Meat technology update

99/2 – March 1999
Reprinted November 2006

MEAT TECHNOLOGY UPDATE
Cutting edge technology for the meat processing industry

FOOD SCIENCE AUSTRALIA
A joint venture of CSIRO & the Victorian Government

Stunning of cattle

Abattoirs are required to slaughter all stock in a humane manner and this involves an effective stun which immediately renders the animal unconscious. At present, virtually all cattle slaughtered in Australian abattoirs are stunned using a mechanical bolt stunner. There are two types of stunner in general use:

- **Penetrating captive bolt**
- **Percussion (non-penetrating)**

These include cartridge, pneumatic and hydraulic types.

Irrespective of the stunning equipment used, it is essential that the animal is adequately restrained, so that the operator can place the device at the correct site on the head (in order to give an accurate stun). Methods of restraint can be considered under four categories:

- *Knocking boxes:* These should be long enough to accommodate one animal comfortably. Animals should not be placed in the knocking box unless the operator who is to stun them is ready to do so as soon as the animal is placed in the pen. They should not be used to accommodate more than one animal at a time, and animals should not be held in them during breaks.
- *V-shaped and 'ride-on' conveyor-type restrainers:* These should be of a design suitable for effective restraint of the animal and they should not be used to hold animals during breaks.
- *Head restraint systems:* These offer many advantages for applying an accurate stun and their use should lead to an overall increase in the effectiveness and efficiency of stunning. They also make the slaughterman's job easier. Researchers at Food Science Australia are able to offer advice on suitable systems.
- *Restraint for religious slaughter*

Personnel stunning animals should:

- possess the expertise necessary to ensure that each animal is rendered unconscious with a minimum of excitement or disturbance and without suffering;
- perform the stunning procedure in a manner that normally should ensure that each animal is immediately rendered unconscious;
- operate the stunning equipment in accordance with the manufacturer's specifications for effective stunning;
- know the responses of unconscious animals and the responses of ineffectively stunned animals;
- have back-up equipment (including a spare gun) available in the event of equipment failure.

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Penetrating captive bolt stunning (irreversible stunning)

The principles of penetrating captive bolt stunning

There are three factors contributing to the stunning effect:

- the penetration of the bolt into the brain tissue;
- the stretching and damage of brain tissue at some distance from the bolt path ;
- the impact of the bolt (which depends on its velocity and its diameter) on the cranium leading to acceleration of the brain which contributes to concussion.

The captive bolt should have a concave piercing end which accumulates tissue as it passes into the cranial cavity, increasing the disruption to normal nervous impulses.

The heart can carry on beating for many minutes after the stun, although it will eventually stop.

Stun-stick duration

Theoretically it is not necessary to stick an animal that has been effectively stunned with a penetrating captive bolt stunner. However there are practical and regulatory reasons why an animal should be stuck soon after stunning.

Percussion stunning (reversible stunning)

The principle of percussion stunning (mushroom head)

The impaction of the heavy mushroom head of a non-penetrating stunner against the frontal bone of cattle causes a large concussive force to be delivered to the skull. This leads to a downward acceleration of the brain which is probably the main factor responsible for producing unconsciousness. Additionally, there is extensive damage to the blood vessels of the brain. As with penetrating bolt stunning, it is probably the velocity which is of major importance in determining stunning effectiveness.

This method of stunning is sometimes called ‘concussion stunning’.

Special requirements when using percussion stunners

Percussion stunning equipment should not be used:

- in positions other than the frontal position;
- on any animal where an effective stun cannot be anticipated, e.g. mature-age bulls; or
- after the stun is ineffective with two applications. In this situation, a penetrating captive bolt stunner should be used as soon as possible (when a percussion stunner is being used, a loaded penetrating bolt stunner should always be available in the stunning area).

Care must be taken to use the correct strength of cartridge.

Stun-stick duration

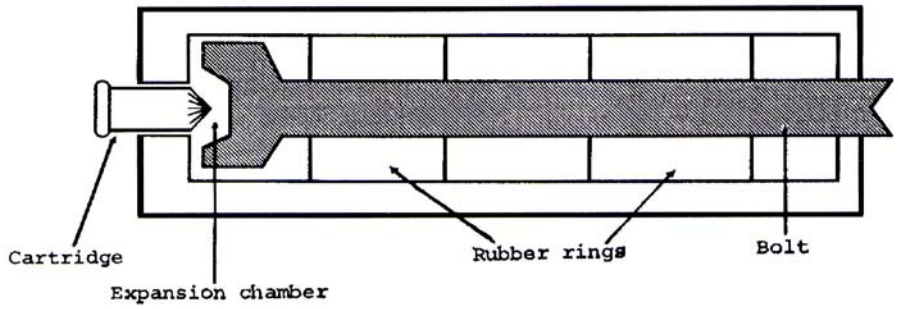
The stun-to-stick interval should be less than 30 seconds.

Causes of ineffective operation of stunning devices

Insufficient air pressure in pneumatically fired guns, underpowered cartridges for the size of animal and poor maintenance of the gun all contribute to reduced velocity and bad stunning. In addition, the size of the expansion chamber for the exploding gases is critical in determining the velocity of the bolt (Fig.1). The smaller the chamber size, the greater the potential velocity of the bolt. If a gun is corroded or contains a build up of carbon, the bolt will not seat back properly, and the expansion chamber will be enlarged. The power of the gun will be correspondingly reduced.

The operator should check to ensure that the bolt retracts to its full extent after each shot. If it does not retract, the instrument should not be used until the problem is rectified.

FIGURE 1: Cutaway diagram of the bolt end of a stunner showing the expansion chamber, bolt and rubber compression rings



If the tip of the bolt is protruding from the muzzle more than the usual distance the gun may need cleaning. Instructions on how to clean a particular make of gun should have been supplied when the gun was purchased. Contact the supplier if the cleaning instructions cannot be found or if specific cleaning tools are necessary for your particular make and model of gun.

The two major factors affecting bolt velocity are the condition of the instrument and the propulsive charge. Lack of cleaning and general maintenance can reduce muzzle velocities by more than 50%. One supplier markets a device for checking that the bolt velocity of a penetrating bolt stunner is conforming to the recommended specification.

Shooting position

Research and practical experience have shown that the shooting position on the animal's head is important.

The frontal position

For both penetrating and percussion stunning, the target area is at the front of the animal's brain (Fig. 2) situated at the crossover point between two lines, each drawn between one of the eyes and the base of the horn on the opposite side of the head (Fig.3). Any shot that comes forward of this line is off target. It is advisable, particularly with bulls, to aim slightly to one side of the midline at the crossover point (Fig. 4). The gun should be applied at right angles to the head (Fig. 2).

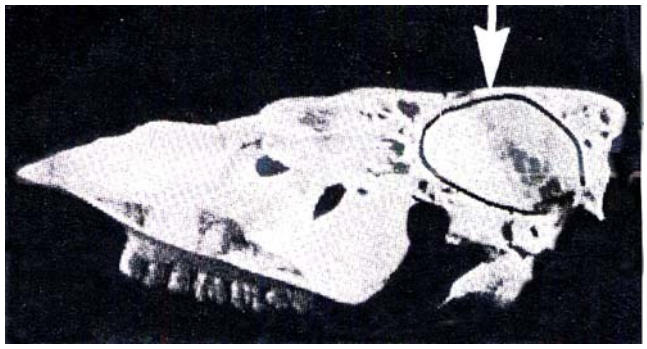


FIGURE 2: Brain target area

In order to shoot in the frontal position, the slaughterman must be able to stand alongside or in front of the animal's head so that the equipment can be applied and operated easily and accurately. The design and layout of the stunning pen and the slaughterman's platform are critical in this respect. Restraining the head of the animal offers many advantages for applying an accurate stun, but when restraint is used, the animal should be stunned as soon as the

FIGURE 3: The frontal position for application of the stunner

FIGURE 4: Alternative site for stunning

The poll position

A captive bolt should not be applied to the poll region in stock owing to its reduced effectiveness. It may be used in an emergency situation, in which case the animal should be immediately stunned from the frontal position after the initial poll stun.

Assessing the effectiveness of a captive bolt stun

When an animal is properly stunned, it immediately collapses to the floor with its hindlegs flexed into the body. The forelegs may also be drawn in, but they straighten after a short period of time. The muscles of the body are contracted and the back is usually arched. If the body is relaxed, or if the animal makes kicking or paddling movements immediately after stunning or shows signs of trying to stand up it has not been stunned properly. Some kicking may set in after the initial muscle contraction phase. This is not a bad sign from the humane point of view, provided the animal has gone through the contracted (tonic) phase.

The animal should not show regular rhythmic breathing movements after it has been stunned. These are best observed by looking at the animal's flank, and if they occur, the animal should be reshot. However, one should be careful to distinguish between normal rhythmic breathing and gagging in which instance the animal makes erratic inspiratory gasps. Gagging indicates a dying brain.

Touching the eyes or eyelids should not produce any response (closure of the eyelids or blinking indicates the presence of a reflex), and the eyes should have a glazed ('glassy') appearance. Good stunning also produces relaxation of the jaw muscles. This can be tested either by prising the jaws apart by hand or by watching for the tongue to hang out of the mouth when the carcass is hoisted. The ears droop in a forward direction.

In summary, the major indicators of an effective captive bolt stun are:

- the animal must collapse immediately;
- it must not attempt to get up;
- rhythmic breathing must stop;
- the eye must have a glazed appearance;
- the eye is unresponsive to touch;
- animals do not vocalise.

Safety Aspects

Most guns are fitted with synthetic rubber rings around the bolt. These protect the gun from excessive wear and should be replaced at regular intervals (usually every 1,000 shots). If this is forgotten, there is a danger that the gun casing will eventually crack. When this happens the gun is potentially dangerous to all staff working in the area.

Special care is required with contact firing guns. These have to be forced against the animal's head in order to get them to fire. If they are dropped on the floor or struck against the stunning box wall, the whole gun can become a dangerous missile.

Kicking is a hazard when slaughtering large stock. Hindleg kicking can occur when brain function is depressed, so it happens even when animals are stunned. Ways of getting around the problem are to stick and/or shackle and hoist soon after stunning whilst the

hindlegs are still doubled up into the body (in flexion).

Summary

Do:

- use a properly trained operator;
- shoot in the correct frontal position;
- use a gun and a cartridge of the strength recommended for the size of animal and head/bone structure (or, if using a pneumatic stunner, use the recommended air pressure);
- check that the animal is stunned before proceeding to stun the next one;
- keep a spare, loaded gun near the stunning pen for use in the case of a poor stun;
- clean, check and maintain the parts of the stunner at least daily.

Don't:

- continue using your existing stunner if repeat shooting is consistently involved.

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Contact us for additional information

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