

GUARDING FARM MACHINERY



Tractor power take-offs and transmission machinery

Addendum: Health and Safety in Employment Act 1992

Since this booklet was first published, the Health and Safety in Employment Act 1992 has come into force. While the technical and general information in this booklet remains current, it contains references to legislation which has been superseded by the new Act. You are advised to read this booklet in conjunction with the Act and any regulations made under it.

Your local Occupational Safety and Health Service office can provide further information.

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Introduction

Mechanisation has meant great improvements in New Zealand farming over the years.

But there is a negative side to the tractors and machinery that make this country's farms so efficient. Each year there are injuries and fatalities among those who work with or near farm machinery. People, sometimes innocent bystanders, are having limbs crushed or amputated and are being maimed in other ways by seemingly innocent machinery—usually unnecessarily and after coming into contact with moving parts that should have been guarded. The most distressing cases involve children.

This booklet examines two types of farm machinery that are hazardous: tractor power take-offs and transmission machinery. It outlines risks, likely types of injuries and the only certain solution — effective guarding.

Farmers and others are legally obligated to guard all hazardous machinery. Usually proper guarding can be constructed cheaply and easily or else be purchased from machinery manufacturers. The Department of Labour is always willing to offer advice.

Every farmer should regularly check that tractor power take-offs and all other potentially dangerous transmission machinery is safe for drivers, operators and others who may come into contact with it.

Section 16 (1) of the Machinery Act 1950 requires that:

Every part of any transmission machinery shall be securely fenced unless it is in such a position or of such construction as to be safe to every person employed or working on the premises as it would be if securely fenced.

Tractor power take-offs

Each year accidents occur on unguarded tractor power take-off stub shafts, couplings and implement drive shafts. Such accidents are not restricted to the tractor driver. Accidents involving passengers, bystanders and children have resulted in death or serious injury.

In most cases the people concerned seemed to have been unaware of the danger in coming close to unprotected couplings and shafts.

Any accessible rotating shaft is dangerous — even if it is slow moving or smooth — and must be suitably guarded.

Farmers, users of tractor-driven equipment and people associated with the farming industry need to be aware of the types of accidents which have occurred and how such accidents may be prevented.

Hazards of stub and drive shafts

Exposed power take-off stub shafts, couplings and drive shafts, as illustrated in figs 1 and 2, present a potential danger in that a person's clothing, hair, jewellery, hands, or even limbs can easily be caught and become wrapped around the shaft or coupling.

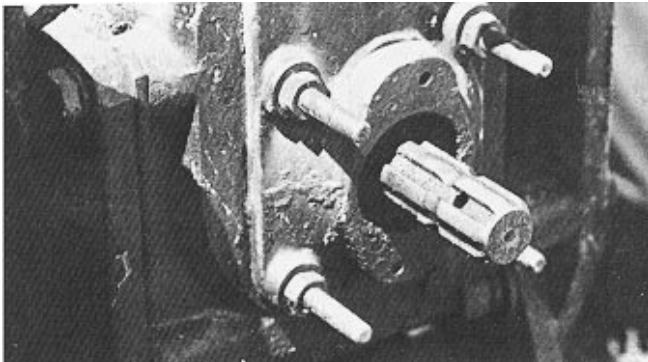


Fig. 1: Unprotected stub shaft.

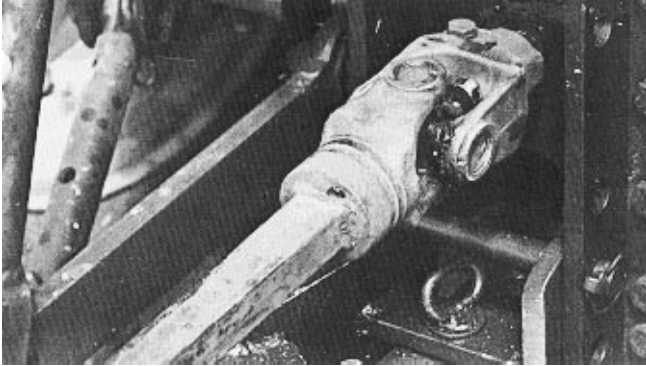


Fig. 2: Unguarded shaft.

If clothing is caught and the material does not tear apart as the shaft continues to rotate, the victim can become trapped between the structural members of the equipment and the shaft, or may be flung to the ground, often receiving fatal injuries.

Even if the clothing is torn apart, there is still a strong possibility that the person will be seriously injured.

Typical accident case histories

- A farmer making adjustments to a pump driven by a power take-off received fatal injuries when his clothing wrapped around the shaft.
- An elderly farmer received serious fractures to his arm, requiring amputation, after his oilskin coat became caught around a power take-off shaft.
- A middle-aged farmer was killed when his oilskin coat wrapped around the power take-off shaft of a tractor-drawn mower.
- A 15-year-old boy engaged in filling a tank trailer with liquid manure was killed when his parka was caught around the power take-off shaft.

- A 12-year-old boy was riding as a passenger on a tractor towing a potato digger when a long coat he was wearing became entangled around the power take-off shaft. He suffered lacerations and a broken arm.
- A 2-year-old girl wandered over to a concrete mixer operated by a tractor power take-off. Although the shaft was revolving slowly, her cardigan became caught around it and she was killed.

Guarding stub and drive shafts

Guards for stub shafts must allow flexibility of operation, while enclosing the dangerous parts.

Where clear access is needed to fit equipment, shields may be attached by hinges or lynch pins. Otherwise they should be firmly bolted to the tractor and driven unit. (See figs 3 and 5.)

When the tractor is in operation and its stub shaft is not in use, the power take-off drive should be disengaged. In addition, a cover should be provided over the stub shaft (fig. 3) to protect people and also to exclude dirt.

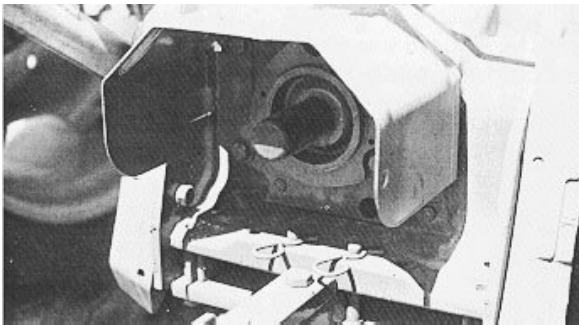


Fig. 3: Tractor protective shield with stub shaft cover.

Suitable designs of guards for tractor stub shafts are shown in fig. 6.

It is also essential that the drive shaft between the tractor and the machine or implement is guarded (fig. 5).

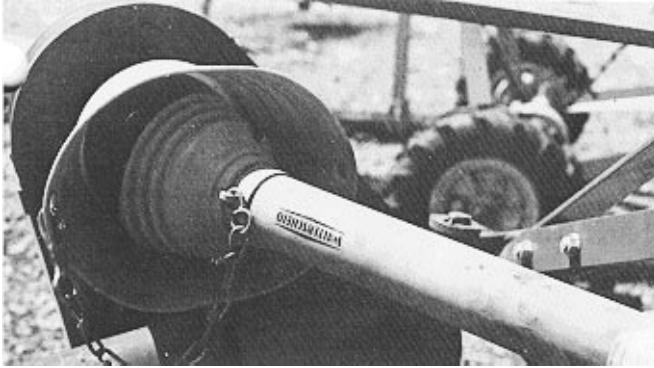


Fig. 4: Protective shield on driven unit.



Fig. 5: Protective tube casing.

The dangers associated with unprotected rotating shafts and universal joints cannot be over-emphasised.

Experience has shown that the best method of guarding transmission shafts is by the use of cover tubes or casings which do not rotate with the shaft. The protective tube or casing should be fitted around the power take-off shaft on bearings and be anchored to a fixed part by means of a chain to prevent rotation.

Protective tubes or casings should have conical guards over the universal joints extending beyond the centre line of the universals and covered by shields at each end (fig. 5). A sectional view of a drive shaft and coupling guards is shown in fig. 7.

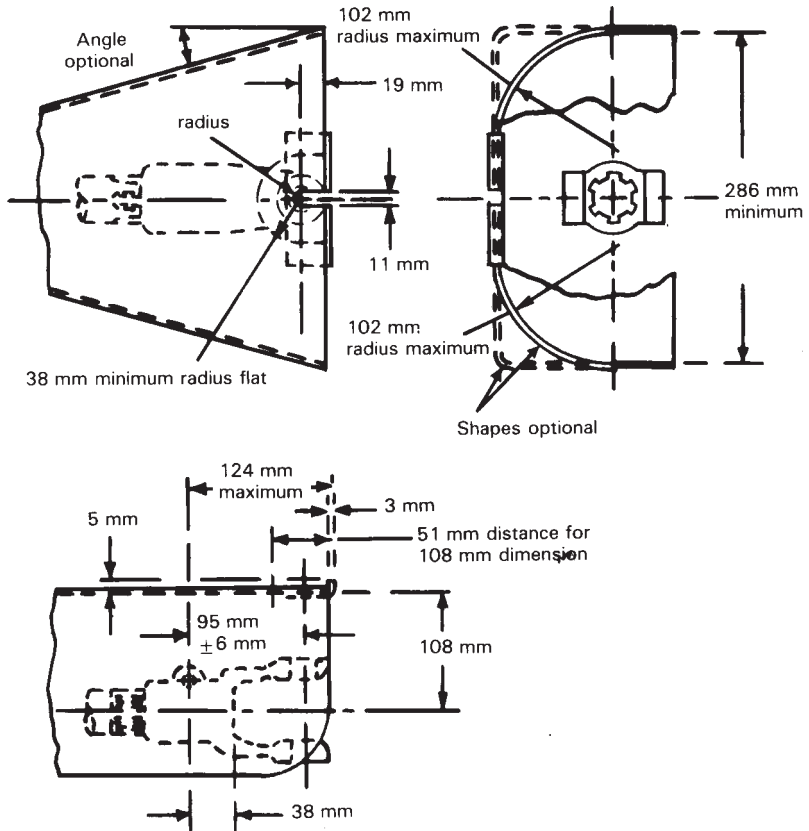


Fig. 6: Extract from BSS 1495 showing details of the tractor power take-off master guard or shield.

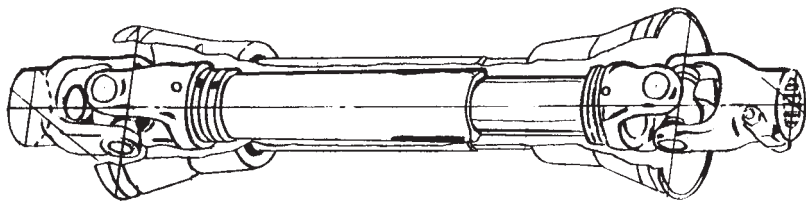


Fig. 7: Sectional view of drive shaft and coupling guards.

Transmission machinery

The Department of Labour is also concerned about the number of accidents which occur with unguarded transmission machinery on farms. As with tractor power take-offs, it has resulted in the death or serious injury of operators, bystanders and even children.

Hazards of in-running nips

These include nips formed between belts and pulleys, chains and sprockets, or meshing gears (as illustrated in figs 8-10).

Dangers from in-running nips include the trapping of fingers, hands, limbs, hair and loose clothing. Accidents may result in fractures, amputation and even death.

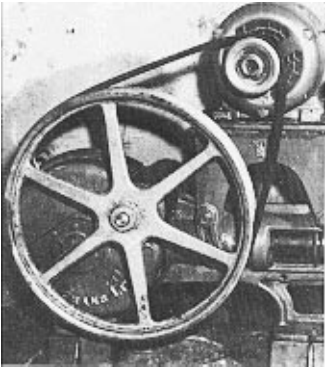


Fig. 8: Belt and pulleys.

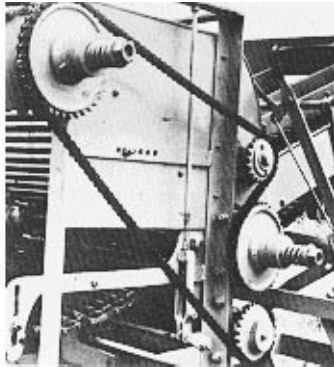


Fig. 9: Chain and sprockets.

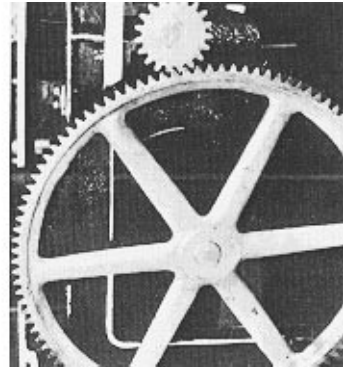


Fig. 10: Meshing gears.

Typical accident case histories

- While levelling out lime in a lime spreader with his hand, an employee's finger was amputated when it became trapped in an exposed chain and sprocket drive.

- A farmer testing a hay baling machine tripped over a tool box and instinctively put out an arm to break his fall. His hand entered an exposed chain and sprocket drive, resulting in the loss of three fingers.
- A contractor removed a cover from the transmission machinery of a hay baler and, while adjusting a revolving pulley, his hand became caught between the V-belt and the pulley. He was flung around, receiving fatal injuries when his head struck a fixed part of the machine.
- A 10-year-old girl climbed on to a shelf 1.2 m above floor level in the separator room of her family's milking shed to retrieve a toy from a rafter. Her hair became entangled in the flat belt and pulley transmission of a water pump and she was partly scalped.

Guarding in-running nips

The only certain method of preventing accidents is to completely enclose the transmission with a guard constructed of sheetmetal, strong wire mesh, wood, or other rigid materials of equal strength (as illustrated in figs 11-13). Guards should be properly secured but may be hinged to allow access for maintenance when the machine is stopped.

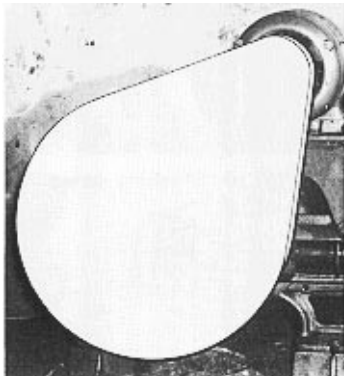


Fig. 11: Belt and pulley guarded.

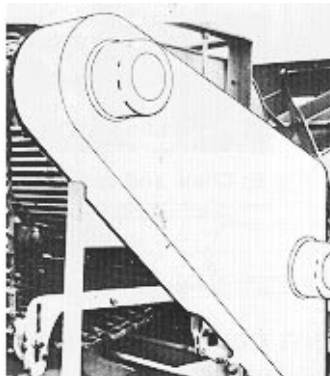


Fig. 12: Chain and sprocket guarded.

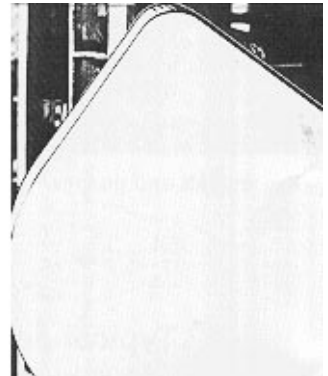


Fig. 13: Meshing gear guarded.

Hazards of shafts and spindles

These include projecting vacuum pump shafts, motor spindles, line shafting, couplings and similar transmission.

Some examples are illustrated in figs 14-16.

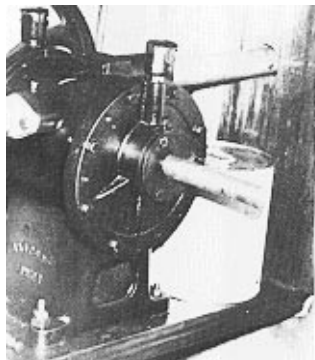


Fig. 14: Projecting spindle.

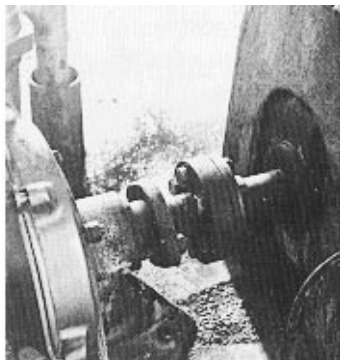


Fig. 15: Coupling.

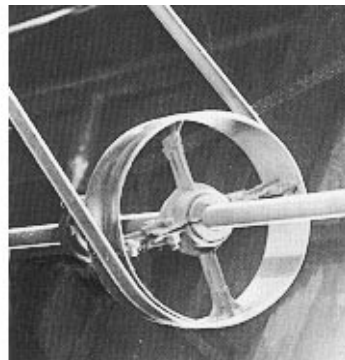


Fig. 16: Line shafting.

As with the machinery outlined above, hair or loose clothing coming into contact with this type of machinery often results in people being entangled in machinery, leading to serious injury or death.

The fact that many shafts may be smooth with no projections does not mean that they are safe.

Typical accident case histories

- A 5-year-old boy received a compound fracture of his right arm when his jersey became entangled around a smooth projecting spindle of a milk pump situated 1 m above floor level in the family's milking shed.
- A 14-year-old boy, while starting a milking machine, was strangled when his clothing became wrapped around the smooth shaft of a vacuum pump.
- A 17-year-old farm worker climbed on to a stall in a milking shed to reach a radio. The hem of his coat became twisted around a milking machine shaft, jamming him between the shaft and the ceiling and inflicting fatal injuries .

- A 9-year-old girl went into a milking shed to fetch some milk and was partly scalped when her hair became entangled around the main drive shaft which was situated about 1.2 m above the floor.

Guarding shafts and spindles

Shafts and spindles should be cut off flush with casings wherever practicable or be totally enclosed in sleeve- or cap-type guards constructed of suitable material, such as sheetmetal. Couplings may be enclosed with inverted U-section guards. Examples of effective guarding are illustrated in figs 17-19.

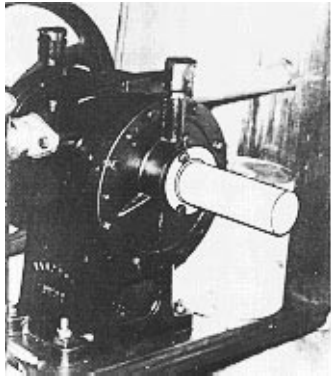


Fig. 17: Projecting spindle capped.

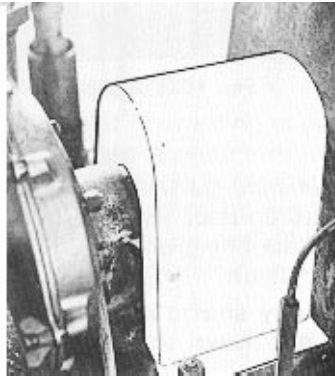


Fig. 18: Coupling guarded.

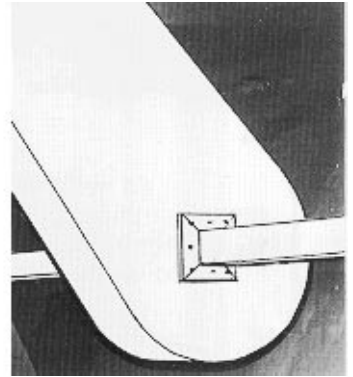


Fig. 19: Sleeve-type guard on line shaft

More detailed information on guarding transmission machinery may be obtained from the Department of Labour's publications *Ergonomics of Machine Guarding*, *Guarding of Transmission Machinery*, and *Wire Mesh Guards for Machinery*, which are available free of charge at any Occupational Safety and Health Service office.