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## **EAST AFRICAN STANDARD**

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**Retro-reflective and fluorescent warning signs for road vehicles —  
Specification — Part 5: Retro-reflective chevron decals**

**EAST AFRICAN COMMUNITY**

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## 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 5: Retro-reflective chevron decals

## 1 Scope

This part of the specification covers requirements for retro-reflective warning signs manufactured as protective coated chevron decals having self-adhesive bases of pigmented vinyl or other polymeric material and intended for use on motor vehicles operating on public roads<sup>1)</sup>.

## 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.

CIE 15, *Colorimetry*

CIE 54, *Retroreflection — Definition and measurement*

ISO 2810, *Paints and varnishes — Natural weathering of coatings — Exposure and assessment*

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 1514, *Paints and varnishes — Standard panels for testing*

ISO 1518, *Paints and varnishes — Scratch test*

EAS 157, *Gasoline (petrol) leaded — Specification*

EAS 177, *Automotive diesel — Specification*

BS 7664, *Specification for undercoat and finishing paints*

EAS 296, *Liquid household hand dishwashing and light duty detergents — Specification*

ISO 9001, *Quality management systems — Requirements*

## 3 Definitions

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

### 3.1

#### **chevron sign**

a warning sign on which retro-reflective stripes are arranged in a chevron pattern and which is intended to be displayed on the rear of a vehicle

### 3.2

#### **overlay**

that part of the decal where a second colour is superimposed on the basic colour of the decal by printing or any other means

### 3.3

#### **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

<sup>1)</sup> To ensure correct use of these signs, consult the relevant road traffic regulations.

3.4

**standard test conditions**

a temperature of 25 °C ± 2 °C and a relative humidity of 50 % ± 4 %

3.5

**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 decal shall be a retro-reflective chevron sign of type J (see Figure 1).

**4.2 Materials and opacity**

**4.2.1 Materials**

The materials of the components of the decal shall be as follows:

- a) **Base.** The base shall consist of a fully pre-shrunk, flexible and dimensionally stable clear or pigmented vinyl or other polymeric material.
- b) **Protective backing.** The removable protective backing shall consist of treated paper or other suitable material.
- c) **Protective coating.** The face of a decal shall be coated with a durable weather-resistant protective coating.
- d) **Adhesive.** The back of the base shall be coated with a non-migratory self-adhesive.

**4.2.2 Retro-reflective surfaces**

The retro-reflective surfaces shall be sufficient in size and performance as to enable the sign to comply with the requirements for the coefficient of retro-reflection given in 4.4.1.

**4.2.3 Opacity**

The base shall be so opaque as to ensure that the colour of the surface to which the decal is applied is not visible through the decal.

**4.3 Design, construction, use and storage**

**4.3.1 Design and construction**

A decal shall be rectangular and shall be in accordance with Figure 1. The decal, when applied to a suitable surface (see 4.3(c)) in accordance with the manufacturer's directions, shall not delaminate at any point nor show any surface irregularity such as wrinkling, bubbling or stretching. The corners of the decal shall, if so required, be rounded.

Overlaid colours shall exhibit no separation from, nor any loss of adhesion to the base nor shall there be any bleeding of colour from the base colour into the overlaid colour. The edges of a decal shall be smooth and clean cut.

**4.3.2 Use**

Decals shall be suitable for use on smooth uni-directional clear surfaces of such materials as glass, painted metal and fully cured rigid plastics.

### 4.3.3 Storage stability

Decals shall be capable of being stored flat for a minimum of two years under conditions recommended by the manufacturer.

## 4.4 Performance

### 4.4.1 Coefficient of retro-reflection

When measured in accordance with 6.3 at angles of observation and incidence of 0.33° and 5° respectively, the coefficient of retro-reflection shall be at least

- in the case of a red retro-reflective surface, 36 cd/lux/m<sup>2</sup>, and
- in the case of a yellow retro-reflective surface, 35 cd/lux/m<sup>2</sup>.

### 4.4.2 Colour of retro-reflective surfaces

When the retro-reflective surface of a decal is tested in accordance with 6.5 both before and after the weathering test given in 6.6 or 6.7, the chromaticity co-ordinates of the surface shall be within the area on the chromaticity diagram bounded by the limits given in Table 1 and Table 2, relevant to the colour.

**Table 1 — Chromaticity co-ordinates of the points of intersection of the boundary lines of the limiting area on the chromaticity diagram — before and after weathering — red surfaces**

1	2	3		
Co-ordinate	Value of co-ordinate			
X	0.735	0.674	0.569	0.655
y	0.265	0.236	0.341	0.345

### 4.4.3 Luminance factor of retro-reflective surfaces

When the retro-reflective surface of a decal is tested in accordance with 6.5 both before and after the weathering test given in 6.6 or 6.7, the luminance factor shall be at least.

- in the case of a red retro-reflective surface, 0.03, and
- in the case of a yellow retro-reflective surface, 0.16.

**Table 2 — Chromaticity co-ordinates of the points of intersection of the boundary lines of the limiting area on the chromaticity diagram — before and after weathering — yellow surfaces**

1	2			
Co-ordinate	Value of co-ordinate			
X	0.545	0.487	0.427	0.465
y	0.454	0.423	0.483	0.534

### 4.4.4 Resistance to weathering

A decal shall comply with either 4.4.4.1 or 4.4.4.2.

#### 4.4.4.1 Natural weathering

When a decal is tested in accordance with 6.6,

- it shall not be removable from the test panel without damage,
- it shall show no sign of cracking, blistering, lack of adhesion, chalking or checking,

- c) it shall show no more than 1 mm edge shrinkage or edge lifting of the base on any edge,
- d) it shall show no edge damage extending more than an average of 1 mm or more than 4 mm at any one point into the decal from the edge, except that non-functioning of cells in cellular decals that have been cut or damaged during the preparation of the test panel shall not be grounds for rejection, and
- e) the coefficient of retro-reflection of the red or yellow retro-reflective surfaces at angles of observation and incidence of 0.33° and 5°, respectively, shall be at least 80 % of the value specified in 4.4.1, relevant to the colour.

#### **4.4.4.2 Artificial weathering**

When a decal is tested in accordance with 6.7,

- a) it shall show no sign of cracking, blistering, lack of adhesion, chalking or checking;
- b) the coefficient of retro-reflection of the red or yellow retro-reflective surfaces at angles of observation and incidence of 0.33° and 5°, respectively, shall be at least 80 % of the value specified in 4.4.1, relevant to the colour.

#### **4.4.5 Elongation**

When a decal is tested in accordance with 6.8, the elongation shall not exceed 30 %.

#### **4.4.6 Flexibility**

When a decal is tested in accordance with 6.9, there shall be no evidence of cracking.

#### **4.4.7 Shrinkage**

When a decal is tested in accordance with 6.10, the shrinkage shall not exceed 0.5 mm.

#### **4.4.8 Adhesion**

When a decal is tested in accordance with 6.11, the following minimum adhesive strengths shall be achieved:

- a) after 1 h: 8 N per 15 mm specimen width;
- b) after 72 h: 15 N per 15 mm specimen width;
- c) after 800 h of artificial weathering in accordance with 6.7: 15 N per 15 mm specimen width.

**4.4.9** Deleted by amendment No. 4.

#### **4.4.10 Hydrocarbon resistance**

When a decal is tested in accordance with 6.13, there shall be no sign of softening or dissolving of the surface, no removal of surface material and no permanent staining.

#### **4.4.11 Resistance to detergent**

When a decal is tested in accordance with 6.14, no part within 10 mm of the edge of the decal shall show evidence of deterioration that would reduce the effectiveness of the decal.

#### **4.4.12 Low temperature behaviour**

When a decal is tested in accordance with 6.15, the base and the adhesive shall not separate before rupture of the base occurs.

#### 4.4.13 Resistance of coatings to scratching

When the warning face and other coated surfaces of a sign are tested in accordance with 6.16, the scratch produced shall be free from jagged edges and shall not have penetrated to the substrate.

## 5 Packing, marking and labelling

### 5.1 Packing

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

### 5.2 Marking

Each decal shall bear, in legible and indelible marking on the warning face, the manufacturer's name, trade name or trade mark. The space occupied by this 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 sign is weathered as in 6.6 or 6.7 and tested in accordance with 6.12, there is no loss of integrity of the marking.

### 5.3 Labelling

Each decal shall bear, on the reverse face, in legible and indelible printing, at least the following information:

- a) a warning that the decal should not be applied in any way that interferes with or diminishes its visibility or the legibility of the marking;
- b) complete and detailed directions for its application to a suitable surface;
- c) a list of suitable surfaces or, alternatively, a list of unsuitable surfaces.

## 6 Inspection and methods of test

### 6.1 Inspection

Visually examine and measure each decal 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 – 6.15 (inclusive).

### 6.2 Preparation of test panels

#### 6.2.1 Aluminium panels

Prepare aluminium panels of the following sizes in accordance with ISO 1514:

- a) 70 mm × 150 mm × 1 mm (nine required);
- b) 100 mm × 100 mm × 1 mm, having a hole of 7 mm diameter in the centre (two required);
- c) 160 mm × 160 mm × 1 mm (two required); and
- d) 450 mm × 150 mm × 1 mm (one required).

#### 6.2.2 Steel panels

Prepare three steel panels each of size 70 mm × 150 mm × 0.8 mm in accordance with ISO 1514, and coat them with paint that complies with the requirements for type II paint of SANS 681. After 16 h to 24 h, repaint them with enamel paint.

### 6.3 Coefficient of retro-reflection test

Determine the coefficient of retro-reflection in accordance with the method given in CIE Publication 54. On each specimen take the average of two readings at rotation angles (about the reference axis) that are 90° apart. Check for compliance with 4.4.1.

6.4 Reserved.

## 6.5 Colour and luminance factor test for retro-reflective surfaces

Determine the chromaticity co-ordinates and the luminance factor of the specimen by means of a spectrophotometer or other equally suitable colour measuring device in accordance with the method given in CIE Publication 54, using 45/0 geometry and Standard Illuminant D<sub>65</sub> as defined in CIE Publication 15. Check for compliance with 4.4.2 and 3.4.3. Repeat the test after the specimen has been weathered in accordance with 6.6 or 6.7, and again check for compliance with 4.4.2 and 4.4.3.

### NOTE

- a) 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<sub>0</sub> is that of a perfect diffuser observed under the same conditions.
- b) The test reports may contain the following information:
  - 1) The type of instrument used (spectrophotometer, tristimulus colorimeter, etc.),
  - 2) its designation (manufacturer and type), and
  - 3) lighting and viewing angles.

## 6.6 Test for resistance to natural weathering



### 6.6.1 Specimens

A specimen of size 450 mm x 100 mm cut from the decal under test, applied to the panel as given in 6.2.1(d), and conditioned under standard test conditions for 24 h.

### 6.6.2 Procedure

- a) Examine the test specimen for any defects such as checking, cracking, blistering, delamination, discoloration, shrinking and loss of adhesion. Record any such defects.
- b) Expose the test specimen to weathering in accordance with ISO 2810 for 24 months.
- c) Examine the test specimen for defects (ignoring those defects previously recorded), and check for compliance with 4.4.4.1.

## 6.7 Test for resistance to artificial weathering

NOTE Weather the specimen required for 6.11.3(i) concurrently with that used in this test.

### 6.7.1 Specimens

A specimen cut from the decal under test, applied to a panel as given in 6.2.1 (a), and conditioned under standard test conditions for 24 h.

### 6.7.2 Procedure

- a) Examine the test specimen for any defects such as checking, cracking, blistering, delamination, discoloration, shrinking and loss of adhesion. Record any such defects.
- b) Using the apparatus and procedure given in ISO 4892-2, expose the specimens accordingly using the parameters given in table 3, for the appropriate period given in Table 3.
- c) Examine the test specimen for defects (ignoring those defects previously recorded), and check for compliance with 4.4.4.2.

Table 3 — Artificial weathering test parameters

1	2	3
<b>Exposure parameters</b>	<b>Air-cooled lamp</b>	<b>Water-cooled lamp</b>
Light/dark/water spray cycle	Continuous light with water spray on specimens for 18 min every 2 h (18/102)	Continuous light with water spray on specimens for 18 min every 2 h (18/102)
Black standard temperature during light only periods	(65 ± 3) °C using a black standard thermometer	(63 ± 2) °C using a black panel temperature
Relative humidity	(50 ± 5) %	(50 ± 5) %
Irradiance (W/m <sup>2</sup> ) controlled at over a 300 nm - 400 nm range over a 300 nm - 800 nm range	60 550	60 630
<p>NOTE 1 Water used for specimen spray should contain no more than 1 ppm silica. Higher levels of silica could produce spotting on samples and variability in results. Water of the required purity can be obtained by distillation or by a combination of deionisation and reverse osmosis.</p> <p>NOTE 2 Whilst irradiance levels should be set at the above levels, variations in filter ages and transmissivity, and in calibration variations, will generally mean that an irradiance error will be in the order of ± 10 %.</p>		

## 6.8 Test for elongation

### 6.8.1 Apparatus

Suitable pendulum type tensile-strength testing machine.

### 6.8.2 Specimens

Five strips each of size 15 mm × 150 mm cut from the decal under test. Each strip is cut from the decal with a different orientation in relation to the decal.

### 6.8.3 Procedure

- Remove the backing from a strip.
- Clamp the strip in the jaws of the machine and ensure that the initial distance between the jaws is 75 mm ± 2 mm.
- Operate the movable jaw at a rate of 300 mm/min ± 5 mm/min and apply a force of 10 N to the strip. Immediately measure the increase in length.
- Express the increase in length as a percentage of the original length between the jaws.
- Repeat steps (a)-(d) above on the remaining four strips.
- Take the elongation as the average of the five values calculated, and check for compliance with 4.4.5.

## 6.9 Test for flexibility

### 6.9.1 Preparation of specimens

Cut a specimen of size 100 mm × 100 mm from the decal under test, remove the backing, and cover the adhesive with talcum powder to prevent sticking. Condition the specimen for 4 h under standard test conditions.

**6.9.2 Procedure**

Wrap the specimen with the reflecting surface outwards around a mandrel of 20 mm diameter and of suitable length. Check for compliance with 4.4.6.

**6.10 Test for shrinkage**

**6.10.1 Specimens**

Two specimens of size 150 mm × 150 mm cut from the decal under test, each applied to a separate panel as given in 6.2.1(c), and conditioned under standard test conditions for 72 h.

**6.10.2 Procedure**

- a) Place the panels in a suitable oven maintained at  $65\text{ °C} \pm 2\text{ °C}$  for 48 h, allow the panels to cool and measure the greatest shrinkage of each specimen either along the panel or across the panel.
- b) Express the total shrinkage as an average of the two values obtained.
- c) Check for compliance with 4.4.7.

**6.11 Test for strength of adhesion**

**6.11.1 Apparatus**

Tensile-strength testing machine, as given in 6.8.1.

**6.11.2 Specimens**

Eighteen strips each of size 15 mm × 170 mm cut from the decal under test.

**6.11.3 Procedure**

- a) Remove the backings from three specimens. Apply the strips separately to a single panel as given in 5.2.2, in accordance with the manufacturer's instructions. Start the application from one of the short edges of the panel and apply the specimens parallel to the long edge. The specimens will overlap the panel by 20 mm.
- b) After 1 h, loosen the overlapping end of one of the three specimens, fold this free end at an angle of  $180^\circ$  and pull off until approximately 50 mm remains bonded to the panel.
- c) Clamp the bare end of the panel in the lower jaw of the tensile-strength testing machine and the free end of the loosened specimen in the upper jaw.
- d) Operate the movable jaw at a rate of  $300\text{ mm/min} \pm 5\text{ mm/min}$  to strip off the specimen and record the maximum force needed.
- e) Repeat steps (b)-(d) above on the remaining two specimens and express the adhesion strength as the average value of the three determinations.
- f) Repeat the entire procedure given in (a)-(e) above, but use three strips applied separately to a single aluminium panel as given in 6.2.1 (a).
- g) Check both average values for compliance with 4.4.8(a).
- h) Repeat steps (a)-(f) above, but carry out the test after 72 h. Check for compliance with 4.4.8(b).
- i) Repeat steps (a)-(f) above, but carry out the test after 800 h of artificial weathering (see note to 6.7).

Check for compliance with 4.4.8(c).

**6.12** Reserved.

### **6.13 Test for resistance to hydrocarbons**

#### **6.13.1 Solvents**

- a) **87 grade petrol** without any alcohol content and that complies with EAS 157.
- b) **Diesel fuel** that complies with EAS 177.

#### **6.13.2 Specimens**

Two decals of suitable size, each applied to a separate panel as given in 6.2.1 (a) and conditioned under standard test conditions for 24 h.

#### **6.13.3 Procedure**

- a) Saturate a clean rag in the solvent as given in 6.13.1 (a), wipe one of the specimens and allow it to stand for 5 min. Check for compliance with 4.4.10.
- b) Saturate a clean rag in the solvent as given in 6.13.1(b), wipe the other specimen and allow it to stand for 5 min. Check for compliance with 4.4.10.

### **6.14 Test for resistance to detergents**

#### **6.14.1 Solution**

A 1 % (*m/m*) aqueous solution of detergent that complies with EAS 296.

#### **6.14.2 Specimens**

Two decals of suitable size, each applied to a separate panel as given in 6.2.1 (a) and conditioned under standard test conditions for 24 h.

#### **6.14.3 Procedure**

Immerse half of each panel for 18 h in the solution maintained at  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ . Remove, rinse and allow to dry under standard test conditions for 24 h. Inspect the immersed area of each specimen and compare it with the area not immersed. Note any defects such as embrittlement, cracking, blistering, bleeding, shrinking, delamination and loss of colour, gloss and adhesion. Check for compliance with 4.4.11.

### **6.15 Test for low temperature behaviour**

#### **6.15.1 Specimens**

A specimen of size 25 mm × 70 mm cut from the decal under test, applied to a panel as given in 6.2.1 (a), conditioned under standard test conditions for 24 h and then conditioned at  $-10^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$  for at least 5 h.

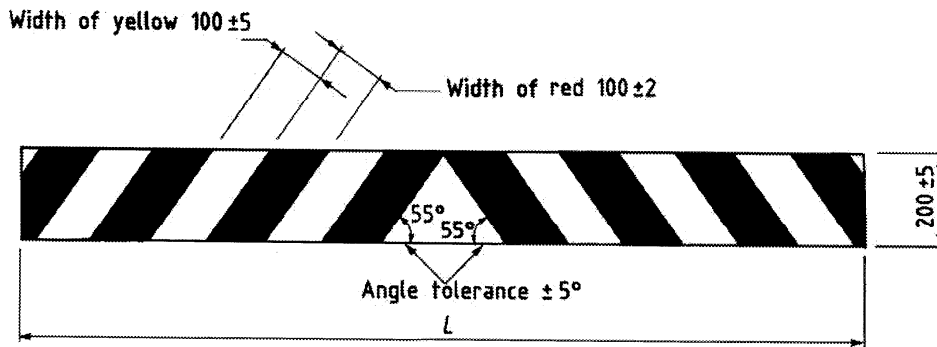
#### **6.15.2 Procedure**

Using a 20 mm wide steel laboratory spatula having a round tip, shock the edge of each specimen sharply with the spatula tip to attempt to induce separation between the base film and the adhesive. Check for compliance with 4.4.12.

### **6.16 Test for resistance of coatings to scratching**

Use the apparatus and procedure described in ISO 1518, with the needle loaded with masspieces to a total mass of 1000 g, to test the coating on each specimen. Check for compliance with 4.4.13.

Dimensions in millimetres



NOTE The length  $L$  shall be selected to indicate the width of the vehicle to within 400 mm on either side, e.g. the length shall be at least 1.70 m for a 2.5 m wide vehicle and at least 1.80 m for a 2.6 m wide vehicle.

Figure 1 — Retro-reflective chevron sign (type J)

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**Annex A**

**Notes to purchasers**

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

- a) The size of the chevron sign (see Figure 1)
- b) Whether the corners are to be rounded (see 4.3.1)
- c) The material to be used for retro-reflective and other surfaces.

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Annex B

Quality evaluation of retro-reflective chevron decals

**B.1 Quality verification**

**B.1.1** When a purchaser requires ongoing verification of the quality of retro-reflective chevron decals, it is suggested that, instead of concentrating solely on evaluation of the final product, he also direct his attention to the manufacturer's quality system. In this connection it should be noted that ISO 9001 covers the provision of an integrated quality system.

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