of diameter 65 mm, having one surface covered with a sheet of rubber of thickness 1.5 — 2.5 mm and having a suitable handle securely attached to the other surface.
- c) **Sand** — A supply of round-grain sand (or Fontainebleau sand) of grain size not less than 160 μm and not more than 315 μm .¹⁰⁾

d) Additional equipment

- 1) a soft brush;
- 2) a rule measuring up to 500 mm;
- 3) a receptacle for storing the sand; and
- 4) a wind-break (e.g. an old tyre that, when necessary, can be placed around the sand)

B.2.2 Procedure

- a) Ensure that the road surface to be tested is dry and, using the soft brush, remove any dirt or loose gravel.

¹⁰⁾ Sand of grain size in this range may be obtained by screening the sand on industrial screens.

Fill the cylinder with sand and ensure, by knocking the base of the cylinder at least three times and topping up with sand if necessary, that its contents are on the road surface in a single heap.

By repeated circular movements of the rubber-faced disc, carefully spread out the sand over the surface until a circle of sand with the largest possible diameter is formed. (The sand will then have filled all the depressions in the surface up to a depth decided by the highest points of the surface and the diameter of the sand circle.)

- b) Measure and record two diameters, one at right angles to the other, of the sand circle formed on the surface and calculate the mean value of these two dimensions. If this value is in the range 240-265 mm, the equivalent geometric roughness of the surface is 0.50 ± 0.05 mm as required for the test given in 6.4.

ward

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Annex C
(informative)**Coatings for mild steel surfaces**

Standard

Mild steel surfaces should be prepared and cleaned immediately before the application of either

- a) a coat, of dry film thickness at least 25µm, of a zinc phosphate primer that complies with the requirements of ISO 6745; or
- b) a powder-coating that has a dry film thickness of at least 75 µm and of a matt or satin finish, or
- c) a zinc/iron phosphate surface-conversion process that produces a coating mass of at least, 1.0 g/m², that is then immediately coated with an anti-corrosion epoxy resin primer that has a dry film thickness of at least 25 µm.

NOTE Primed coats as described in (a) and (c) above that are not further protected by the application of retro-reflective (see 4.2.2) or fluorescent materials (see 4.2.4) or matt red or black coatings (see 4.3.5) shall be top-coated with an additional coating.

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Annex D
(informative)

Quality evaluation of triangles produced to the requirements laid down in this part of the specification

D.1 Equality verification

D.1.1 When a purchaser requires quality verification on an ongoing basis of triangles produced to this part of the specification, it is suggested that, rather than concentrating solely on evaluation of the final product, he also direct his attention to the quality management system applied by the manufacturer. In this connection it should be noted that ISO 9001 covers the provisions of an integrated quality system.

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Standard