

# Power take-offs and power take-off drive shafts



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A tractor power take-off (PTO) and the power take-off drive shaft of a machine are very dangerous if used and not correctly guarded. Every year people are killed or seriously injured in accidents involving PTOs and PTO drive shafts.

Most of these accidents are preventable if the PTO and PTO drive shaft are fitted with guards of good design which are properly used and maintained.

## **BROKEN, DAMAGED OR BADLY FITTING GUARDS CAN BE JUST AS DANGEROUS AS NO GUARD AT ALL**

This leaflet is aimed at all users of PTO-driven equipment.

A 26-year-old stockman was adapting the pump unit of a slurry tanker to provide vacuum drive to a milking unit. On stepping over the partially unguarded PTO shaft his left trouser leg became entangled in the revolving PTO, resulting in his leg being severed.

## Guarding

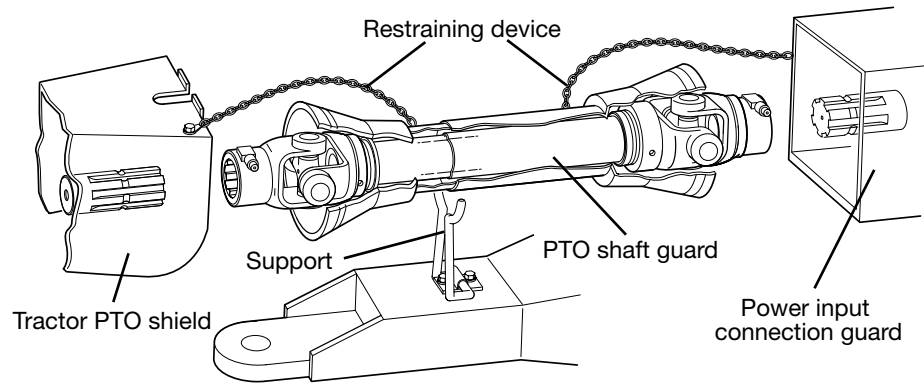
- Protect the tractor PTO with a shield covering the top and both sides of the PTO so that it stops anyone making contact with it, either with parts of their body or their clothes. Make sure this shield is well constructed and capable of supporting a downward load of at least 120 kg. When the PTO is not in use, it may be covered by a fixed cap.
- Guard PTO drive shafts by enclosing them along their full length from the tractor to the first bearing on the machine.
- Advice on guard dimensions and design specifications for agricultural PTO drive shaft guards are contained in BS EN 12965:2003. Criteria for wear and strength tests for guards are in BS EN ISO 5674:2006.

## Choosing and fitting a guard

- When buying a guard with a PTO drive shaft, make sure it has the CE mark on it and has a Declaration of Conformity which shows it complies with the Supply of Machinery (Safety) Regulations 1992 (as amended). If in doubt ask the supplier. PTO drive shaft guards sold individually do not have to have the CE mark on them. Users have a duty to ensure that the equipment they buy meets any relevant legislation.
- If buying a guard on its own, check with your supplier that it has been made and tested to the appropriate standard, BS EN ISO 5674:2006, for wear and strength.
- Make sure the guard is the correct size and length for the drive shaft. If in doubt consult the guard supplier. Remember to take into account the shaft's vertical and lateral movements during work.

**IMPORTANT** – always refer to the manufacturer’s fitting, operating and maintenance instructions.

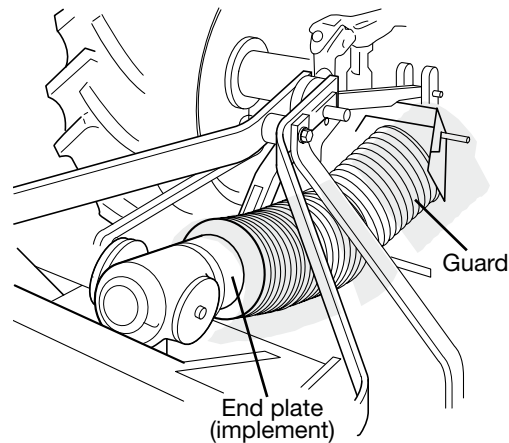
A 23-year-old employee was killed when he caught his wax coat in the partly exposed revolving PTO shaft of a roller mill. He was dragged over the shaft and struck his head on one of the mill’s supporting girders.



**Figure 1** Cone and tube type guard

**Points to consider for the guards shown in Figure 1**

- Ensure the closed and extended length of the guard and the drive shaft are right for the tractor and machine. The guard tubes should be slightly shorter than the appropriate drive shaft telescopic halves by not more than 25 mm so that they will not separate at its longest length or ‘bottom’ at its shortest.
- Ensure the guard’s bearings are secure in the correct position on the shaft grooves, and a restraining device, eg a rope or chain, is in place to prevent the guard rotating with the shaft.
- Attach restraining devices at suitable points. At the machine end they should be attached near the power input connection guard, and at the tractor end they should be coupled to a hole in the PTO master shield. BS EN 1553 gives information on this. Ensure there is no restriction to allow for vertical and side movement.
- Clean the sliding inner and outer surfaces of the guard daily and lubricate the guard bearings weekly (or more frequently if the manufacturer recommends it) with a lithium-based grease. Similarly grease the sliding drive shaft halves and the grease nipples at universal joints in accordance with the manufacturer’s operating and maintenance instructions (normally before starting work and after every 8 hours of use).
- Ensure the spring-loaded plunger of the quick release yoke is adequately lubricated. Again a lithium-based grease is best.
- Check that wide-angle joints are not exposed at tractor/implement turning angles.
- Both the tractor PTO shield and the power input connection guard must overlap the PTO shaft guard by 50 mm.



**Figure 2** Bellows type guard

### **Points to consider for the guards shown in Figure 2**

- Check that end plates are fitted, eg bolted to the tractor and implement.
- Ensure the guard is held correctly to both the tractor and implement end plates.
- Check for wear, holes, deformation of the guard etc and replace if necessary.

### **For all guards**

- Check all guards regularly, eg daily when in use, for wear and damage. Damaged guards must be replaced before use.
- Where it is necessary to have some form of protection in the PTO drive line, torque limiters, free wheels or clutches should be located at the power input connection (machine end) of the PTO drive shaft.
- The restraining devices used to prevent the rotation of the shaft guard should not be used as a means of supporting the PTO drive shaft/guard when the machine is uncoupled.

### **How to avoid damage to the PTO shaft and guards**

- When the machine is not in use, support the drive shaft and guard on the cradle provided. If there is no cradle, support the shaft and guard by other means to give equivalent protection against damage.
- Do not rest PTO drive shafts and guards on drawbars and do not drop them on the ground.
- Make sure drawbar pins of trailed machines cannot foul and damage the shaft guard. The recommended height of pins above the drawbar is 20 mm. Allow enough clearance between the guard and the parts of the tractor and machine to prevent the guard being fouled. This is particularly important when working on undulating land.
- Note that the restraining devices fitted to guards may not be capable of supporting longer or heavier shafts when the machine is uncoupled.

### **Safe use**

- Ensure no one is in danger before engaging the PTO drive, eg sound the tractor horn to warn bystanders.
- Don't turn too sharply as this could cause the lower links or tractor tyre to foul the PTO drive shaft. Always disengage the PTO drive when making sharp turns.
- Do not wear scarves, loose or damaged clothing, eg loose anorak cords, which could be caught in moving parts. It is advisable when operating any machinery to tie back long hair, and wear overalls or close-fitting clothing.

**NEVER try to clear blockages from a PTO-driven machine while it is moving. Always:**

- **disengage the power drive;**
- **stop the tractor engine;**
- **ensure controls are in neutral and the hand brake is applied;**
- **remove the engine key;**
- **wait for all movement to cease before attempting to clear any blockage and use a tool to clear the blockage.**

## Dual-speed PTOs

- Shafts for the two speeds are different: six splines for the 540 rpm and 21 splines for the 1000 rpm. In both cases the speed should be achieved at not less than 80% of the engine-rated speed.
- Any adaptor allowing a six spline shaft to drive 1000 rpm machines is potentially dangerous and is not recommended. Adaptors create the further problem of extending the length of the shaft so that the standard guard no longer offers the necessary protection.
- It is essential not to drive the machine too fast. If a machine is used in excess of its design speed it will come under too much stress and there is a possibility of it disintegrating. This can be caused by using the wrong shaft speed or too high an engine speed when using an adaptor.
- Make sure you use the right shaft and engine speed.

## Legal requirements

### ***Provision and Use of Work Equipment Regulations 1998***

These Regulations require employers and the self-employed to take effective measures to ensure that:

- access is prevented to any dangerous part of machinery;
- all dangerous parts are enclosed by fixed guards which are:
  - of good construction, sound material and adequate strength;
  - maintained in an efficient state, in an efficient working order and in good repair;
- information, instruction, training and supervision is provided.

### ***The Health and Safety at Work etc Act 1974***

This places general obligations:

- on employers:
  - to ensure the safety of their employees at work, for example by maintaining safe plant, safe systems of work and safe practices;
  - to provide training, instruction and supervision of employees, as necessary to ensure their safety;
- on employees and the self-employed, to take reasonable care to avoid injury to themselves by work activities; and
- on employers, the self-employed and employees, not to put at risk the health and safety of a third party, eg a child or a member of the public.

## **Further information**

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