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**PHILIPPINE AGRICULTURAL ENGINEERING STANDARD PAES 139:2004**  
**Agricultural Machinery – Roll-Over Protective Structures (ROPS) – Specifications**

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## **Foreword**

The formulation of this National Standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) with support from the Department of Agriculture (DA).

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word “shall” is used to indicate mandatory requirements to conform to the standard.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

In the preparation of this standard, the following documents/publications were considered:

American Society of Agricultural Engineers (ASAE) S383.1:1983 – Roll-over Protective Structures (ROPS) for Wheeled Agricultural Tractors.

Guidelines for the Design, Construction, and Installation of Rollover Protective Structures (ROPS) for all Terrain Vehicles. 1998. Occupational Health Safety and Health Service, Department of Labour, Wellington, New Zealand.

International Organization for Standardization (ISO) 3463:1989 Wheeled Tractors for Agriculture – Protective Structures – Dynamic Test Method and Acceptance Conditions.

International Organization for Standardization (ISO) 5700:1989 Wheeled Tractors for Agriculture – Protective Structures – Static Test Method and Acceptance Conditions.

Organisation for Economic Co-operation and Development (OECD) Standard Code for the Official Testing of Protective Structures on Agricultural and Forestry Tractors (Dynamic Test): Code 3. March 2000.

Organisation for Economic Co-operation and Development (OECD) Standard Code for the Official Testing of Protective Structures on Agricultural and Forestry Tractors (Static Test): Code 4. March 2000.

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## **1 Scope**

This standard specifies the requirements for roll-over protective structure (ROPS) attached to a four-wheel tractor with a minimum of 15 kW engine power.

## **2 References**

The following normative documents contain provisions, which through reference in this text, constitute provisions of this National Standard:

ISO 3776: 1989, Tractors for Agriculture – Seat Belt Anchorages

ISO 5353:1995, Earth-moving Machinery, and Tractors and Machinery for Agriculture and Forestry – Seat Index Point

PAES 103:2000, Agricultural Machinery – Method of Sampling

PAES 118:2001, Agricultural Machinery – Four-Wheel Tractor – Specifications

PAES 311:2001, Engineering Materials – Bolts and Nuts for Agricultural Machines – Specifications and Applications

PAES 140:2004, Agricultural Machinery – Roll-Over Protective Structures (ROPS) – Methods of Test

## **3 Definitions**

For the purpose of this standard, the following definitions shall apply:

### **3.1**

#### **roll-over protective structure (ROPS)**

cab or frame installed on agricultural tractors to protect or minimize injury of the operator from accidental overturning during operation (see Figures 1 and 2)

### **3.2**

#### **seat index point (SIP)**

point on the central vertical plane of the seat (see Figure 3 and 4a)

**NOTE** For more detailed specification of the SIP refer to ISO 5353.

## 4 Classification

### 4.1 Two-post ROPS

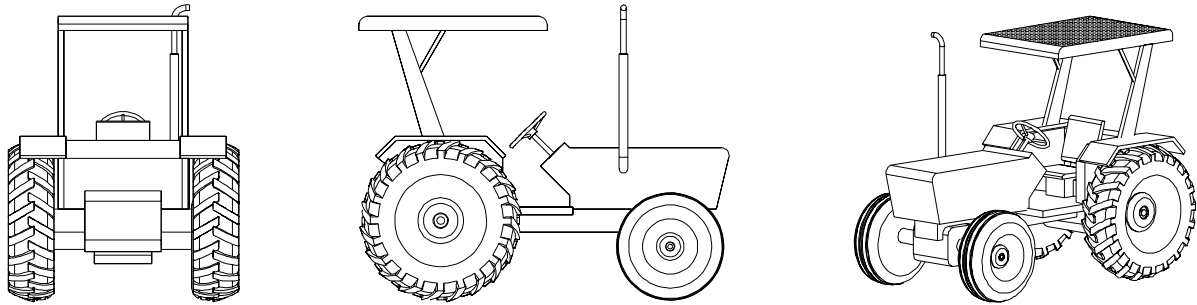
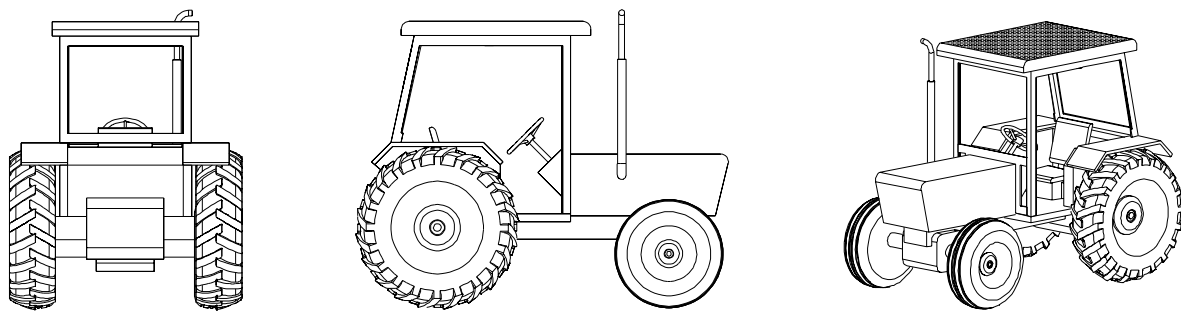
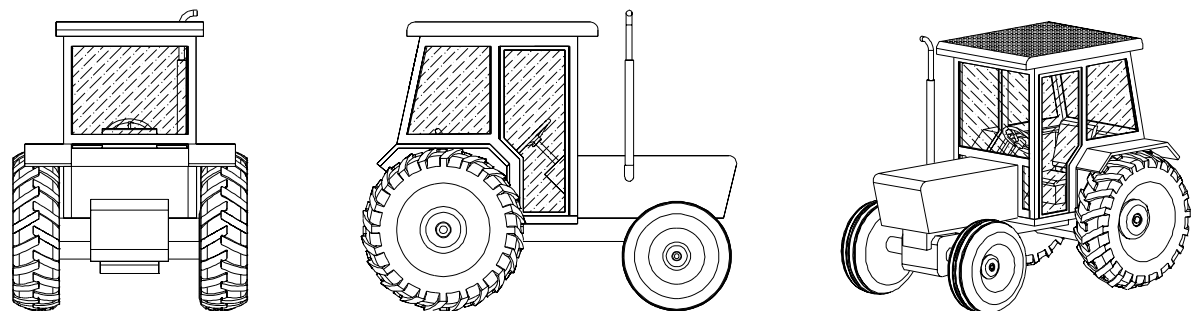


Figure 1 – Tractor with Two-post ROPS and Optional Canopy

### 4.2 Four-post ROPS



a. Frame with Optional Canopy



b. Cab

Figure 2 – Tractor with Four-post ROPS

## 5 Construction Requirements

**5.1** Steel with an as-rolled thickness of not less than 2.5 mm and with a carbon content of not less than 0.2 % shall be used in the manufacture of ROPS.

**5.2** Bolts and nuts used to attach the protective structure to the machine frame and to connect structural parts of the protective structure shall exhibit suitable toughness properties. For more detailed specifications of bolts and nuts, refer to PAES 311.

**5.3** All welding electrodes used in the fabrication of structural members and mounts shall be compatible with the protective structure materials.

**5.4** In case of a cab ROPS, safety glass shall be used.

**5.5** The construction shall be rigid and durable.

**5.6** ROPS equipped tractors shall be fitted with seat belt assemblies conforming to ISO 3776 and PAES 118.

## 6 Clearance Zone

**6.1.1.1** The clearance zone is illustrated in Figures 3, 4a and 4b and dimensions are shown in Table 2. Referring to the figures, the zone is defined in relation to the vertical reference plane. This reference plane shall be assumed to move horizontally with the seat and steering-wheel during impact/loading tests but to remain perpendicular to the tractor or the protective structure floor.

**6.1.1.2** The clearance zone assumes a seat adjustment of  $\pm 75$  mm horizontally and  $\pm 30$  mm vertically from the seat mid-position. Where the seat adjustment exceeds these values, the clearance zones shall be modified in accordance with the following:

**6.1.1.2.1** If the horizontal seat adjustment provided exceeds  $\pm 75$  mm from the mid-position, then any dimensions forward from the SIP shall be reduced, and dimensions to the rear from the SIP increased, on the basis:

[Total adjustment to the rear of the seat mid-position minus 75 mm]

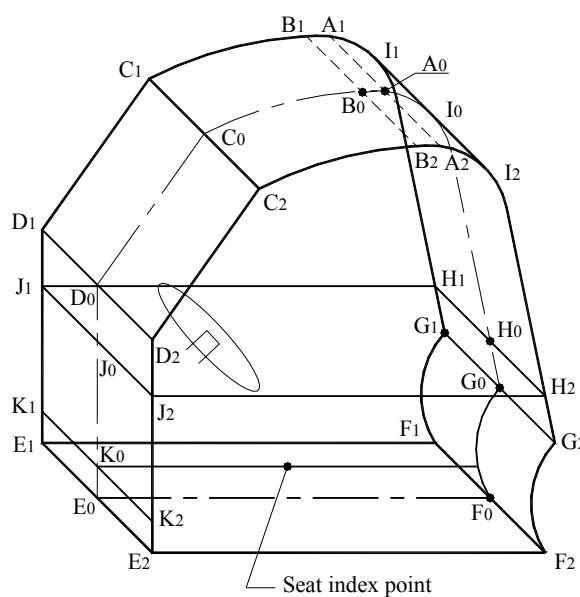
**6.1.1.2.2** If the vertical seat adjustment provided exceeds  $\pm 30$  mm, then any dimensions above the SIP shall be increased and dimensions below the SIP reduced on the basis :

[Total adjustment above the seat mid-position minus 30 mm]

**6.1.1.3** The clearance zone is defined as in a) to j) when the tractor is standing on its wheels on a horizontal surface, with, where applicable, the steering-wheel adjusted to the mid-position for seated driving.

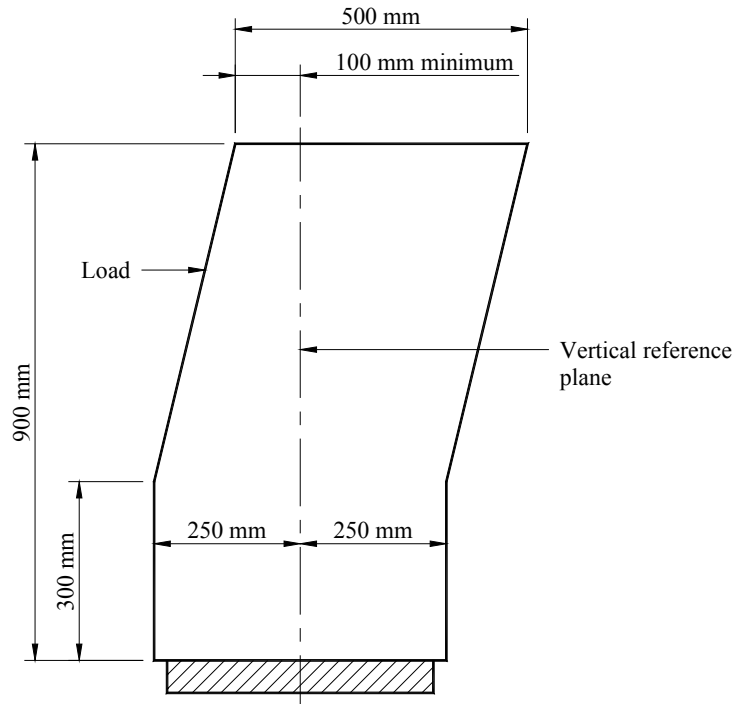
- a) a horizontal plane –  $A_1B_1B_2A_2$  – 840 mm above the SIP with line  $B_1B_2$  located 65 mm behind SIP;

- b) an inclined plane –  $G_1G_2I_2I_1$  – perpendicular to the vertical reference plane and including the rearmost point of the seat backrest extended rearwards by 75 mm and upwards by 30 mm, the extension of which passes through a point 840 mm above the SIP, 215 mm behind the SIP;
- c) a cylindrical surface –  $A_1A_2I_2I_1$  – perpendicular to the vertical reference plane, with a radius of 120 mm tangential to the planes defined in a) and b);
- d) a cylindrical surface –  $B_1C_1C_2B_2$  – perpendicular to the vertical reference plane, having a radius of 900 mm and center 65 mm behind and 60 mm below the SIP, with the line  $C_1C_2$  located 400 mm forward of  $B_1B_2$ ;
- e) an inclined plane –  $C_1D_1D_2C_2$  – perpendicular to the vertical reference plane, joining the surface defined in d) at its forward edge and passing 40 mm from the steering-wheel rim;
- f) a vertical plane –  $D_1E_1E_2D_2$  – perpendicular to the vertical reference plane 40 mm forward of the steering-wheel forward edge;
- g) a horizontal plane –  $E_1F_1F_2E_2$  – 60 mm below the SIP;
- h) a surface, curved if necessary –  $G_1F_1F_2G_2$  – from the bottom limit of the plane defined in b) to the horizontal plane defined in g), following the general direction of and parallel to a surface in contact with the seat backrest rear surface, extended rearwards 75 mm and upwards 30 mm;
- i) vertical planes –  $J_1E_1F_1G_1H_1$  and  $J_2E_2F_2G_2H_2$  – at not less than 250 mm on either side of the vertical reference plane where the distance  $E_1E_2$  shall be equal to the steering-wheel diameter plus 40 mm on each side of the steering-wheel rim or 500 mm, whichever is greater;
- j) parallel planes –  $A_1B_1C_1D_1H_1I_1$  and  $A_2B_2C_2D_2H_2I_2$  – inclined so that the plane upper edge on the side to which the side blow is struck is at least 100 mm from the reference plane.



**Figure 3 – Clearance Zone**





**Figure 4b – Clearance Zone from Front or Rear, 65 mm behind the Seat Index Point**

## 7 Acceptance Conditions

For the protective structure to be accepted, it shall conform to the following conditions during and after the test specified in PAES 140.

**7.1.1** No part shall enter the clearance zone. No part shall strike the seat during the tests. Furthermore, the clearance zone shall not be outside protective structure protection. For this purpose, it shall be considered to be outside protective structure protection if any part of it would have come in to contact with flat ground had the tractor overturned towards the direction from which the blow/load was struck/applied. To estimate this, the tires and track width setting shall be the smallest standard fitting specified by the manufacturer.

**7.1.2** There shall be no protruding member or component which would be likely to cause serious injury during an over-turning accident or which, through the deformation occurring, might trap the operator, for example by a leg or foot.

**7.1.3** There shall be no other components presenting a serious hazard to the operator.

## 8 Workmanship and Finish

**8.1** The ROPS shall be free from manufacturing defects such as sharp edges and surfaces that may be detrimental to the tractor operator.

**8.2** The ROPS shall be free from rust and shall be painted properly.

## **9 Sampling**

The ROPS shall be sampled for testing in accordance with PAES 103.

## **10 Testing**

The sampled ROPS shall be tested in accordance with PAES 140.

## **11 Labeling**

**11.1** Each protective structure shall be marked in English with the following information using a plate, stencil or by directly punching it at the most conspicuous place:

**11.1.1** Registered trademark of the manufacturer

**11.1.2** Type

**11.1.3** Identification number

**11.1.4** Production date (optional)

**11.1.5** Name and address of manufacturer

**11.1.6** Name and address of the importer, if imported

**11.1.7** Country of manufacture (if imported) / “Made in the Philippines” (if manufactured in the Philippines)

**11.1.8** Make, model, serial number of the tractor the structure is designed to fit.

**11.1.9** Maximum mass (M) for which the ROPS structure complies with all of the performance requirements of this standard.

**11.1.10** The relevant standards and other performance requirements, e.g. ISO standards with which the structure complies (optional).

**11.1.11** Any other information as deemed appropriate by the manufacturer, e.g. installation, repair or replacement information.

**11.2** Safety/precautionary markings shall be provided when appropriate. Markings shall be stated in English and Filipino and shall be printed in red color with a white background.

**11.3** The markings shall have a durable bond with the base surface material.

**11.4** The markings shall be weather resistant and under normal cleaning procedures, it shall not fade, discolor, crack or blister and shall remain legible.