This document will be useful even if you have no current knowledge of either health and safety risk management or guarding requirements. It talks about machinery guarding and your legal responsibilities. The law not only requires that necessary guards are in place, but also holds you accountable for the quality and effectiveness of the guard. The advice in this document is intended to help you so that your guards are as good as they can be, and so that you know what the legal implications are.

Have a read, to get a good idea about what the law now requires you to do, and get some useful information and specs for farm machinery guarding design.

If you're not sure about "*Health and Safety*", it's best to read this guideline from start to finish. We suggest you grab a cuppa, have a seat, and read on to pick up some new knowledge.

Contents

Machinery Guarding Design

We all know what a guard does, but regulation introduced in the mid 90's throughout Australia has changed the idea behind machinery guarding. These new laws will ensure the effectiveness of your guards, regardless of how big, small, old, or new your farm is, and regardless of who it is that uses or gets injured by the machine. (The *only* exception to prosecution is if a sole trader injures him/herself)

The idea of a guard

The ***old*** idea of guarding might have been to put some protection between a person and the danger (the hazard).

The ***new*** idea of guarding, is that the guard is part of a ***system*** that ensures it is not possible, or extremely unlikely, for a person to be injured or killed while the system is in place ***– that is, it takes care of the problem.***

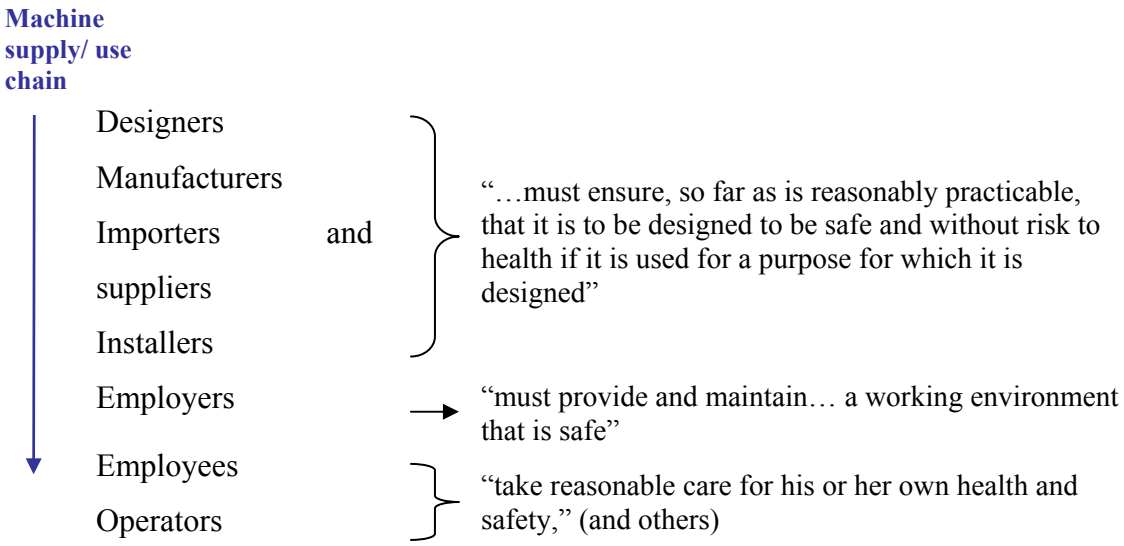
How is this done? Well the new idea of a guard is that it is the right size, in the right place, it may have cut-off switches attached to it if necessary, and a plan is in place to check it over time. It also includes training of people who might come near the machine.

Guarding, moreover, is required to be considered as part of an overall ***risk management*** plan on all workplaces, and is just one step toward making sure that no one gets injured or killed on farms. This approach is now required by law in all states and territories of Australia.

Legal obligations with guarding

Designing and building a guard takes quite a bit of careful thought. Here is how you are legally accountable for building a guard (or choosing <u>not</u> to build a guard).

All state health and safety laws place specific duties of care or legal obligations on various parties in the 'chain' of machinery design, supply and use. Similar responsibilities are placed on the groups, as the following wording from the Victorian OHS Act shows. (Note that the OHS Regulations outline many other requirements, including keeping records, monitoring conditions, providing training, worker consultation, etc.)



So no matter where you are in the chain, as long as you or your equipment is in a workplace, (or even if it *might* be used in a workplace), then you are either responsible for ensuring it is used safely, and/or it is safe to use.

- Your responsibility as an employer is to provide a workplace that is safe, therefore you must ensure that all manufacturers' guards are in place and in working order before use.
- If you modify the machine, you are considered to be a designer by law, and are responsible for the safe design of any modifications.
- If you sell the machine to another farmer, you are considered a supplier.

Here are some good pointers:

1. If a machine comes with guards on it, they should meet relevant Australian Standards, so they should be left in place, checked to be sure they are effective, and replaced when they break or wear out.
2. In any event, and regardless of whether the machine came with a guard, a guard must be in place if there is a need, and it must be effective and safe.
3. The design and implementation of guards is a serious matter that requires quite a bit of thought and time.
4. The best approach with machine safety is to make a judgement using the recommended *risk management* procedure, and *keep a record* of this process.

Risk Management

There is a lot of risk management information available from all state work safety authorities. That information will be more comprehensive than this short summary, and is legally recognised, and its generally free.

What is risk management? It is a procedure for checking for safety problems in a workplace and is required by state occupational health and safety laws in Australia.

Going through a risk management procedure might seem like overkill if you are considering a guard as the required safety measure. However, if any injuries occur, your record of this process it is your best defense in court.

The risk management procedure may also bring up some good design ideas. In addition, it may reveal some hazard management options that are superior to relying on a guard alone. Briefly, here is the risk management procedure:

1. **Consult -** or involve the people who use the machine in your process. Those who use the machine will have interest and practical knowledge to help.

2. **Hazard identification** – look for *any* hazardous scenarios, such as exposed moving parts, hot spots etc.

3. **Risk Assessment** – What is the hazard and its likely impact on injury if left unattended? For each hazard consider:
   - The likelihood of an injury happening
   - The consequence of that injury, and
   - How often people are exposed to the hazard

Consequence of Injury	Frequency of Exposure to Hazard			
	Daily	Weekly	Monthly	Rarely
Kill or Disable	HIGH	HIGH	HIGH	HIGH
Several Days Off Work	HIGH	HIGH	MEDIUM	MEDIUM
First Aid	HIGH	MEDIUM	LOW	LOW

4. **Risk Control**
   The *hierarchy of controls* is a list of control strategies in priority order shown below. You try the first one, if it is not reasonable or practicable to the situation, then you try the second one, then so on.

The groups in the 'hierarchy of control' are

1. Elimination (retire the machine or task)

If not then: → 2. Substitution (upgrade machine, or change the job so it is safer)

If not, then: → 3. Engineering / isolation (guarding, fencing, cut off switches etc)

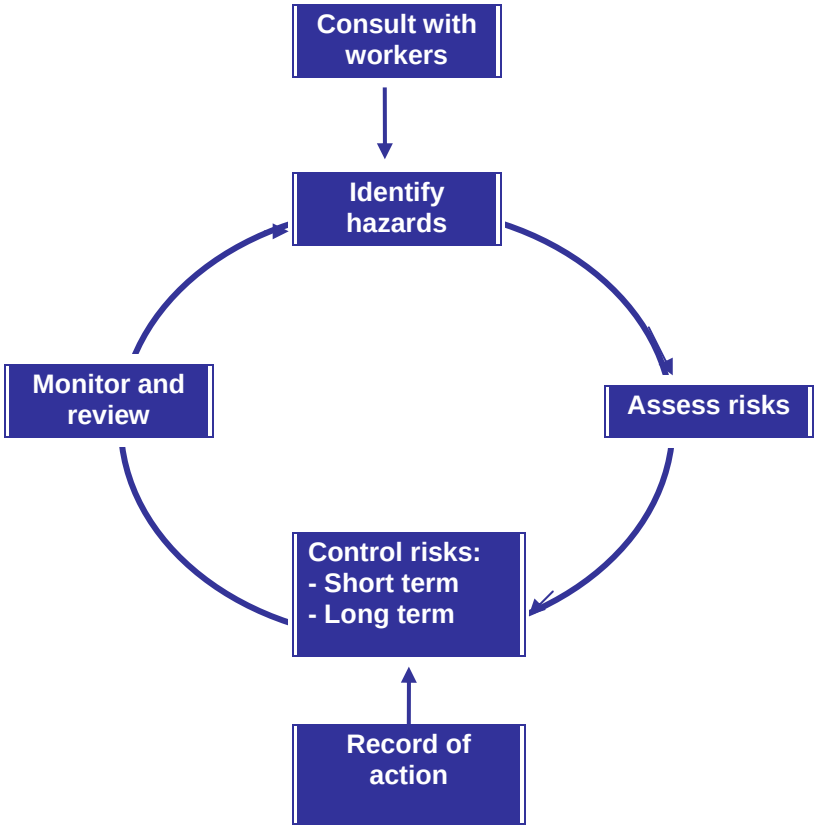
If not, then: → 4. Administration (workplace rules, systems of work, decals, training)

If not, then: → 5. PPE (Personal Protective Equipment)

Note that using a guard is an *Engineering* control. However, guarding almost always needs instruction and training of workers – an *Administrative* control.

5. **Review** – check if your new control measure is OK, and doesn't introduce any problems of its own.

6. **Record keeping** – make notes of your good work against each step of the risk management process, it is your record and may become your best defense in court.



How effective is guarding as a method of risk management?

If you consider the *hierarchy of control*, guarding is a less effective control than selecting elimination or substitution control, but is better than adopting administrative controls (training etc) or Personal Protective Equipment (PPE).

Note also that some guards require regular checking for effectiveness (if they are a consumable) and some require training (if they are not permanent or interlocked) as part of the hazard control.

Key principles for guarding farm machinery

The following general guarding advice is summarized at the end of this chapter in the ***Guard Design Reckoner*** on page 14. You may find this handy for the shed or office wall.

Buy safe machines

Manufacturers and suppliers of machines are legally obliged to provide safe machines with good guards. Machines must be safe when used for a purpose for which it was designed and for the design-life of the machine. As with any product, the quality of guards and safety systems will vary, so it is important when buying to look for the safest machine, and let your suppliers know that you look for quality guards and good safety systems on machines. This puts pressure on suppliers to provide machines that are as safe as they can be.

The law also requires manufacturers and suppliers to provide health and safety information about the machine at the point of sale. As a buyer you can request this information from them.

Look for things to guard

There are many components of farm machinery that clearly need a guard, and have clearly been identified in Farmsafe Australia and State work safety authorities ***checklists***. See attached Appendix 1 - Farm Machinery Checklist. The following list is derived from the Queensland Workplace Health and Safety inspector's machinery checklist

Engine

- ☐ Fan belts covered on old tractors
- ☐ Spark plugs covered
- ☐ Exhaust is in working order and pointed in a safe direction
- ☐ Fuel storage is OK

Power Transfer

- ☐ PTO Shaft guarding
- ☐ PTO Master guards
- ☐ Belt or sprocket guarding
- ☐ Hydraulic systems OK

Working Mechanism

- ☐ Auger flight guarding
- ☐ Other moving parts

Machine as a whole

- ☐ ROPS on tractors
- ☐ Safe for maintenance access
- ☐ Safe for repair access
- ☐ Safe when under way eg. towing
- ☐ Tyres

Human Interaction

- ☐ Access steps and handles
- ☐ Railing to prevent falls, eg elevated work platforms
- ☐ Fences - isolation from common danger areas

Parts to guard

The following are the specific parts that if exposed and accessible to people will guarding to prevent injury:

- Smooth shafts
- Joints
- Shaft ends
- Crank shafts
- Keyways
- Grease nipples
- Pulleys
- Flywheels
- Gearing
- Cables
- Sprockets
- Belts
- Chains
- Clutches
- Couplings
- Fans
- Pinch Points
- Shear Points
- Sliding Tracks
- Augers
- Hot Spots
- Chemical Hazards
- Product Flow
- Trip Hazards
- Sharp bits or other protrusions
- Access points in workplaces, eg using gates, latches, locks etc
- Guard tractor operator e.g.
  - Tractor Rollover Protective Structure -ROPS
  - Falling object protective structure - FOPS

Types of guards

There are various types of guards that can be used in different situations:

- Shields
- Covers on some sides - eg PTO master guard
- Enclosed on all sides – full solid material
- Enclosed on all sides – full transparent material
- Enclosed on all sides – mesh
- Access guards - eg lockable guards on ladders
- Interlocking guards - eg. cut of switches on guards

Guard strength

The Australian Standard for Agricultural Machinery AS 2153.1:1997 Part 6 - Tractors and machinery for agriculture and forestry – Technical means for ensuring safety, part 1: General requires the guard to be able to withstand a load of 1200N.

1200N = 122kg = 270 lb = 19 Stone.

Under this load, it must not crack, tear or permanently deflect. (That's about the weight of one and a half blokes, or maybe one bloke, who has been in a very good paddock for a while.)

Other practical aspects need to be taken into account, such as if the guard is in a good spot to be used as a seat or step – it should be made strong enough for any expected use.

Guard life

There are two approaches to consider when designing the guard's life. A guard should either:

- outlive the machine, and maintain its integrity regardless of corrosion, wear and tear, weather exposure, or chemical exposure, or
- it is a consumable, and should be monitored and replaced when it wears out, eg brake pads. For consumable guards, you will need to make some provision over the machine's life, so that guards are actually checked as part of routine maintenance, replacements are available, and they are actually replaced when necessary. Most PTO shaft guards should be considered as a consumable.

Guards stay in place when the danger exists

There are four ways to ensure that a guard remains effective. Make one of the following choices depending on the particular and your risk assessment.

1 Make guarding a permanent fixture that cannot be removed whatsoever.

2 If there is any need to access the machine during its life for cleaning, maintenance etc, then there must be an interlock (eg automated kill switch) in place to make sure that the machine cannot run if the guard or barrier is not in place. If the guard comes off, then a mechanism causes the moving part to stop. It must be designed such that:

- Manual operation is required to restart the machine after the interlock has tripped.
- Must not be able to open the guard until the danger can subside (eg. machine to run down to stop, hydraulic pressure to release, hot item to cool, etc) and
- The interlock must '*fail safely*', ie if it's not working, then the machine doesn't work either.

3 If the guard needs to be removed from time to time, and an interlock is not practicable, then it should at least require a tool to remove (or in some cases, special tools or a key). It must also be attached to the machine by hinge or the like, to ensure it isn't misplaced. This means that workers need to be trained to not run the machine when the guard is not in place. Using the above ***risk management*** terminology, this involves additional *administrative controls* – ie it involves people. Some reasonable steps to help with training are:

- Training and instruction (keep a record! – note it in your diary)
- Develop a safe work procedure or a safe system of work for the process

- Develop workplace rules that include the particular machine
- Signage on the machine (decals).

You can see why it is preferable not to rely on training etc - it may be more of a nuisance than installing an interlock, and possibly less reliable.

4 If none of the above are practical, then you must install a presence sensor to ensure that the machine does not run if people are in the area. Note again the conditions on this sensor:

- Manual operation is required to restart the machine after the interlock has tripped.
- Must not be able to open the guard until the danger can subside (eg. machine to run down to stop, hydraulic pressure to release, hot item to cool, etc.)
- The interlock must 'fail safely', ie. if it's not working, then the machine doesn't work either.

Practicality

Guards tend to get the short shrift if they are a nuisance. Here are common design considerations.

- Guard should not hinder the normal operation of the machine
- Guard should not hinder the operator of the machine
- Guard should not hinder maintenance or other necessary access to the machine
- Guard should be easy to maintain or replace if required
- Guard should allow visibility of moving parts or other areas of interest, if required

Dimensions

It is important that the guard is placed in a position that protects persons from the hazard. To ensure this is the case for the life of the machine, the guard should be designed so that it is virtually impossible for any human of any size or shape, to reach around, over, under, or through the guard, for any reason – ie it *doesn't matter* if you can't think of a reason for them to want to reach past. This is particularly important if mesh is to be used.

In most cases, guards can be reasonably designed so that this is the case; such as creating a full solid enclosure. However, for some types of guards, minimum distances are needed to ensure humans cannot reach objects - eg over rails, through mesh, reach distances. These minimum distances are described in Australian Standards.

The field of design for human use is an area called *ergonomics,* or *human factors,* and is concerned with designing things that people use, so that the use is efficient and safe.

Handy dimensions (ergonomic data) are available from Standards Australia:

- The Australian Standard for Agricultural Machinery (AS 2153.1: 1997 – Sections 6 and 7)
- The Australian Standard for Machinery Guarding (AS 4024.1:1996)
- The Australian Standards Ergonomic Design Handbook (SAA HB59-1994)

For free ergonomic information, the following are available:

- South Australian Workcover has a great brochure called *Machinery Guarding* that you can download free over the internet.
- Queensland Workplace Health and Safety also has a very good brochure called *A Guide to Practical Machine Guarding*, which can also be downloaded from the internet.

The following information may be sufficient for many guarding applications.

- If you use a mesh with an aperture of 40mm, then it is OK to have the mesh 200mm or greater from the danger point. However, at the time of printing, no major Australian mesh manufacturer makes or imports 40mm mesh as a standard size.

- The following table shows Australian off-the-shelf square mesh sizes, and the distances required to ensure that feet or hands cannot reach the dangerous part. The clearance distances are pretty big. Rectangular mesh is not shown here, as a rectangular aperture is considered in the Australian Standard to be a 'slot', and requires an even greater clearance from the danger area.

Common mesh sizes, and Australian Standard safe guarding distances

Size of standard sheet		**Mesh Specifications**			**Safe Distances**	
Length (m)	**Height (m)**	**Wire Thickness (mm)**	**Square Aperture (mm)**	**% of surface area that is an open aperture**	**Foot/leg safe distance (mm)**	**Hand/arm Safe distance (mm)**
3	2.4	2.5	25	82.6	25	120
2	1.2	2.3	25	83.9	25	120
2.4	1.2	3.15	25	78.9	25	120
2	1.2	3.5	50	87.3	80	850
3	2.4	4	50	85.7	80	850
3	2.4	5	50	82.6	80	850
2	1.2	4	100	92.5	1100	850
3	2.4	5.6	100	89.7	1100	850

Source: AS4024.1-1996, A5, A6, A7 – Safeguarding of Machinery – Part 1: General Principles

For example, if we chose a mesh with 25mm aperture (mesh size), and we were worried about both hand/arm and foot/leg access, then the distance away from danger ie between the hazard and the guard, would need to be at least 120mm (the larger of 25mm and 120mm). If we chose a 100mm aperture, then it would need to be 1100mm away (the larger of 850mm and 1100mm).

One can see from this example that 100mm mesh is not practical as a guard in many circumstances, given the large distance that it needs to be away from the danger area, in order to be effective. It seems like a long way, but nevertheless, it is the distance that will be considered in court when Australian Standards are used.

Safe systems of work

Health and Safety law specifically refers to the phrase '*safe systems of work*' as a workplace consideration, and it is particularly applicable to guarding. This takes into account the usual workplace dynamics, including:

- Whether workers tend to remove the guards for whatever reason.
- Maintenance habits and schedules.
- Level of skill of workers. This might include experience and language skills.
- Machine operation requirements – Guarding should allow for greasing if required, or a method of removing debris safely, etc.
- Complexity of the duties over time. If a memorised procedure is required for the continual safe operation of a machine over time, workers may become complacent. (eg shutting down machine before removing a guard then cleaning moving part).

Training workers to use a safe work procedure as a means to increase safety is a good thing and comes under '*safe systems of work*'. However, this must not be used in place of guarding if guarding is required. Any training or procedure that was in place prior to an injury would come under scrutiny in court, so it is handy to have records of what the procedure was, and when and how this was passed on to the workers.

Risk to people nearby – 'third party'

Many agricultural machines, particularly implements on tractors, are not suitable for fully enclosed guards, as the guard might prevent the machine from running effectively. Also, the hazard might only exist when the operator is in the cabin and therefore protected from flying debris etc. However, as an employer you must control the risk associated with the machine, which includes a level of protection to people nearby, or *third party* protection. This includes children, visitors, contractors or workers who may not be aware of the danger the machine poses.

In this case, where it is clearly not practical to provide for full guarding, then the *risk management* approach must be followed through to control the risk (see the *risk management* section of this guideline). The next step in the *hierarchy of control* is '*administration*'. One aspect of *administration* is decals (warning signs), but choosing *administration* as a control measure also involves workplace rules, safe systems of work, and training.

Risk management – Check again

This is all being done as part of a risk management procedure. Having designed the control (in this case let's say we choose to install a guard), then once again, you should look at the new guard, and the system of work, and go through the *risk management* procedure.

That is, look for *hazards* with the guard in place, eg sharp edges, tendency for workers to sit on it, etc. *Assess the risk,* and *control the risk* by changing the design if necessary. This *review* process, outlined above, should pick up on any problems that the guard itself might introduce. The final step is to *make a record* of your efforts, which will form your best defense in court should the machine lead to injury.

This will enable you to regularly review your risk controls from time to time by referring to your records. It will also enable you to defend your actions should they be called into question in a court or incident investigation.

Guard Design Reckoner

	Question →	Answer →	Requirement →	Specification →	Reference
Guard, Cage, Fence or Shed – Ensure it is a safe distance away from the hazard. Ergonomic data can be used, from : Australian Standards – AS 4024.1:1996, AS 2153.1:1997, SAA HB59-1994 (Handbook)	Minimum Strength?	Agricultural machine	Capable of handling the following loads:	Guard should be 'rigidly fixed' with no sharp edges, loads: 1200N in any direction, which is 1200N = 122kg = 270lb = 19 Stone	AS 2153.1:1997 Section 6
		Non – agricultural machinery	Guard must be capable of holding load with less than 12mm deflection under the following loads:	450N in any direction, which is 450N = 46kg = 102lb = 7.2 Stone ***OR*** if the guard potentially needs to take people's weight on it: 75kg Vertical and 23kg Horizontal simultaneously.	AS 4024.1:1996 Section 8.3.2
	Vision of the danger required, or material needs to flow through the guard?	Vision not required	Fine mesh or solid material	-Fine mesh less than 9mm aperture or solid -Ensure it is not possible to reach around; reach distances can be determined using ergonomic data	Appendix A of AS 4024.1:1996
		Vision required	Mesh	See mesh safe distance table in this document	Appendix A of AS4024.1:1996
			Perspex	Replace when it is no longer clearly transparent	State Regulations – 'fit for purpose'
	Does it outlive the machine?	Does not outlive the machine	Consumable	Must ENSURE inspection interval, and maintenance or replacement requirements	National Standard for Plant, State Plant Regulations.
		Outlives the machine	Permanent guard, consider the following→	-Wear and tear, fatigue -Corrosion -Fastening points -Maintenance Requirements	National Standard for Plant, State Plant Regulations, common sense
	Access Required?	No access required during machine life			
		Access Required periodically for cleaning, adjustment, etc. If an interlock is not practical for your situation, then →	Interlock required – a switch that is engaged if the guard is removed, particularly guards on hinges.	-Manual operation is required to restart the machine after interlock has tripped. -Must not be able to open the guard until the danger can subside (eg. machine to run down to stop, hydraulic pressure to release, hot item to cool, etc.) - The interlock must 'fail safely', i.e. if it's not working, then the machine doesn't work either.	National Standard for Plant, State Plant Regulations, AS4024.1:1996.
		Access Required periodically for cleaning, adjustment, etc. If an interlock is not practical for your situation, then →	The guard must be locked in place, or fixed in place such that tools are required to remove it, to ensure that it is difficult to bypass.	You need to ensure that the guard is in place while the danger exists. This means: -Training, and setting up: -Workplace rules -System of work -Warning signage on machine ('decals')	National Standard for Plant, State Plant Regulations, AS4024.1:1996
		Access Required periodically for cleaning, adjustment, etc. If neither an interlock nor bypass constraints are practical for your situation, then →	A proximity sensor must be in place that removes the danger if a human is sensed in proximity to the dangerous item.	-Manual operation is required to restart the machine after proximity sensor has tripped. -Must not be exposed to danger until the danger can subside (eg. machine to run down to stop, hydraulic pressure to release, hot item to cool, etc.) -The sensor must 'fail safely', i.e. if it's not working, then the machine doesn't work either.	National Standard for Plant, State Plant Regulations, AS4024.1:1996
	Fence with Gate?	Ask the same questions as for 'Guard' above. In addition: →	-Train workers and others not to climb over the fence or open gate. -Do you need a pool style fence and gate to keep children out?	This means: -Training, and setting up: -Workplace rules -System of work -Warning signage on machine ('decals')	National Standard for Plant, State Plant Regulations, AS4024.1:1996
	Cage or shed?	Ask the same questions as for 'Guard' above. In addition: →	-Workers need to know not to open door to area, perhaps an interlock is required? -If a shed, is it as a confined space, can chemicals such as fumes build up?	This means: -Training, and setting up: -Workplace rules -System of work -Warning signage on machine ('decals')	National Standard for Plant, State Plant Regulations, AS4024.1:1996

PTO Guarding

Getting caught up in the Power Take Off assembly invariably results in horrific injuries, and usually results in death unless there is someone present to turn off the tractor and get the victim taken quickly to medical care.

> *There doesn't need to be any protruding parts from the PTO assembly for entanglement to happen. Clothing only needs to wrap around onto itself once, then the friction of the contact makes it stick, and this force actually increases as the PTO turns, or you try to pull away.*

There is a specific Australian Standard for PTO guards, which gives the required specifications for the plastic housing around the power transfer shafts, as well as the 'masterguard' housing that covers the PTO shaft (the drive shaft poking out of the tractor) and the PIC shaft (the Power Input Connection poking out of the implement). All off-the-shelf guarding components should meet these specifications in the Australian Standard *AS 1211 1983 – Guards for Agricultural Tractor PTO Drives.*

All state work safety authorities specifically require that you have these in place on all PTO assembly components.

PTO Shaft Guarding

The PTO shaft may be protected by any of a number of standard PTO shaft sleeves and universal joint covers, so long as they meet the requirements of Australian Standard AS 1211-1983 or better. These items wear out, and are a consumable that needs to be regularly checked and replaced when required.

PTO shaft guarding on farm machines is commonly absent or discarded, and the following reasons are often offered:

- ***Maintenance access is a nuisance, such as to grease the universal joint and shaft.***

Greasing under the PTO guards greatly extends their life, but access to the moving parts is major problem. There are some newer designs that have access points to improve things a bit. The Australian Standard for PTO design is due for amendment to better allow for this in the future.

- ***They don't last long.***

  They are a consumable – they will need replacing every few years, depending on use, storage, etc. They should be checked during normal maintenance intervals, and replaced with ones that are UV resistant, which will make a big difference to their life, particularly if they are exposed to sun when stored.

- ***They may not be 100% effective.***

  It is possible to become entangled despite the PTO guarding being in place, so make sure no one leans against or works near it when it is working, even if there is a guard. A *safe work procedure* should address this issue.

PTO Masterguard

Many tractors manufactured before the Australian Standard *AS 1121-1983 – Guards for Agricultural Tractor PTO Drives,* do not have an original masterguard, or the original may have deteriorated. To solve this problem, you can order an aftermarket guard, or you can make one, or have one made.

As long as the masterguard is made to dimension and strength specifications described in the Australian Standard, then it will do the job. Unfortunately, as Australian Standard material is copyright, we cannot provide exact specifications here. However, any tractor made after 1983 should have the proper guard on it, so the easiest solution is simply to copy the *exact* dimensions from it, and make it out of mild steel sheet of the same thickness or thicker.

The masterguard must be able to withstand a force of 1200N, (1200N = 122kg = 270lb = 19 stone) so ensure the steel plate is adequate. Steel sheets such as "tin" (thin gal steel), is not strong enough. Make sure that you copy one that has similar PTO diameter and torque rating, as the requirements are slightly different depending on this. It is obviously easier to bend up a square guard such as in Figure 1 below, rather than the tapered guard type in Figure 2. It is worth looking into incorporating a pre-sprung hinge arrangement such as in Figure 3, if some implements require greater access.

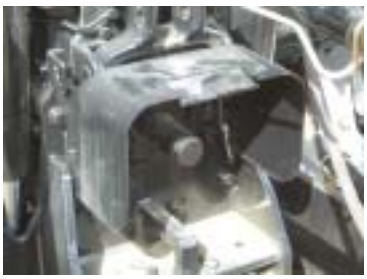


Figure 1: Square masterguard

Figure 2: Tapered masterguard

Figure 3: Square masterguard, hinged

Auger Guarding

The auger guarding section is here at the rear end of the brochure, which is appropriate, given what we are trying to cover. It will require all of the skills we have picked up so far in this brochure, so it is a great example of how to handle some of the more curly safety problems on farms. Grain augers have hazards associated with engines and drive belts, which can be dealt with using the various machine guarding principles outlined elsewhere in this brochure. The most horrific auger injuries, however, come as a result of being caught in the auger flight.

Grain Augers have been responsible for hundreds of missing fingers, hand, toes and feet, making the auger one of the most dangerous machines on Australian farms.

Because there is a degree of monitoring and access required during grain flow, auger *risk management* is a special case. It requires not only an *engineering control*, but also some *administration controls*, to make it safe.

A problem with auger guarding *risk control* is that existing auger guards do not meet the Australian Standard for machinery guarding, and cannot meet Australian Standards and still operate effectively (see the dimensions in the *Guarding Advice* section above.

When designing a guard for grain augers, the Australian Standard *AS 1755 – 2000 Conveyors – Safety requirements* describes the safety requirements for screw conveyors.

Most Australian manufacturers volunteer to use an American Society for Agricultural and Biological Engineers (ASABE) standard for the auger mesh. A mesh guard designed according to Australian Standards for safe mesh distances is too wide to be practical. For example, looking at the *mesh safe distance table* above, which is taken from Australian Standards, even a 50mm mesh (2 inch), needs to be 850mm (nearly 3 feet) away from the auger to be effective at keeping hands out.

This is a good example of a grey area. Until someone comes up with a clever way to solve the problem, we need to use all of the methods we have just learnt to ensure that we have done everything *reasonably practicable* to make it safe.

The rule of thumb is that when we come across a safety *grey area*, a *risk management* approach is the best way to make it safe for use, and a written record of it is recognised by courts. Let's look through the *risk management* procedure for this problem:

1. Where possible, ***involve*** the people using the auger in the risk management process.
2. The auger flighting has been ***identified as a hazard***.

3. We ***assess the risk*** as being worth acting on, given that even though an incident is fairly unlikely, the injuries are always horrific (lost limbs etc).
4. The next step is ***risk control***. We now know that the original guard is not great on its own. So we look for other ways to reduce the chances of anything happening. Then work through the *hierarchy of control:*

    1. **Elimination** - Do we need to use the auger or move grain at all?

    2. **Substitution** - Is it possible to use grain elevators or vacuum flow instead?

    3. **Engineering** / **Isolation** - what are our guarding, fencing, cut off switches etc options?

    Here are a few ideas:

    – Ensure that the original guarding or equivalent is in place, even if it does not meet the Australian Standard. It still might help to prevent some injuries. If you modify the machine to remove the guard, then you wear the legal obligations as designer of that aspect of the machine.

    – Insert the auger end into a purpose built chute that is longer than the human arm. If this also incorporates an interlock for the auger position (a trip – switch linked to the auger engine), then the auger must be stopped and taken out of the chute in order to sample or unblock.

    – Wire up a nearby cut-off switch for the engine that is easy to trip, so that in the event that you or a worker get caught up, it is possible to stop the auger's engine.

    – Fence off the grain hopper where the auger is working, such as by welding a waist height rail on the auger about 4 or 5 feet back from the flighting, as something to limit access to the grain flow area, with workplace rules in place to make sure people do not simply step over it. A tool, chained to the auger, is then used to access the grain flow for sampling or to clear a blockage. This might help reduce the temptation for people to reach into the danger area.

    – Hang a tool (a steel bar or wooden stick, or plastic poly pipe, whatever works) off the auger near the flight that can be used to unblock the auger or collect samples of grain, so there is no need to put a hand in there in the first place. It couldn't hurt to rope or chain it on to stop it disappearing, and replace it when it is worn, to make sure that it is always there, and always useful.

    4. **Administration** – What rules, systems of work, signs and training is needed?

    – Introduce a safe work procedure for auger use, and introduce workplace rules regarding hand or foot access near the flighting. It is the employer's

responsibility to ensure that every worker knows the workplace rules, and follows them. It is also worth writing down *workplace rules*, and ensure that every worker knows the rules, and follows them. One rule might be to never, ever, place a limb near the auger flighting when it's moving.

- *Training*: Regardless of their experience, tell all workers how to use the machine safely, and have a record of what you told them, and when. A safe work procedure is one additional way of dealing with a *hazard* but is it the least effective way.

- Decals (warning signs) are only any good if people read and understand them, and then take heed. However, they may be effective as a reminder on the auger, if they are kept clean and replaced when they wear off.

5. PPE (Personal Protective Equipment) - PPE is not effective to protect against auger flighting injuries.

5. We then need to ***review*** our system and **c**heck that your choice control measure is OK, and doesn't introduce any problems of its own. This includes discussion with any other people who use or come near the auger.

6. Making notes of your good work against each step of the risk management process is your ***record*** for future reference, and will be your best defense should your risk management strategy come under scrutiny in court or during an incident investigation.

Farm Machinery Checklist

A. Tractors & Machinery	Yes No	Risk Level	Action Planned	Cost $	Target Date	Action Date	Person Responsible	Notes
Tractors - Guarding								
Are all tractors fitted with approved rollover protection structures (ROPS) or cabin?								
Do all tractors fitted with a front-end loader or forklift, have approved rollover protective structure with falling object protection (FOPS)?								
Are all power take-off shafts (PTOs) and drive shafts guarded, including the master shield on tractors?								
Are all appropriate guards; including manufacturer's guards in place, in good condition and well maintained on all tractors?								
Are steps and handrails and in good condition?								
Do all exhaust systems function properly and in good condition?								
Are lights, reflectors, screens and mirrors, clean and functional?								
Are brakes, including handbrake in good working condition?								

A. Tractors & Machinery	Yes No	Risk Level	Action Planned	Cost $	Target Date	Action Date	Person Responsible	Notes
Tractors - Safe Operation								
Are all operator and maintenance manuals available for each machine?								
Are all seats on tractors ergonomically designed for prolonged use?								
Are earmuffs or plugs available for tractor and machinery operators if they have to raise their voices to be heard over loud noise?								
Is a fire extinguisher kept in all tractors?								
Is a first aid kit kept near the operating environment of the vehicle?								
Additional Hazards								

A. Tractors & Machinery	Yes No	Risk Level	Action Planned	Cost $	Target Date	Action Date	Person Responsible	Notes
Policies and Practice								
Have all tractor and machinery operators been inducted for their safe use on this farm?								
Have all people who operate tractors and machinery been trained in their proper use?								
Is it a known and observed rule that where possible machine power is turned off before adjusting, unclogging or servicing a tractor, including PTO driven machine?								
Is there a known policy that only persons nominated / approved by management are permitted to operate farm tractors and other machinery?								
It is an observed policy that all operators are trained and aware of safety details including those listed in the operator's manual?								
Are all guards kept in place when machinery is operating?								
Are passengers kept of tractors and implements?								
Is there a known and observed policy that children are kept away and do not ride on tractors and machinery?								

A. Tractors & Machinery	Yes No	Risk Level	Action Planned	Cost $	Target Date	Action Date	Person Responsible	Notes
Are routine services completed and maintenance records kept on all tractors and machinery?								
Are all machines and powered equipment properly labelled with safety signs?								
Are the keys of all tractors harvesters and vehicles removed and stored away from children and other unauthorised persons when not in use?								
Are pre-operational checks undertaken on all machinery and equipment, including tractors and harvesters prior to use?								
When working under raised machinery, is equipment secured, properly chocked and supported?								
Have all workers received training/ instruction in the safe use of hydraulic jacks?								
Are there appropriate time limits for individuals operating machinery at any one particular time?								
Are all vehicles and/ or fuel, oil drums parked or stored away from any electrical power tools eg grinders?								
Are all state regulations compiled within the operation of gantries and cranes?								

A. Tractors & Machinery	Yes No	Risk Level	Action Planned	Cost $	Target Date	Action Date	Person Responsible	Notes
Are all chains and slings checked prior to their use for signs of wear?								
Additional Hazards								