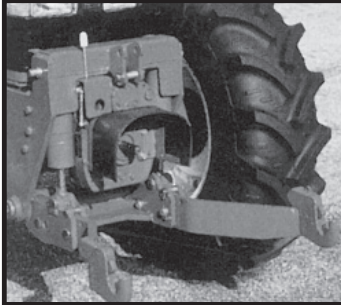


3. TRACTOR POWER TAKE-OFFS (PTOs)



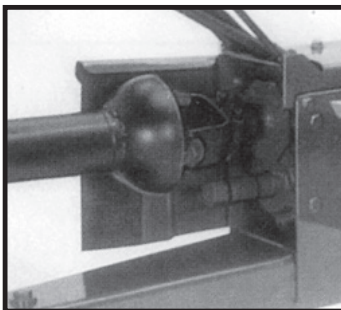
THE HAZARD



The tractor's power take-off (PTO) provides the power source for many implements and equipment used in production farming. Examples include the post-hole digger, slasher, fertiliser spreader and many others.

The power take-off is a rotating stub shaft at the rear of the tractor. The power take-off and its attachments are a series of high speed shafts that move in a circle 88mm from the centre of a shaft revolving at 540 RPM at a speed of 5 linear metres per second.

This rotating shaft assembly poses a severe hazard. The rotational force of the shaft is the source of the hazard. It is present wherever implements are power-driven by the tractor power take-off shaft. There is a risk of entanglement of body parts with the shaft. It usually occurs when hair, clothes or jewellery become caught in the rotating shaft.



HAZARD IDENTIFICATION

Tractor safety assessments should look for all possible causes of power take-off entanglements. Assessment will include aspects of the machine, the environment, the operator and the interaction between these.

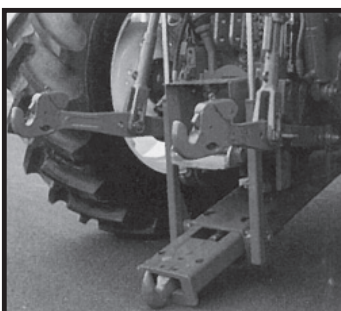
It should cover:

- The presence and condition of guarding of exposed moving parts which are accessible to the operator or a passer-by.
- Condition of the terrain which may cause shaft stress and separation.
- Training of the operator (all tractor operators should have the training to enable them to operate a tractor safely).



To identify further hazards relevant to tractor power-take-offs, refer to Health & Safety Guidance Notes on:

- ☛ Tractor Runovers (Number 2)
- ☛ Noise on Farms (Number 4)
- ☛ Farm Machinery (Number 5)
- ☛ Children on Farms (Number 7)



THE RISK

1. Who is at risk

- All operators of power take-off equipment as well as bystanders are at risk of being killed or injured through power take-off entanglement.

- Children are more at risk due to their curiosity and limited understanding of hazards.
- Any person who goes near an **inadequately guarded power take-off shaft** runs the risk of entanglement. It only takes a strand of hair, a piece of jewellery or a thread of cloth to initiate an entanglement.
- People who are wearing clothing which is loose-fitting or has drawstrings or toggles are more at risk of entanglement.
- People who use unsafe work practices such as stepping over an operating power take-off shaft are more at risk of entanglement.
- Fatigue will increase the risk for operators of implements powered by the tractor take-off as their reflex times will be slowed and concentration lost. People generally suffer from fatigue at busy times such as harvest or sowing time and will usually be more at risk at night. The increased exposure time to the hazard as well as the slow reaction time and loss of concentration resulting from fatigue places them at higher risk of death or injury from the tractor power take-off.

2. Nature of potential injury/illness

If death does not occur, injuries associated with power take-off entanglements are usually massive and include:

- lacerations
 - dislocation of joints
 - amputations
 - severe twisting of body parts
- During an entanglement, the body is wrapped around the shaft at high speed resulting in serious injuries. These result from both the twisting motion and from being thrown against other parts of the machinery.
 - These injuries have the potential to be fatal. In non-fatal cases, the injuries are generally very severe and rehabilitation requirements are high as amputations and/or severe muscle damage are common.

3. Degree of risk

When assessing the degree of risk associated with tractor power take-offs, the following questions should be considered:

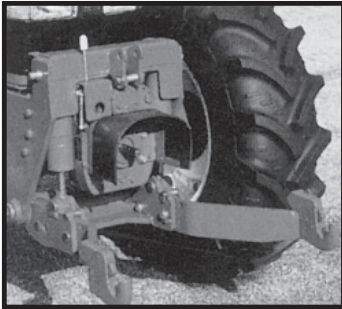
- How common is entanglement in the tractor power take-off ?
- How severe is the likely resulting injury ?
- How often and for how long are people exposed to the hazard associated with the tractor power take-off ?

How common is entanglement in the tractor power take-off?

Death or permanent disability from entanglement is common on Australian farms. Factors which influence the likelihood of injury or death include:

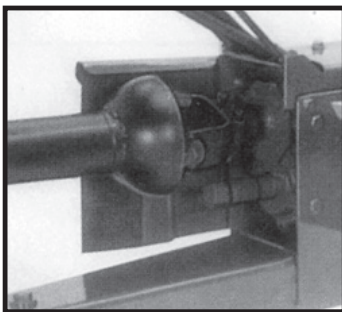
Features of the operator:

- Safer work practices are more likely to be adopted when operators have been trained. Practices which increase the risk of injury include the wearing of unsuitable clothing which is likely to become entangled, stepping over an operating power take-off shaft, operating the power take-off at the incorrect speed and attempting to service or adjust a power take-off driven implement while the power take-off is still engaged.



Features of the machine:

- The moving exposed shaft must be adequately guarded and the guards and shafts maintained. Loose clothing or hair can be entangled by wrapping around the bare, turning shaft or caught on an exposed bolt, clip or grease nipple. When these parts are adequately guarded, the risk of entanglement is relatively low. However, if there is no guarding or if guarding is in a state of disrepair, the risk is high.



Features of the environment:

- Uneven ground and tight turns can cause shaft stress and separation. If separation occurs, the powered end of the shaft can flail about and increase the risk of injury. Therefore, uneven ground can increase the risk of injury. If the tractor drawbar is not positioned properly for each machine used, the risk of shaft stress and separation is increased when driving over uneven ground.

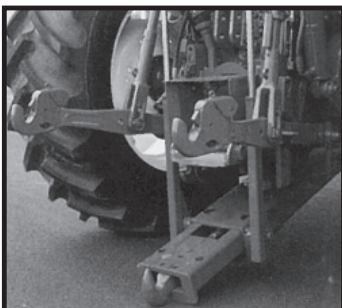


How severe is the likely resulting injury ?

From this, the consequences or likely outcome of entanglement with a power take-off need to be considered. These consequences could range from the worst outcome of death or permanent disability through to the least serious outcome which is First Aid treatment. However, the most likely outcome from entanglement in a tractor power take-off is death or permanent disability.

How often and for how long are people exposed to the hazards associated with tractor power take-offs ?

Every time the power take-off is used, people are exposed to its hazards. However, the level of risk is influenced by the number of times and length of time that a tractor power take-off is used. The more often it is used, the more likely it is that entanglement will occur. The longer it is operated, the more chances there are for an entanglement to occur.



As death or permanent disability from entanglement in tractor power take-offs is very common, the level of risk associated with tractor power take-offs should be assessed as high and action should be taken as soon as possible.

The following control measures will not be suitable for everybody. They are presented as options which are available to reduce the risk of injury or death while not interfering with farm productivity.

In fact, well-designed control measures should increase productivity by decreasing human physical demands and reducing the cost of injury.

An option which may seem impractical to one person in their particular situation may well be possible for somebody else in their circumstances. Where an option may not be practical at present, it may become so in the future; for instance, when planning the purchase of new machinery or tractors.

1. *Elimination of the hazard*

- Elimination of the hazard altogether is usually not an option. It could involve either altering the task altogether or using a piece of equipment which does not need to be power-driven by a tractor. An example of this could be the use of aerial applications of fertiliser instead of a spreader which requires the power take-off shaft.

2. *Substitution for a lesser hazard*

- Substitution of the hazard involves using a piece of machinery which poses less risk of entanglement for the same task. An example of this could be the use of hydraulic transmission to replace the power take-off as a power source for implements.

3. *Engineering/design options*

- **Engineering and design controls involve the fitting and maintenance of power take-off guards and master shields.** Guards should protect people from parts of the tractor which pose a risk of entanglement either when the tractor is in normal operation or undergoing routine maintenance. It must be secured from turning with the shaft or be capable of being stopped by hand. The most recent power take-off shield is totally enclosed and clips on to either end of the shaft. The cover can be easily moved from implement to implement.

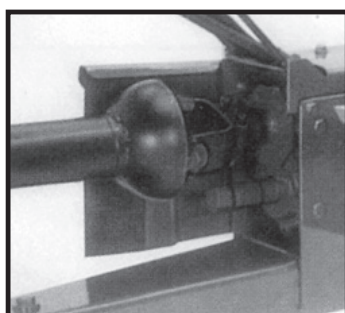
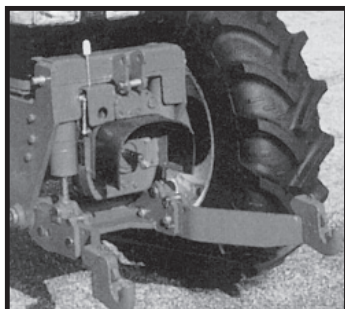
- **In order to comply with Occupational Health & Safety Regulations in Australia, a power take-off shaft should be fully guarded or have relevant machinery parts situated so that they are as safe as if guarded.**
- **Damaged guards must be replaced!**

4. Safer work practices and procedures

Improving work procedures and practice includes the following:

Pre-operational

- ✓ Ensuring that only people who are absolutely necessary for the task are present during power take-off operations is a safe work practice which isolates people from the hazard. Thus, **passengers** should **never** be carried on the **implement or tractor**.
- ✓ Guards should only be removed for repair or maintenance. If removed, guards should be refitted before further operation. When undertaking these activities, the power take-off should always be disengaged and the tractor shut off beforehand. It must be possible to stop the shaft guard by hand if it rotates with the shaft. They should be regularly tested by spinning and rotating them when the tractor or other power source is switched off. This can be a part of a pre-operational check which includes inspection of the shafts for signs of damage as well as general tractor safety features such as presence of a fire extinguisher, hearing protection if necessary, condition of tyres, brakes, steps and other surfaces as well as the seat.
- ✓ Provision of training for tractor operators. Apart from a formal training course, available through TAFE or Agricultural Colleges, which should include attention to maintenance of guards and shields, the Operator's Manual for both tractor and implement should be studied. Training in universal hand signals is also very important in tractor safety.



Operational

- ✓ Reduce power take-off shaft abuse by observing the following:
 - a. Avoid tight turns that pinch rotating shafts between the tractor and machine.
 - b. Keep excessive telescoping to a minimum.
 - c. Engage the power take-off gradually and avoid over-tightening of slip clutches on power take-off driven machines.
- ✓ Disengage the power take-off before dismounting.

When not in use

- ✓ Separate children from tractors and other machinery by providing a safe play area for the children. As a safeguard, always remove keys from the tractor when not in use.



5. *Personal protective equipment and clothing*

- There is no personal protective equipment specifically recommended to prevent or manage the effects of power take-off entanglements. However, when working outside, sunscreen, hat and shirt with collar will provide sun protection. Hearing protection may be necessary. (See Health & Safety Guidance Notes: Number 4. Noise on Farms).
- It is especially important when working with power take-off equipment that clothing be of a snug fit, buttons done up and sturdy boots are worn. Jackets should be buttoned or zipped up. Rolled up shirt sleeves should be avoided. Pants or overalls with straight legs which don't drag on the ground are preferable to reduce the risk of entanglement.

Drawstrings and toggles on clothing represent a significant hazard and clothing with these should not be worn around power take-off shafts. Likewise, hair poses a severe entanglement hazard and a few strands are enough to initiate an entanglement. Thus, long hair should always be kept tied back. Jewellery can also be entangled and should not be worn.

6. *First Aid*

- An effective rescue and First Aid technique can dramatically improve a person's chance of survival in the event of a power take-off injury.
- Develop a contingency plan for every recognised crisis situation.
- At least two individuals on each farm need to be trained in First Aid.
- First aid kits should be in handy locations on the farm. The size of the kit will vary according to the number of workers on the farm. The legal requirements vary from state to state and should be checked with your local Occupational Health & Safety Authority.

RELEVANT LEGISLATION AND STANDARDS

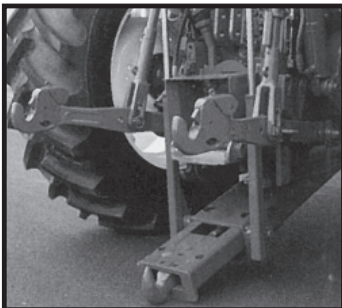
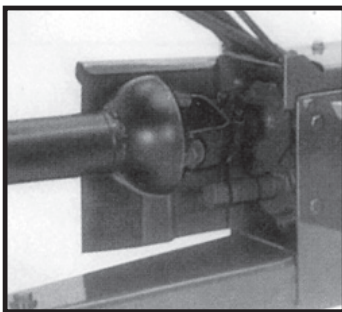
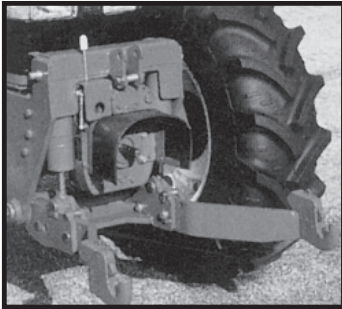
- The Occupational Health & Safety Act and accompanying Codes/Regulations pertaining to Plant and Machinery in each state or territory. Legislation will vary from state to state and requirements should be checked with your state/territory Occupational Health & Safety organisation.

Guards must conform to:

- **AS 4024.1-1996;** Safeguarding of machinery, Part 1. General Principles.
- **AS 1121-1971;** Guards for Agricultural PTO Drives, or at least afford the same degree of protection as would that standard.
- **AS 2153-1978;** Guarding of Agricultural Tractors and machines.

USEFUL REFERENCES

1. Tractor Operation and Maintenance Course. NSW Farmsafe. 1995
2. John Deere, *Fundamentals of Machine Operation*. Deere & Company Service Training. Illinois. 1983
3. Baker, J. & Ritchie, B. *Advanced Tractor Safety*. Accident Compensation Corporation of New Zealand. New Zealand. 1988
4. Video: *Consolidated Safety*. John Deere Ltd. USA



CONTACTS

Australian Agricultural Health Unit

PO Box 256
Moree NSW 2400
Telephone: (02) 6752 8210
Facsimile: (02) 6752 6639

Rural Training Council of Australia

PO Box E10
Queen Victoria Tce
Kingston. ACT 2604
Telephone: (02) 6273 2514
Facsimile: (02) 6273 4811

State/Territory Occupational Health & Safety Organisations as listed below:

- ☛ New South Wales WorkCover Authority: Ph: 131 050
- ☛ Victorian WorkCover Authority: Ph: (03) 9628 8188
- ☛ Queensland Division of Workplace Health & Safety:
Ph: (1800) 177 717 or (07) 3247 4711
- ☛ South Australian WorkCover Corporation: Ph: (08) 8226 3120
- ☛ WorkSafe Western Australia: Ph (08) 9327 8777
- ☛ Tasmanian Workplace Standards Authority: Ph (03) 6233 7657
- ☛ Northern Territory Work Health Authority: Ph (08) 8999 5010
- ☛ Australian Capital Territory WorkCover : Ph (02) 6205 0200

Your local supplier of tractors and implements.

AGHEALTH

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Rural Industry Development Corporation**

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