

## Technical note – Captive Bolt

### Mechanical killing for disease control.

#### **Introduction**

Captive-bolt stunning equipment has been in existence for some 75 years and is a contained mechanical stunning or killing device (vs free bullet). The aim for killing on farm for disease control is to rapidly and safely kill an animal with minimal to no spread of the disease agent.

#### **How does it work?**

All types of captive-bolts are percussive in action; that is they involve the striking of one body, the bolt, against another, the animal's head. If these percussive forces are strong enough they will produce concussion in the animal and thus insensibility, and if permanent damage, death.

Penetrative and non-penetrative devices exist. Pigs are the most difficult animals to stun with captive bolts as the pig brain is rather small and well protected by a massive skull. Captive bolt can be used, however heaviest cartridges (or pressure) are recommended. Immediately after stunning with penetrative captive bolt, pigs exhibit high levels of clonic (kicking) activity which gets worse usually as you increase the size of the cartridge. Unconscious animals must be pithed immediately to ensure rapid death (ie. penetration with a long metal rod inserted at the site of bolt entry to ensure brain destruction).

Penetrating captive bolt (plus pithing to complete tissue destruction) is approved by the OIE Technical chapter 7.6 for killing pigs for disease control (except neonates). Non-penetrative captive bolt is approved for neonates (newborn piglets). Animals must be humanely restrained prior.

#### **IMPORTANT:**

A hand-held device is firing and there are limits as to how many pigs can be killed without user fatigue and over-heating of the device. There are also newer devices which hold more than one charge and can be repeat fired, though access and safety must be balanced. Due to the problems which might arise with adult large pigs it is recommended that, where possible, pigs are stun-killed electrically. Captive bolt stunning is often used as back up when electrical stunning fails.

## Physics

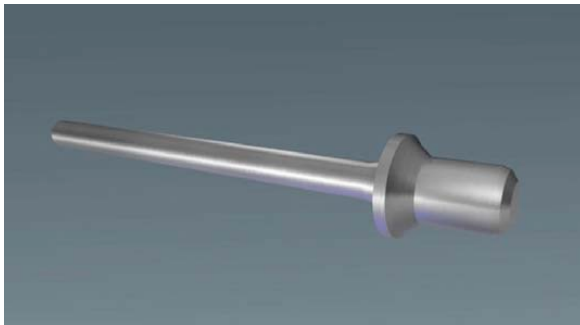
Not every blow to the head, to either a human or an animal, will produce a state of unconsciousness or death. It relies upon transferring enough energy from a moving object, the bolt, to the animal's brain. This can rarely be done effectively and instantly, manually via a hammer or pole axe, as the velocity is inadequate. Hence mechanised devices are essential to assure consistent and effective velocity and effect.

Where there is sufficient energy imparted to the brain by the impact, this will generate movement of the cerebral hemispheres and increase the chance of tissue damage, or deformation, between the brain cortex and the skull. Penetrating captive-bolts will produce some additional irreversible damage. Along the track of the bolt there will be severe destruction and loss of neural tissue. There will be some negative pressure from the shockwave and collapse of the brain tissue induced by the retracting bolt. This is the goal as we need to induce permanent loss of brain activity and death in the disease control context.

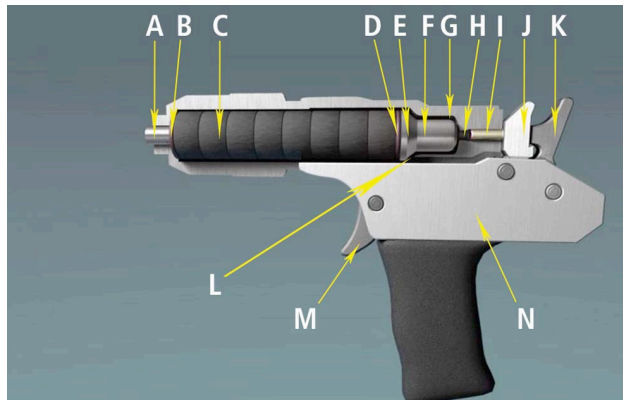
There has been progressive improvement in the performance of many makes and models of captive-bolts. However, even in a modern stunner, any factor which reduces the bolt velocity, such as poor maintenance, can seriously affect the performance and the likelihood of an effective stun.

## Equipment

All captive bolts work along similar basic principles. There is a steel rod with a flange and a piston which make up the bolt.



The bolt is contained within a barrel, with the piston fitting tightly into a combustion chamber and the bolt being surrounded by compressible recuperative sleeves. When fired, the power source propels the piston forward. The bolt then emerges through the opening at the muzzle and either strikes or penetrates the skull. The bolt is retained by the flange (hence the name "captive-bolt") and the energy is absorbed by the recuperative sleeves. The bolt should penetrate to its maximum limit to combine the effects of concussive forces and physical damage.



- A – Bolt**
- B – Stopwasher**
- C – Recuperative Sleeves**
- D – Flange Washer**
- E – Flange**
- F – Piston**
- G – Combustion Chamber**
- H – Breech**
- I – Cartridge**
- J – Firing Block**
- K – Hammer**
- L – Undercut**
- M – Trigger**
- N – Barrel**

Stunners can be fired with a trigger mechanism or fired on contact with the animal's skull. The trigger-fired, penetrating stunners are perhaps the most versatile; being suitable for a wide range of different types of animals and situations.

### **Power Source**

The power required to propel the bolt forward is from either a blank cartridge or compressed air.

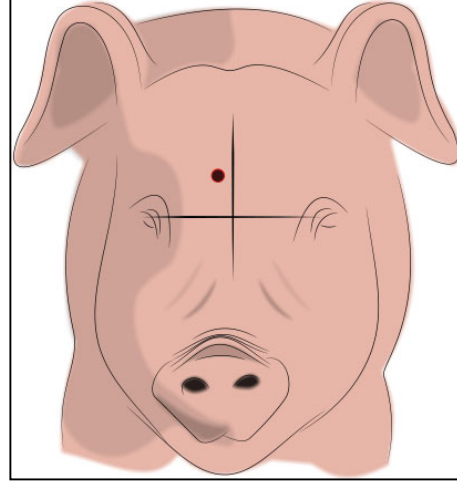
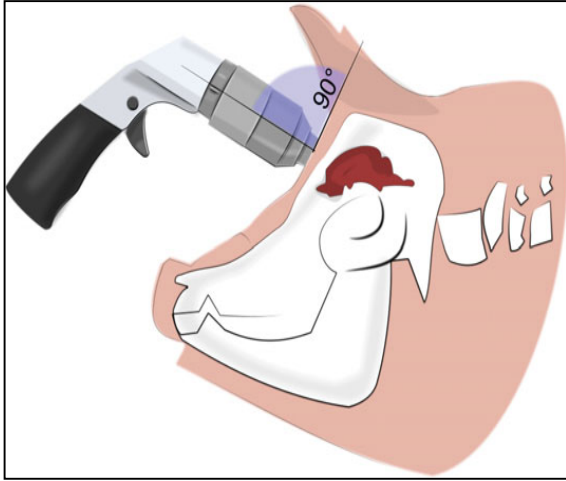
**a) Cartridge** – these vary in strength and are classified by the amount of propellant they contain, measured in grams. It is essential that the correct cartridge is used for the make and model of stunner and appropriate for the size of animals to be stunned. Cartridges can be identified by calibre (e.g. 0.22 or 0.25), colour and head stamp. Larger size and so number for larger pigs, especially sows and boars.

**b) Compressed Air** – power is provided via a high-pressure air compressor. The equipment is heavy and not easily manoeuvrable and needs to be suspended by a counter-balance arrangement overhead. Compressed air may not always be feasible on a farm site, however it offers the avoidance of supplying charges which may involve official approval and clearance for importing and transporting.

### **Penetrating captive-bolt – position and technique**

Animals need to be calm and well restrained to ensure effective device placement. (See other technical notes for behaviour and handling of pigs).

Operator should target 2.5 cm above the line between eyes. Older sows and boars do have a ridge in the middle of the skull it is advised to position gun about 1 cm aside from the imaginary middle line.



A range of devices below:



### Signs of an Effective Stun

Monitoring Points:

- Immediate collapse
- Immediate and sustained absence of rhythmic breathing
- Absence of righting reflex
- Absence of tonic phase and vigorous kicking (strong clonic phase)
- Absence of vocalisation

**If the animal does not show these signs then it must be re-stunned immediately.**

### Failure to Stun

In the practical situation there may be occasions when the animal is not effectively stunned this could be the result of:

- Incorrect stunning position
- Not enough power e.g. wrong cartridge size or drop in air pressure
- Stunner malfunction

A back-up stunner should always be close to hand should the main equipment fail. If the first stun fails the next attempt should always be in a slightly different position because the swelling and damage caused by the first attempt reduces the effect of a second impact in the same place.

- If the first stun was off target, the second stun should be as close to the correct position as possible.
- If the first stun was on target and failed the second stun should be above and to one side
- If a third stun is required this should be above and to the other side.

**Always confirm effective stun and death before movement and disposal.**