

Foreword

This standard is a revision of the Philippine National Standard (PNS) 606:1991 – “General Code of Safety for Agricultural Machinery”. The revision was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled "Enhancing the Implementation of AFMA Through Improved Agricultural Engineering Standards" which was funded by the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA).

This revised standard was reviewed by the Technical Committee for Study 1- Development of Standards for Agricultural Production Machinery and was circulated to various private and government agencies/organizations concerned for their comments and reactions. This standard was presented to the Philippine Society of Agricultural Engineers (PSAE) and subjected to a public hearing organized by the National Agriculture and Fisheries Council (NAFC). The comments and reactions received during the presentation and public hearing were taken into consideration in the finalization of this standard.

This standard has been technically revised in accordance with PNS 01:Part 4:1998 - Rules for the Structure and Drafting of Philippine National Standards. The main changes are listed below:

- title of the standard has been modified in conformity to the format of International Standard;
- detailed information on safety distance from dangerous part was included;
- safety requirements for hitches, jacks and supports were included;
- safety requirements on location and operation of foot-operated and hand-operated clutches were lifted from ISO 3789-2:1982 – Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Location and method of operation of operator’s controls- Part2: Controls for agricultural tractors and machinery; and
- safety requirements on drawbar were lifted from ISO 500:1979 – Agricultural tractors – Power-take-off and drawbar - Specifications

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

International Organization for Standardization (ISO) 4252-1:1989 Technical Means for Ensuring Safety – General.

American Society of Agricultural Engineers (ASAE) S318.8:1985 Safety for Agricultural Equipment

Agricultural Machinery – Technical Means for Ensuring Safety – General

1 Scope

This standard provides guidelines pertaining to the prevention of accidents arising from the use of tractors and machinery for agriculture. It also specifies technical means of improving the degree of safety of operators and others involved in the course of normal operation, service and maintenance of the machine.

2 References

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

ISO 5692 : 1979, Agricultural vehicles – Mechanical connections on towed vehicles – hitch-rings – Specifications.

ISO 6489-1 : 1991, Agricultural vehicles – Mechanical connections on towing vehicles Part 1: Hook type.

3 Principles in providing safety

Tractors and machinery for agriculture shall be designed and constructed in such a way that they do not cause danger when properly used.

Operating and maintaining the machine should be carried out in accordance with the manufacturer's instructions. These requirements shall primarily be met by the design of the machine. If this is not possible, the machine shall be equipped with special means for ensuring safety, for example guards or safe location of the dangerous parts. Functional components that need to be exposed for correct operation shall be shielded to the maximum extent permitted by the intended function of the components. Additionally, in such circumstances, warning of the hazard shall be indicated on the machine (see clause 8).

4 Moving parts treated as dangerous

In general all moving parts shall be treated as dangerous; particular attention is drawn to the following :

- all shafts (including joints, shaft ends and crank shafts), pulleys, flywheels, gearing (including friction roller mechanisms), cables, sprockets, belts, chains, clutches, couplings and all blades or wings of fans;
- the run-on point of any belt, chain or cable;
- keyways, keys and grease nipples, etc. that protrude from moving parts;
- all points where the danger of pinching or shearing is possible;
- ground wheels or tracks adjacent to the operator's position (standing platform, seat, footrest) and passenger seat (where provided).

5 Guard types

There are three types of guards designed to prevent contact with the moving parts by a person and/or clothing. These may be classified as:

- a) shield or cover;
- b) casing;
- c) enclosure;

and are described respectively in 5.1 to 5.3.

5.1 Shield or cover

Protective devices designed and fitted so that alone or with other parts of the machine, they prevent the dangerous part being reached from the side or sides covered (see figure 1).

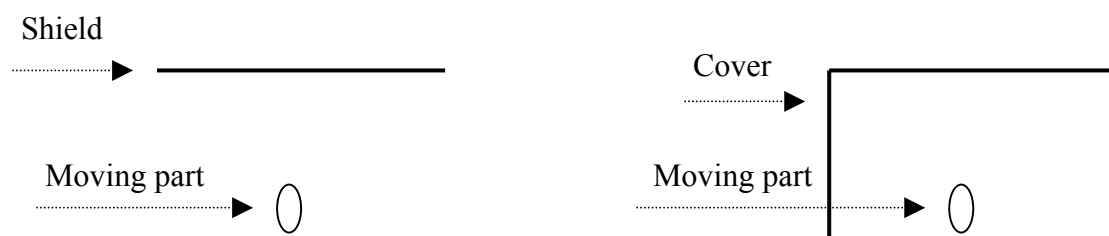


Figure 1 – Shield and cover

5.2 Casing

Protective device designed and fitted so that, alone or with other parts of the machine, it prevents contact with the dangerous part from all sides (see Figure 2).

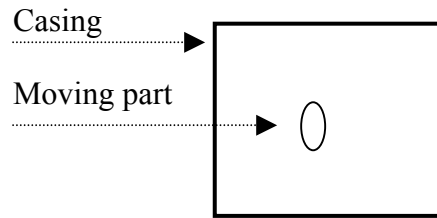


Figure 2 – Casing

5.3 Enclosure

Protective device, which by means of a rail, fence, frame or the like ensures the safety, distance necessary so that the dangerous part cannot be reached inadvertently.

6 Guard construction

Guards shall be sufficiently strong. Unless it is clearly inappropriate, these shall, without cracking, tearing or permanently deflecting, withstand a perpendicular static load of 1,200 N.

Parts designed as platforms and steps, which are also guards, shall comply with appropriate strength requirements for platforms and steps.

Where a guard is in such position that it may occasionally be used as a step, it shall withstand a load of 1,200 N.

Guards shall be rigidly fixed, have no sharp edges, be weather-resistant and retain their strength under extremes of temperature, taking into account the intended use.

Guards shall be designed in such a way that operating and servicing the machine can be readily carried out.

Guards shall normally be permanently attached to the machine; these may be easily opened, in which case these should remain attached to the machine in some way, for example by means of a hinge, slide, linkage or other suitable means, and should be provided with a convenient means to keep them closed. “Permanent attachment” includes the use of threaded fasteners, split pins, or other means that can be dismantled with common hand tools.

In some circumstances it is necessary for guards which can be opened to be designed so that the movement of dangerous parts is automatically stopped when the guard is opened or the design prevents the guard from being opened until all movement of the dangerous parts has ceased. This can be achieved for example by designing the guard securing device(s) so that the part will stop before the guard is opened. A suitable warning notice shall be fitted to all such guards and to any opening in them without such securing devices.

Guards may be formed of a welded or rigid mesh or grill. The size of the allowable opening depends on the distance between the guard and the moving parts as given in clause 7. The design of the guard shall be such that it is not possible to distort the mesh or the grill during proper use in such a way that the opening size and distance relationship exceeds the limits given in clause 7.

7 Safety distance

There may be circumstances where the requirements of clause 3 can be met by ensuring a safety distance, as described in 5.3, from dangerous part.

It is possible to circumvent the protection provided by a safety distance (as specified in 7.1) by the misuse of steps, ladders, boxes or chairs, etc., but the general principle of a safety distance, in compliance with clause 3, is acceptable provided the criteria in 7.1 and 7.2 are met so that the dangerous parts are out of reach.

7.1 Safety distance from dangerous part

The safety distance is based on measurements from the location where a person can occupy to operate, maintain or inspect the dangerous part.

7.1.1 Upward reach

The safety distance for upward reach is 2,500 mm for persons standing upright.

7.1.2 Reach below barriers

No safety distance is specified where it is possible to reach below a safety barrier, unless the aperture is small enough to be considered only in relation to finger, hand or arm access in which case the requirements of 7.1.6 apply.

7.1.3 Reach over barriers

Barriers, the height of which is less than 1,000 mm above the location, which a person can occupy, shall not be acceptable.

The safety distance for sideward or downward reach over barriers of 1,000 mm or greater height depends on

- a) the distance from the ground level to the dangerous part;
- b) the height of the guard;
- c) the horizontal distance between the dangerous part and the guard.

When designing a barrier, the dimensions in Table 1 shall be met (see figure 3).

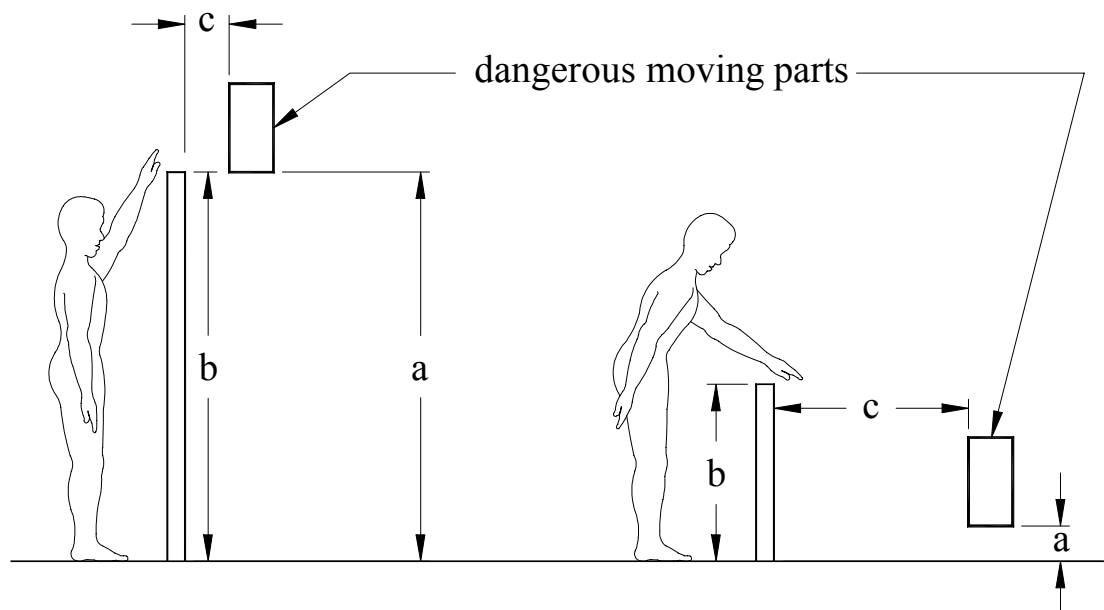


Figure 3 – Principles for determining the distance required from a guard to the dangerous part

Table 1 – Downward and sideward safety distance

Dimensions in millimeters

a	b ¹⁾							
	2400	2200	2000	1800	1600	1400	1200	1000
	c							
2400	-	100	100	100	100	100	100	100
2200	-	250	350	400	500	500	600	600
2000	-	-	350	500	600	700	900	1100
1800	-	-	-	600	900	900	1000	1100
1600	-	-	-	500	900	900	1000	1300
1400	-	-	-	100	800	900	1000	1300
1200	-	-	-	-	500	900	1000	1400
1000	-	-	-	-	300	900	1000	1400
800	-	-	-	-	-	600	900	1300
600	-	-	-	-	-	-	500	1200
400	-	-	-	-	-	-	300	1200
200	-	-	-	-	-	-	200	1100

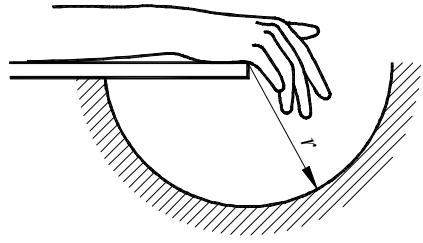
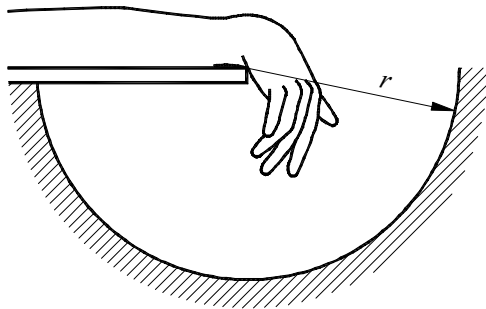
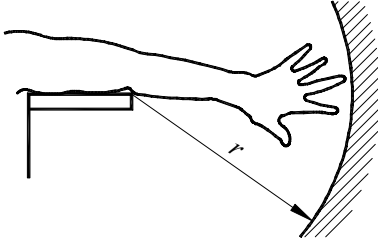
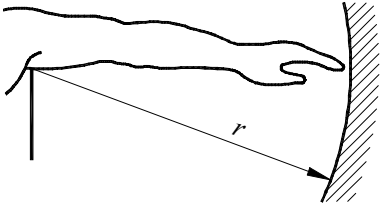
1) Values of b < 1000 mm do not increase the reach. Moreover, the danger arises of falling towards the danger source.

7.1.4 Round reach

Table 2 shows the extent of reach around barriers, which can be attained, taking into account the aperture and the distance from other obstructions. Dangerous components shall be beyond these limits if they are not independently guarded.

Table 2 – Extent of reach

Dimensions in millimeters

Limb		Illustration	Safety distance, <i>r</i>
From	To		
Finger base	Finger tip		$r > 120$
Wrist	Finger tip		$r > 230$
Elbow	Finger tip		$r > 550$
Shoulder	Finger tip		$r > 850$

7.1.5 Inside reach through guards

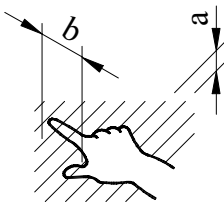
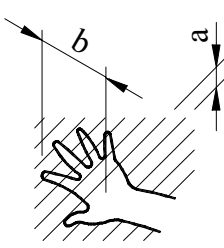
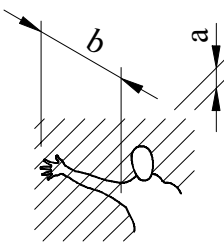
The safety distances depend on the shape of the openings.

7.1.6 Openings

The openings shall not exceed the size appropriate to the distance of the guard from the moving part (see Tables 3a and 3b).

Table 3a – Reach dimensions through rectangular opening or slot

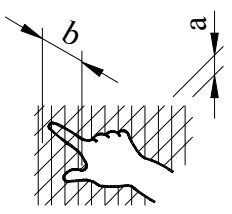
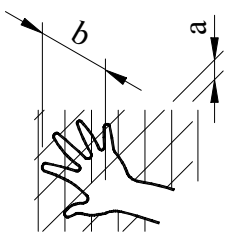
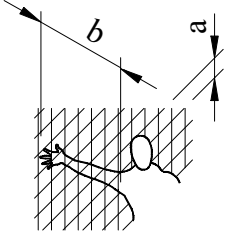
Dimensions in millimeters

Limb	Illustration	Width of aperture (rectangular opening or slot), a	Safety distance to danger source, b
Finger tip		$4 < a < 8$	$b > 15$
Finger		$8 < a < 20$	$b > 120$
Hand		$20 < a < 30$	$b > 200$
Arm		$30 < a < 135$ ¹⁾	$b > 850$

¹⁾ When the width is greater than 135 mm, part of the body can also pass through the aperture. In this case, safety distances as specified in 7.2 shall be observed.

Table 3b – Reach dimensions through mesh or grill

Dimensions in millimeters

Limb	Illustration	Width of aperture (diameter or lateral length), a	Safety distance to danger source, b
Finger tip		$4 < a < 8$	$b > 15$
Finger		$8 < a < 25$	$b > 120$
Hand		$20 < a < 40$	$b > 200$
Arm		$40 < a < 250$	$b > 850$

7.1.6.1 Polygonal openings


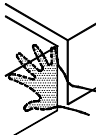
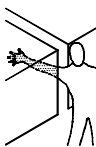

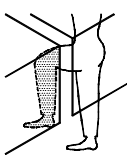
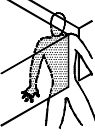
Polygonal openings, where the diameter of the largest circle that can be inscribed is not less than the distance between the two apexes that are the furthest apart, shall meet the same requirements as for round openings. The diameter of the inscribed circle shall be regarded as the size of the opening. All other polygonal openings shall be regarded as slots.

7.2 Pinching points

A pinching point is considered dangerous for the parts of the body illustrated in Table 4 if the appropriate minimum separation distance is not maintained. The design of the machine shall ensure that the next bigger part of the body cannot pass through.

Table 4 – Minimum separation distance for pinching points

Dimensions in millimeters

Limb	Illustration	Minimum separation distance required
Finger		25
Hand Wrist Fist		100
Arm		120
Foot		120
Leg		180
Body		500

8 Provision of information

8.1 Operating manuals

Where safety precautions are necessary during operation and servicing of agricultural machines, appropriate instructions shall be provided with the machine.

Operating manuals shall also include a warning that a revolving hitch or a revolving clevis shall not be connected with a mating unit which also revolves on a towed machine or trailer.

8.2 Warning notices

Durable warning notices shall be affixed to the machine where parts present danger to the operator. Also included are circumstances where the inadvertent lowering of parts of equipment can cause danger. Particular danger or safety warnings shall be indicated on the notice.

Existing national or other regulations may require specific symbols, sizes, layout or color. The warning notice shall be either pictorial or text in a language acceptable to the user or, if appropriate, the national regulating authority concerned.

9 Working stability

Machines and trailers that may create a danger to the user through tilting, as a result of the shifting of the center of gravity (for example when emptying or filling), shall be provided with means of preventing such danger.

Hydraulically raised components that need to be held in a raised position to allow servicing or adjustment shall be provided with an independent and reliable means of retaining them in the required position.

10 Operator's workplace

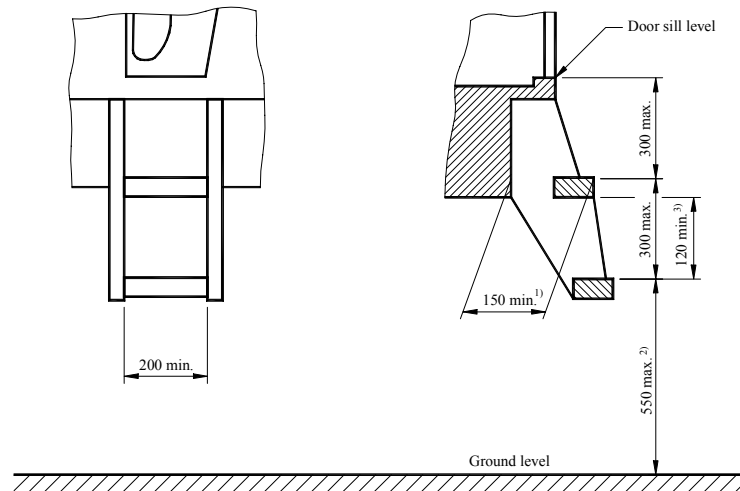
10.1 Handholds and steps

Any machine, on which the presence of a driver or operator is necessary, including any place to which access is required for service or maintenance, shall be fitted with handle or handholds and steps so the person has a safe, convenient means of mounting and dismounting.

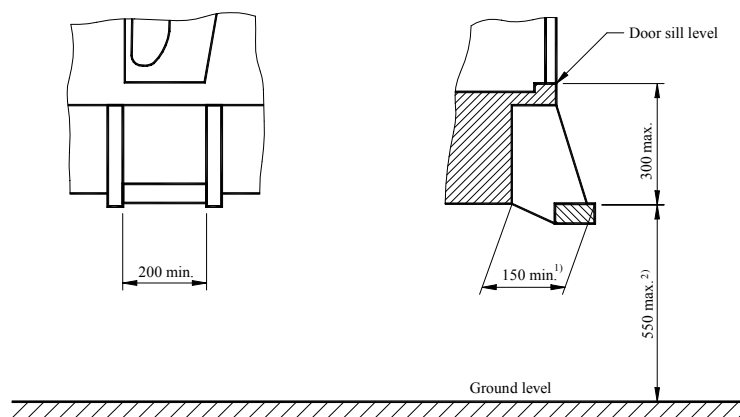
Both handholds and steps may be parts of the machine if they are suitably designed and placed. Steps shall be designed in relation to the general construction in order to ensure protection from moving parts. If moving parts, for example tire sections, form restrictions or trapping areas with the steps, a suitable means of protection shall be provided. Steps shall have a non-slip surface a vertical retainer at both sides.

The dimensions for steps will normally be found in the parts of this standard relating to specific machines. Where there is no specific provision, the steps shall comply with the dimensions in millimeters as shown in Figure 4.

Where access is provided by a series of steps which are designed to be used alternately each by one foot, then the minimum width and height specified do not apply.



a) multi-step configuration



b) single step configuration

Figure 4 – Limiting dimensions of steps

- 1) Minimum clearance and not size of tread surface.
- 2) The dimensions shall be obtained also with the largest tires (normally inflated).
- 3) The vertical distance between adjacent steps shall be equal (within a tolerance of ± 20 mm).

10.2 Operating positions

Means shall be provided to prevent the operator from falling from his workplace. Any platform on which the operator is required to stand during the operation of the machine shall be level and shall have a non-slip surface, and if necessary, drainage shall be provided.

The platform shall be provided with the following:

- a) a foot-guard (toe-board) on all sides, which shall be fitted around the edge of the platform or not more than 50 mm farther away and shall extend not less than 75 mm above the platform;
- b) a guard-rail which shall be not less than 1000 mm and not more 1100 mm above the platform and an intermediate rail so that the vertical distance between any two rails does not exceed 500 mm.

However, it is not required to provide a foot-guard or fixed guard-rails for the platform:

- a) when the machine itself affords protection at least equal to that which the foot-guard and guard-rail would provide if these were fitted;
- b) when the operation permits access of persons or movement of material. A rail or chain shall be provided across the access when the machine is operating.

10.3 Seats

On a machine on which the operator is required to sit, a seat shall be provided which will adequately support the operator in all working and operating modes. Adequate and comfortable support and protection for the feet shall be provided.

10.4 Operating control

The operating controls, such as steering wheel or steering levers, transmission levers, cranks, pedals, and switches, shall be arranged and fitted in such a way as to allow safe and easy control and manipulation by an operator in the normal operating position. Pedals and controls shall be positioned so that they do not obstruct access. The function of the controls shall be marked on or near the control.

10.4.1 Steering mechanism

The steering mechanism shall be so designed as to reduce the force of any sudden movement of the steering wheel or steering lever(s) due to reaction from the steered wheel(s).

10.4.2 Lifting and lowering controls

Provision shall be made to protect and locate controls so as to prevent accidental operation which may cause dangerous movement.

10.4.3 Clutches (Drive engagement controls)

The following requirements shall be complied with where appropriate:

a) Foot-operated clutches

It should be located in a position convenient to the operator's left foot. To disengage, the pedal should be pushed forward. In such case of a combined traction-drive/PTO clutch, the PTO shall be disengaged on the second stage.

b) Hand-operated clutches

It should be located in a position convenient to the operator. To disengage, the control should be moved rearward. Control should be operated only with the operator in the operator's station.

10.4.4 Stopping devices for power sources

Every power source shall be fitted with a device by means of which it can be stopped quickly. It shall be so designed that it does not depend on sustained manual effort for its operation and that, when it is in the "stop" position, the power source cannot be started unless the device is reset manually.

This device shall be readily accessible

- on manned machines: to the operator in his normal operating position;
- on unmanned machines: on or near the power source or near the operating control position.

The purpose and method of operation shall be clearly indicated. The control shall be red in color and preferably in contrast with the background and other controls.

10.4.5 Valves, taps and switches

In the case of hand-operated valves, taps and switches or their means of control provided for controlling pneumatic, hydraulic or electrical systems, the function and effect of the device in each of its positions shall be clearly indicated, where necessary for safety reasons.

10.4.6 Pedals

Pedals shall be of adequate size and of appropriate configuration. These shall have slip-resistant surfaces in order to minimize the possibility of the operator's foot slipping off the pedals, and where necessary, be provided with a rim at the edge of the pedal.

10.4.7 Differential locks

Any manually operated device fitted to a machine to lock the differential gear shall be designed and fitted so that there is a clear indication to the operator that the lock is engaged. It shall be designed so that it minimizes the possibility of inadvertent actuation.

11 Means for moving and supporting machines

11.1 Hitches

Mobile machines that are not self-propelled shall be provided with suitable hitch devices. Machines used for towing or which are towed shall be provided with a towing device constructed and fitted to be secure for the purpose.

11.1.1 Hitch hook

If the towing machine is equipped with a hitch hook, it shall be in accordance with ISO 6489-1. The towed machine shall, in such case, have a drawbar eye according to ISO 5692.

11.1.2 Drawbars

The drawbar shall be situated in the longitudinal mid-plane of the tractor. The diameter of the hole in the drawbar should be $33 \begin{smallmatrix} -0 \\ +0.5 \end{smallmatrix}$ mm. The thickness of the drawbar shall be not more than 32 mm.

11.2 Jacks and supports

11.2.1 Machines, which are not stable when disconnected, shall be provided with a jack or other support to prevent tilting.

Supports shall be attached (to avoid the risk of losing them), but these may be detached only if necessary to permit the machine to operate.

11.2.2 Non-stable machines or trailers having a drawbar shall be provided with a jack capable of raising or lowering the drawbar.

The jack shall be constructed and secured to the machine so as to prevent the drawbar from falling when the jack is in use and shall have a base of adequate size to prevent it from sinking into soft ground.

This requirement applies to:

- all trailers of unladen mass (bare weight) exceeding 500 kg;
- any other machine when the machine is unladen and the downward force acting through the drawbar at the hitch point exceed 250 N. The downward force acting through the drawbar shall be measured with the machine stationary on horizontal ground and the drawbar hitch point at a height of 400 mm above the ground.

This requirement shall not apply to a machine or trailer with a drawbar designed to be picked up mechanically by the towing vehicle, but in such cases, a stand capable of securely supporting the drawbar with the hitch point 150 mm above the ground level shall be fitted.

12 Power transmission

12.1 Power take-off (PTO)

The PTO shall be protected as indicated in 12.1.1 to 12.1.3.

12.1.1 When in use, a cover or, if necessary, a casing that protects the sides of the PTO, shall be fitted.

12.1.2 An additional non-rotating casing shall be provided when the cover or casing is not in position and when the PTO is not in use. This casing shall encase the PTO completely and be fixed to the tractor or machine body.

12.1.3 The provisions covering instructions of guards (see clause 6) shall also be met.

12.2 Power intake connection (PIC)

The PIC shall be protected as indicated in 12.2.1 and 12.2.2.

12.2.1 A casing which completely encloses PIC and overlaps the casing fitted to the PTO drive-shaft so that no part of the shaft (or couplings, clutches, etc.) is exposed at any time shall be fitted.

12.2.2 The provisions covering construction of guards (see clause 6) shall also be met.

12.3 PTO drive-shafts

The drive-shaft shall be protected as indicated in 12.3.1 to 12.3.3.

12.3.1 A casing which provides stationary protection against contact with the PTO drive-shaft and protects the shaft throughout its length (whether the machine is towed, mounted or semi-mounted) shall be fitted.

12.3.2 The guard shall be firmly mounted, i.e. it shall be detachable only by means of tools. It may be permanently fitted to the shaft.

12.3.3 The provisions covering construction of guards (see clause 6) shall also be met.

13 Miscellaneous

13.1 Exhaust pipes

The outlet of the exhaust pipe shall be located and directed in such a way that the driver or any other operator obliged to stand on the machine will not normally be exposed to harmful concentrations of noxious gases or fumes, for example by locating the outlet over or to the side of the head level of the operator or the air intake of the cab.

13.2 Hot parts

Protection shall be provided to minimize the possibility of inadvertent contact with any exposed element which may cause burns during mounting, dismounting or operating the tractor or machine.

13.3 Battery

The location of the batteries shall be such that hazards to the operator due to fumes and electrolyte are minimized.