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## **EAST AFRICAN STANDARD**

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**High penetration-resistant laminated safety glass for motor vehicles — Specification**

**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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# High penetration-resistant laminated safety glass for motor vehicles — Specification

## 1 Scope

This specification covers high penetration-resistant laminated safety glass including bullet-resistant glazing materials for use in vehicles.

NOTE When relevant, the provision of flat safety glass specimens for the tests in 6.6, 6.7, and 6.8 is a matter for agreement between the manufacturer and the purchaser.

## 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.

BS EN 1063, *Glass in building — Security glazing — Testing and classification of resistance against bullet attack*

CD/K/035:2008, *Uniform provisions concerning the approval of safety glazing materials and their installation on vehicles*

## 3 Definitions

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

### 3.1

#### **acceptable**

acceptable to the authority administering this standard, or to the parties concluding the purchase contract, as relevant

### 3.2

#### **bullet-resistant glazing material**

a glazing material that is constructed, treated or combined with the intention of affording protection against a specified level of attack with handguns, rifles and shotguns

NOTE Such materials might include laminated glass with one or more plastics interlayers, laminated glass that incorporates high tensile steel wire mesh in a plastics interlayer, rigid plastics or laminated plastics interlayers, or an acceptable combination of these materials.

### 3.3

#### **defective**

a safety glass product that fails in one or more respects to comply with the appropriate requirements of the specification

### 3.4

#### **glass for special applications**

glass of which the direct luminous transmittance has been reduced on purpose

### 3.5

#### **high penetration-resistant safety glass (HPR)**

glass that complies with the specified impact resistance requirements for windscreens

### 3.6

#### **laminated safety glass**

two or more layers of glass held together by one or more layers of plastics material

**3.7**

**lot**

not less than 10 and not more than 10 000 safety glasses from the same source of manufacture and of the same type and bearing the same trade mark, submitted at any one time for inspection and testing

**3.8**

**obscuration band**

an opaque or tinted band along the bottom edge of a glass

**3.9**

**primary vision area**

that part of a windscreen through which the principal field of vision is obtained and, in the absence of specified boundaries, extending to within 100 mm from the top and side edges and 50 mm from the bottom edge of the windscreen (or 50 mm from the top of the obscuration band, if present), but excluding areas where designed changes in curvature give rise to inherent optical distortion

NOTE Specified boundaries for the primary vision area may be laid down by the vehicle manufacturer.

**3.10**

**safety glass**

a glass that, if broken, is less likely (in comparison with ordinary glass) to cause serious physical injury

NOTE The tests described in the specification are designed to ensure that production conditions are properly controlled. In any of these tests there should be no fragments of significant mass having sharp edges such as to render the glass inconsistent with this definition.

**3.11**

**safety glass for windscreens**

safety glass through which objects ahead of the vehicle can be seen without appreciable distortion and which, if fractured, permits a view sufficient to enable the driver to drive the vehicle safely

**3.12**

**secondary image**

a spurious or ghost image usually seen at night when the object being viewed through glass is very bright in relation to its surroundings

**3.13**

**shade band**

a band along the top edge of a glass that has been tinted to limit sunglare

**3.14**

**type of safety glass**

the type as determined by

- a) the production process,
- b) the shape and dimensions, and
- c) in the case of laminated safety glass, the number and thickness of interlayers

**3.15**

**vehicle**

a carriage or conveyance of any type used on land

**4 Requirements**

**4.1 Optical requirements**

**4.1.1 General**

A safety glass shall be free from defects (e.g. undissolved or foreign material in the glass, and cracks, scratches, bubbles, etc.) which will interfere with vision or service, or both, and the general appearance of the glass shall be acceptable (see 7.2).

#### 4.1.2 Luminous transmittance

When a safety glass is tested in accordance with 7.3, its direct luminous transmittance (excluding that of shade bands, obscuration bands, and glass for special applications) shall be not less than 70 %.

In the case of thick glass such as for armoured vehicles, the direct luminous transmittance shall be not less than 60 %. Shade bands on windscreens shall not extend into the principal field of vision of the driver.

#### 4.1.3 Secondary image

When the primary vision area of a windscreen is tested in accordance with 7.4, there shall be

- a) not more than one secondary image;
- b) no displacement of the secondary image of the central spot beyond the point of tangency with the inside edge of the translucent concentric slit; and
- c) no abrupt change in the displacement of the secondary image from point to point in the test area.

#### 4.1.4 Distortion of vision

A windscreen shall be tested in accordance with, and shall comply with the requirements in, 10.2 in Annex 3 of CD/K/035:2008.

### 4.2 Physical requirements

#### 4.2.1 Resistance to high temperature

When tested in accordance with 6.6, no bubbles or other defects shall develop further than 13 mm from the edge of the specimen or from any cracks that may develop.

#### 4.2.2 Resistance to ultraviolet radiation

When tested in accordance with 7.7,

- a) the direct luminous transmittance after irradiation shall be
  - 1) not less than 70 %, and
  - 2) not less than 90 % of the original value;
- b) there shall be not more than a very slight discoloration; and
- c) after removal from the boiling water no bubbles or other noticeable decomposition shall have developed in the irradiated portion.

NOTE Glass for special applications and shade or obscuration bands shall be exempted from requirement 4.2.2(a).

#### 4.2.3 Fracture and adhesion

##### 4.2.3.1 Ball

When tested in accordance with 7.8.3.2,

- a) the ball shall not pass through the specimen;
- b) the specimen shall not break into separate large pieces;
- c) immediately opposite the point of impact the area of the interlayer exposed as a result of small fragments of glass leaving the specimen shall be not more than 650 mm<sup>2</sup> and this area shall remain covered to a large extent with tiny particles of tightly adhering glass; and

- d) the total area where loss of adhesion between interlayer and glass occurs shall be not more than 2000 mm<sup>2</sup>. (Spalling of the glass surface opposite the point of impact and adjacent to the area of impact is permitted.)

#### **4.2.3.2 Dart**

When tested in accordance with 7.8.3.3,

- a) the body of the dart shall not pass completely through the specimen;
- b) the specimen shall not break into separate large pieces;
- c) the interlayer shall not be exposed as a result of fragments of glass leaving the specimen, except within a radius of 25 mm from the point of impact; and
- d) there shall be no loss of adhesion between the glass and the interlayer for a distance greater than 37 mm from any crack.

(Spalling of the glass surface opposite the point of impact and adjacent to the area of impact is permitted.)

#### **4.2.4 Impact resistance**

When tested in accordance with 7.8.3.4, the ball shall not pass through the test specimen within 5 s after impact.

#### **4.2.5 Resistance to humidity**

When safety glass is tested in accordance with 7.9, no separation of materials shall develop, except for occasional small spots, none of which shall extend inward from the adjacent edge of the test specimen to a depth of more than 6 mm.

#### **4.2.6 Resistance to firing**

Bullet-resistant glazing materials shall comply with the requirements of CD/K/035:2008.

## **5 Marking**

**5.1** Each high penetration-resistant laminated safety glass product shall be distinctly and durably marked with the following information:

- a) manufacturer's name or registered trade name or registered trade mark or any of these;
- b) the word "laminated" or the symbol "///"; and
- c) in the case of bullet-resistant glass, the identification and classification as required in EN 1063.

## **6 Sampling and compliance with the specification**

**NOTE** This section applies to the sampling for inspection and testing before acceptance or rejection of single lots (consignments) in cases where no information about the implementation of quality control or testing during manufacture is available to help in assessing the quality of the lot.

### **6.1 Sampling**

The following sampling procedure shall be applied in determining whether a lot complies with the relevant requirements of the specification and the samples so taken shall be deemed to represent the lot:

From the lot take at random the number of safety glasses shown in column 2 of Table 1 relative to the appropriate lot size shown in column 1.

Table 1 — Sample sizes and permissible defects

1	2	3
Lot size, safety glasses	Sample size, safety glasses	Acceptance number
10 - 15	2	0
16 - 50	3	0
51 - 150	5	0
151 - 500	8	1
501 - 3 200	13	2
3201 - 10000	20	3

## 6.2 Compliance with the specification

The lot shall be deemed to comply with the requirements of the specification if, after inspection and testing of the sample taken in accordance with 6.1, the number of defectives found does not exceed the relevant acceptance number given in column 3 of Table 1.

## 7 Inspection and methods of test

### 7.1 Ambient conditions

Carry out all tests at an ambient temperature of  $23 \pm 3$  °C.

### 7.2 Inspection

Visually examine the safety glasses for compliance with the requirements of section 4 and, using the unaided human eye at a distance of 0.6 m under normal lighting conditions for such work (i.e. an illuminance of at least 500 lx using incandescent light sources), examine the glasses for compliance with the requirements of 4.1.1.

NOTE The use of spectacles, if normally worn, is permitted.

### 7.3 Luminous transmittance test

#### 7.3.1 Apparatus

Use a suitable photometer and an incandescent lamp operating at a colour temperature of approximately 2 850 K.

#### 7.3.2 Procedure

Measure the direct luminous transmittance with the direction of the incident light normal to the surface of the safety glass and check for compliance with the requirements of 4.1.2.

### 7.4 Test for secondary image (windscreens)

#### 7.4.1 Apparatus

A box, approximately 300 mm × 300 mm × 150 mm, the front of which has a translucent central hole and a translucent concentric slit forming a "ring and spot" target. The diameter of the hole is 12.5 mm and the concentric slit is 1.5 mm wide and has an inside diameter of 79 mm. The inside of the box is painted matt white and the outside matt black, and it is internally illuminated by means of a 25 W incandescent lamp. The central hole is covered with a yellow-red filter.

#### 7.4.2 Procedure

Carry out the test in a dark room so that the target and any secondary image are distinctly visible. Place the windscreen at the appropriate rake angle specified by the vehicle manufacturer or, if not specified, at a rake angle of 32° with the horizontal on a suitable support so that the centre of the windscreen is situated on the

horizontal plane passing through the centre of the target and at a distance of 7.5 m from the target. Maintaining the rake angle, so move the windscreen laterally (and simultaneously rotate it if necessary) that the direction of viewing is perpendicular to both the horizontal tangent at the point of inspection and the plane of the target.

View the target through each part of the primary vision area of the windscreen in order to detect the presence of any secondary images associated with the illuminated target. (A 2x monocular may assist viewing.) Check for compliance with the requirements of 4.1.3.

## **7.5 Boil test**

### **7.5.1 Test specimen**

A representative specimen of flat laminated safety glass approximately 300 mm square that has been processed in the normal production process or a specimen of the same size cut from the finished safety glass product.

### **7.5.2 Procedure**

Submerge the specimen vertically in water at approximately 65 °C for 3 min and then quickly transfer and similarly submerge it in boiling water. Retain the specimen in the boiling water for 2 h and then remove and inspect it for compliance with the requirements of 3.2.1. (If the glass cracks to such an extent that a definite conclusion cannot be reached, repeat the test using another specimen.)

## **7.6 Radiation test**

### **7.6.1 Test specimen**

A representative specimen of flat laminated safety glass approximately 300 mm × 300 mm that has been processed in the normal production process or a specimen of the same size cut from the finished safety glass product.

### **7.6.2 Procedure**

- a) Measure the direct luminous transmittance of the test specimen in accordance with 7.3.
- b) After the luminous transmittance has been determined, subject the test specimen to ultraviolet radiation which could be achieved with UVA-351 lamps. Protect a portion of the specimen from radiation for comparison purposes when any colour change that has taken place during the test is being assessed. Maintain the following operating exposure conditions:
  - 1) continuous ultraviolet radiation only (no moisture cycle);
  - 2) an operating temperature of 44 °C + 2 °C;
  - 3) a radiation duration of 100 h;
  - 4) UV lamp(s) facing the surface of the test specimen corresponding with the exterior of the vehicle being exposed to ultraviolet radiation;
  - 5) an average irradiance of the specimen throughout the test of 0.83 W/m<sup>2</sup>/nm ± 7 % measures at 340 nm. Ensure that the radiometer used to measure irradiance has a detector that can be placed in the specimen plane of the apparatus. Calibrate the detector for the specific lamp used;
  - 6) if any irradiance deviates by more than 15 % from 0.83 W/m<sup>2</sup>/nm ± 7 % at 340 nm, terminate the test until the cause of the deviation has been determined, corrected and documented; and
  - 7) maintain and calibrate the apparatus to the manufacturer's specifications.

- c) Measure the direct luminous transmittance of the irradiated portion of the test specimen in accordance with 7.3 and check for compliance with the requirements of 4.2.2(a).
- d) Inspect the test specimen against a white background to check for compliance with the requirements of 4.2.2(b).
- e) Submerge the specimen vertically in water at approximately 65 °C for 3 min and then quickly transfer and similarly submerge it in boiling water. Retain the specimen in the boiling water for 10 min and then remove and inspect it for compliance with the requirements of 4.2.2(c). (If the glass cracks to such an extent that a definite conclusion cannot be reached, repeat the test using another specimen.)

## 7.7 Tests for fracture and adhesion and impact resistance

### 7.7.1 Apparatus

- a) A support (see Figure 1) consisting of two square steel frames with machined borders of width 15 mm, fitting one on top of the other and faced with rubber gaskets approximately 3 mm thick and 15 mm wide and of hardness 50 IRHD. The lower frame rests on a steel box of height approximately 150 mm. The test specimen is held in place by the upper frame, the mass of which is approximately 3 kg. The supporting steel box is welded onto a sheet of steel approximately 12 mm thick resting on the floor, with an interposed sheet of rubber of thickness approximately 3 mm and of hardness 50 IRHD.
- b) A solid hardened steel ball of mass  $230 \pm 5$  g and of approximate diameter 38 mm.
- c) A dart of mass  $200 \pm 5$  g and dimensions as shown in figure 2.
- d) A solid hardened steel ball of mass  $2.27 \pm 0.02$  kg and of approximate diameter 82 mm.
- e) An electromagnet, or other equally suitable apparatus for so supporting a ball or the dart at the specified heights that the ball or dart, when released, drops freely and strikes the specimen within 25 mm of its centre.

### 7.7.2 Test specimens

Representative test specimens of flat laminated safety glass 305 mm square that have been processed in the normal production process or test specimens, 305 mm square, cut from the flattest portion of the finished safety glass product.

### 7.8.3 Procedure

#### 7.8.3.1 General

Condition the specimens at a temperature of  $23 \pm 3$  °C for at least 4 h before the test.

#### 7.8.3.2 Fracture and adhesion (ball test)

Place a test specimen (see 6.8.2) horizontally on the support (6.8.1 (a)) and drop the 230 g ball (6.8.1(b)) from a height of 9 m (measured from the lowest part of the ball) onto the surface of the specimen which would be glazed to the outside of the vehicle. Check for compliance with the requirements of 3.2.3.1.

#### 6.8.3.3 Fracture and adhesion (dart test)

Place a test specimen (see 7.8.2) horizontally on the support and drop the dart (7.8.1(c)) from a height of 9 m (measured from the lowest part of the dart) onto the surface of the specimen which would be glazed to the outside of the vehicle. Check for compliance with the requirements of 4.2.3.2.

#### 7.8.3.4 Impact resistance

Place a test specimen (see 7.8.2) horizontally on the support and drop the 2.27 kg ball (6.8.1(d)) from a height of 3.65 m (measured from the lowest part of the ball) onto the surface of the specimen which would be glazed to the inside of the vehicle. Check for compliance with the requirements of 4.2.4.

### 7.9 Humidity test

Keep three specimens (see 7.8.2) for 2 weeks in a closed container over water. Maintain the temperature of the air in the container within the range 49-54 °C. Ensure that all surfaces and edges of the specimens are freely exposed to the humid atmosphere, and that the support system used cannot exert any forces that promote separation of the safety glass layers.

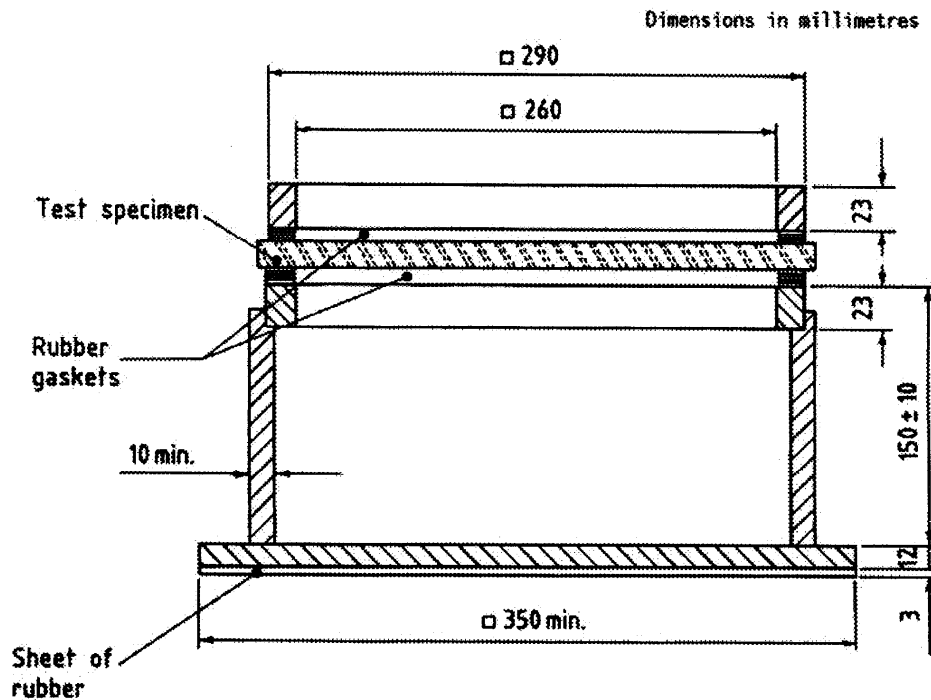


Figure 1 — Support for fracture and adhesion test and impact-resistance test

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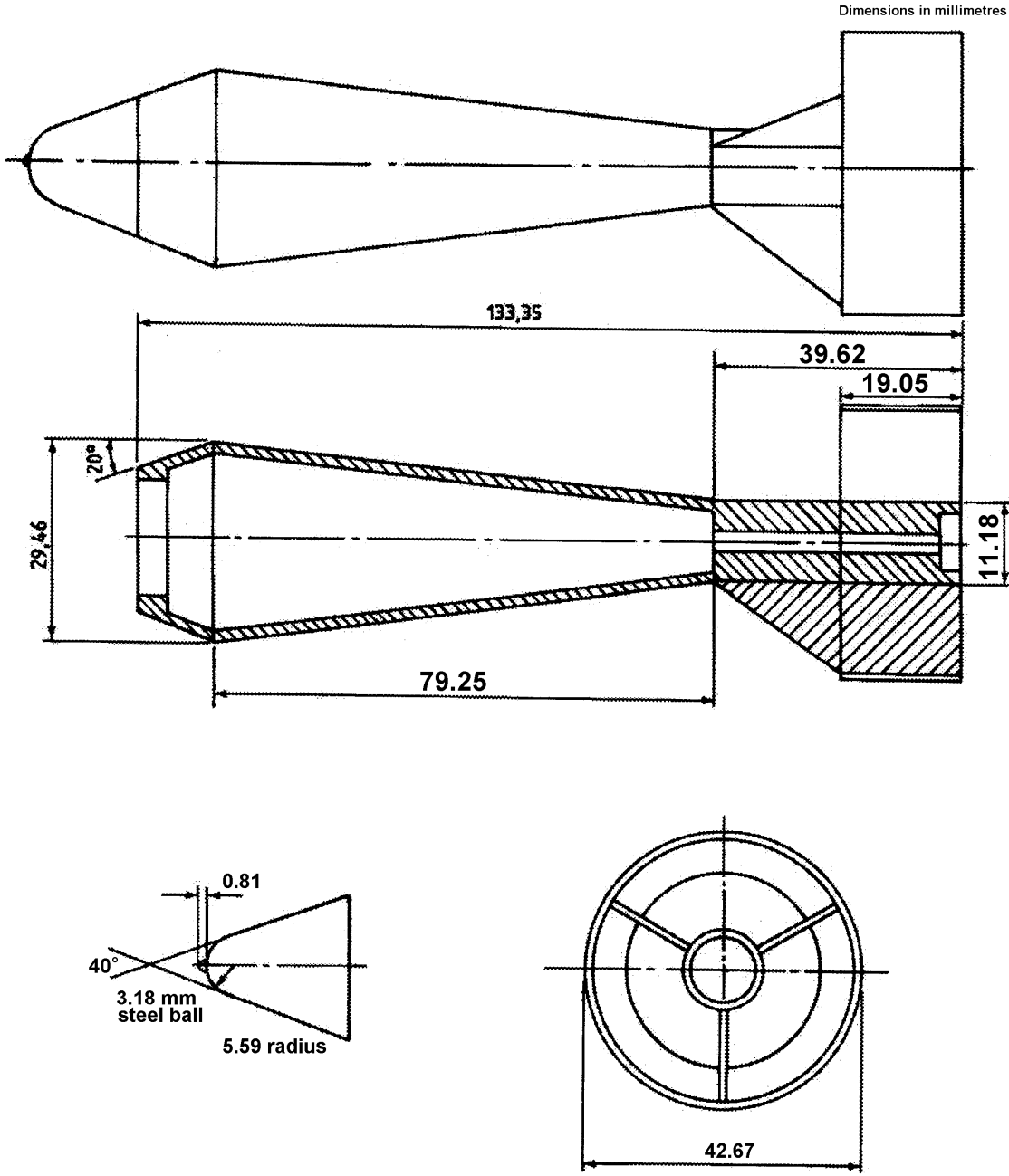


Figure 2 — Dart

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