# THE DEVELOPMENT OF A STUN QUALITY AUDIT FOR CATTLE AND PIGS AT SLAUGHTER

**Atkinson, S. and Algers, B.**

*Swedish University of Agricultural Sciences, Department of Animal Environment and Health*

## SUMMARY

Swedish regulations for stunning of cattle and pigs stipulate that the time interval between stun to stick should be within 60 seconds. There are difficulties for many abattoirs to achieve this due to the technical design of the shackle line. An auditing system was developed by the Swedish University of Agricultural Sciences to perform externally conducted assessments investigating stun quality in relationship to stun to stick interval times.

In total 2700 cattle in 5 abattoirs and 8941 pigs in 7 abattoirs were studied. There were no cattle abattoirs that had a 100% effective stun rate, but 92% of all cattle were considered deeply stunned. Reasons for failure to stun properly in cattle abattoirs were identified mainly to be related to the stun weapons used.

Five of 7 pig abattoirs achieved a 100% deep stun effect. Two abattoirs were re-audited due to some pigs displaying corneal reflex. Reasons for poor stun effect were contributed to too low $CO_2$ exposure which was solved by slightly increasing the $CO_2$ exposure time and $CO_2$ gas concentrations.

At all pig and cattle abattoirs stun to stick intervals exceeded 60 seconds. Only 30% of all pigs and 5% cattle audited were stuck within 60 seconds. When animals are deeply stunned, the stun to stick interval is less critical. However, auditing results detected problems with achieving short stun to stick intervals and a 100% stun effect. This highlights the importance of good stunning practice as well as the use of a stun auditing procedure.

**Keywords:** animal welfare; stun quality; cattle; pigs; slaughter

## INTRODUCTION

To ensure good animal welfare during post stun stunning, unconsciousness should be induced of a sufficient duration to include not only the stun stun-stick interval but also the time taken for the animal to become insensible due to de-bleeding, which must be started as soon as possible (93/119/EC). A good stun will however make the time interval less critical. The slaughter operations in abattoirs vary considerable due to different technical designs, different stun systems, and different killing rates.

In Sweden, the slaughter industry in response to societal demands started to upgrade standards for handling and stunning, including installing automatic driving of pigs in groups and automatic driving of cattle into the stun pen. Swedish regulations for stunning of cattle and pig species stipulate that the time interval between stun to stick should be within 60 seconds. There are difficulties for many abattoirs to achieve this due to the technical design of the shackle line which cannot transfer carcasses to the sticking area in less than 60 seconds. This is especially the case for newer designs of $CO_2$ group stunning of pigs, where up to 10 pigs can be stunned at a time. A

demand for externally conducted assessments arose by the abattoir industry in Sweden to investigate stun quality in relationship to stun to stick interval times. As a part of this, evaluations of stun quality were developed and stun quality audit programs were implemented. This paper describes the process of ensuring welfare standards at slaughter in Sweden through the development of a stun quality audit protocol and its use in 7 pig and 5 cattle abattoirs. It also highlights how critical stun to stick intervals may be for cattle when using captive bolt stun and for pigs when using $CO_2$ gas stunning.

## METHOD AND MATERIALS

In total 2700 cattle in 5 abattoirs and 8941 pigs in 7 abattoirs were studied. For both cattle and pigs information was collected on the design of the stun to stick areas, the stun system used, the stun to stick intervals and the stun quality. The stun quality was assessed by recording the symptoms displayed by each animal after stunning until the point of sticking. Stun to stick intervals were recorded using a stop watch and analysed for minimum, maximum and average time intervals. For cattle the start of the stun was timed as soon as the shot was heard from the stun gun. For pigs it was started at the point where the stun box opened to release the $CO_2$ stunned pigs. The stun to stick interval was timed for every pig in the group. Sticking for both species was considered to be the point at which the knife was pushed into the throat of the animal for de-bleeding. The following information for cattle was recorded on a set Pro Forma;

- the number of times each animal was shot
- type of animal being shot i.e. sex, age, breed
- physical reactions and reflex symptoms on the animals that could indicate a bad stun
- any incidents or stops in the system between stun to stick
- stun to stick intervals

A similar Pro Forma was completed for pigs, but included group sizes and stun to stick interval times for every pig in the stun group. Details of the gas procedure such as number of boxes in the system, box rotation times, gas chamber depth and $CO_2$ exposure times were also measured.

Animals that were suspected of not being stunned properly were closely examined and symptoms noted. The eyeballs and corneal area were touched to watch for any eyelid blink. If there was a reaction this was considered as a corneal reflex. Stun quality details were grouped into 3 categories (Table 1) which identified the stun quality as being either good, poor or undefined i.e. a stun that does not clearly fit into good or bad stun categories.

**Table 1.** Symptoms that indicate stun quality level

| Stun Quality | Symptoms |
|---|---|
| Deep or good stun | – Dilated pupils<br>– No eye ball rotation<br>– No corneal reflex<br>– Minimal kicking and reaction to sticking procedures |
| Poor stun | – Corneal reflex<br>– Spontaneous blinking<br>– Breathing/respirations<br>– Full or partial eye ball rotation up to sticking |
| Undefined stun quality but separating stun from deep or poor stun quality symptoms | – Gasping, groaning<br>– Excessive kicking or struggling at sticking in combination with above symptoms in this category |

For cattle, any symptoms other than a deep stun effect were rated in seriousness from 1 to 4 (Table 2), with ratings 1 or 2 indicating low stun quality (rate 1 being the lowest i.e. corneal reflex present, and rate 2 reflex indicating spontaneous blinking and or fixed eyeball rotation). The reason this was developed was because cattle tended to show more and stronger symptoms than pigs post stunning, due to the physical damages caused to the brain from being physically hit which evokes many uncontrolled neural reflexes compared to the anaesthetic effects after $CO_2$ gas stunning. Symptoms such as eye ball rotation could also disappear and deep stun symptoms appear after a few seconds post stunning. Therefore it was decided that the variation of symptoms should be rated, to help with stun quality assessments.

**Table 2.** Symptoms of a poor stun effect used for cattle

| | |
|---|---|
| 1 | – Corneal reflex |
| 2 | – Spontaneous blinking<br>– Full or partial eyeball rotation up to sticking |
| 3 | – Full or partial eye ball rotation followed by pupil dilation before sticking |
| 4 | – Gasping, groaning<br>– Excessive struggling or kicking at sticking |

## RESULTS

The development and implementation of the auditing program showed that there was a large variation between both pig and cattle abattoirs in respect to design of the stun system, but also in stun to stick intervals and stun quality (Table 3).

**Table 3.** Average stun to stick intervals and the stun quality results for all audits

| Cattle | % animals with stun to stick interval less than 60 seconds | % Animals deeply stunned | % Animals poorly stunned | % Animals with undefined stun |
|---|---|---|---|---|
| Audit 1 | 0 | 88 | 10 | 2 |
| Audit 1b* | 2 | 94 | 2 | 4 |
| Audit 2 | 1 | 93 | 5 | 2 |
| Audit 3 | 15 | 96 | 2 | 2 |
| Audit 4 | 1 | 96 | 2 | 2 |
| Audit 5 | 68 | 98 | 1 | 1 |
| Pigs | | | | |
| Audit 1 | 65 | 100 | 0 | 0 |
| Audit 2 | 59 | 98 | 2 | 0 |
| Audit 2b* | 75 | 100 | 0 | 0 |
| Audit 3 | 94 | 97 | 3 | 0 |
| Audit 3b* | 82 | 100 | 0 | 0 |
| Audit 4 | 43 | 100 | 0 | 0 |
| Audit 5 | 64 | 100 | 0 | 0 |
| Audit 6 | 1 | 100 | 0 | 0 |
| Audit 7 | 21 | 99.8 | 0.2 | 0 |

*Abattoirs that were re-audited

One cattle abattoir used a pneumatic powered stun gun, 2 abattoirs used guns that fired free bullets for larger bulls, and the rest used only captive bolt guns for all cattle classes. No cattle abattoir had a 100% effective stun rate, but the abattoir with the best stun quality (98% well stunned), used the pneumatic stun weapon. Of all cattle audited, 92% were considered deeply stunned.

Three pig abattoirs had a 1 box stun system, each with different capacities for stun group sizes of 3,5, and 7 pigs. Two abattoirs had 4 boxes, 1 holding 3 pigs, and the other 5 pigs per stun group. The largest abattoirs had 6 and 7 boxes in the stun system, and could stun 5 to 10 pigs respectively. $CO_2$ concentrations ranged from 91 to 93% during stunning, and the exposure times ranged from 1 minute 54 seconds to 8 minutes. Five of 7 pig abattoirs achieved a 100% deep stun effect. Two abattoirs were re-audited due to a number of pigs displaying corneal reflex (3% in one abattoir, 2% in the other), but after re-auditing 100% of pigs were deeply stunned. Of all pigs audited, 99.4% were considered deeply stunned. After re-auditing, all seven pig abattoirs had such good stun quality that the fact that the stun to stick intervals were longer than 60 seconds were considered to be less critical from an animal welfare perspective.

## DISCUSSION AND CONCLUSION

The results of these audits showed that few abattoirs can consistently achieve stun to stick intervals within 60 seconds. However, good stun quality was achieved despite this, especially in pig abattoirs where stun to stick intervals over 60 seconds could be considered less critical. There were more problems with stun quality in cattle abattoirs. Reasons for failure to stun properly were contributed to shooting outside the area required to cause appropriate brain damage, use of unclean or unserviced guns (with worn out parts) and use of damp ammunition. In all audits bulls were more difficult to stun properly than any other cattle even if shot correctly (up to 11% of bulls were poorly stunned in 1 abattoir).This was attributed to bulls having thicker skulls and the use of too weak weapons. In 2 abattoirs more powerful weapons were available for use on larger bulls, (9.6 calibre free firing bullet, compared to a 0.22 calibre retractable bolt). This gun type however, is more dangerous to use for staff and is therefore used as minimally as possible. To ensure proper stun quality for bulls, it would be better welfare to use it more often, or invest in another type of weapon. Weapons used in abattoirs in Sweden for large cattle should be reconsidered as well as the training of the people performing the stunning. If the stun effect is good and lasts for several minutes, then the stun-to stick interval becomes less critical; though, immediate bleeding ensures better welfare.

Reasons for poor stun effect in pigs were contributed to too low $CO_2$ exposure times for each stun group which was solved by increasing the $CO_2$ exposure time by just 16 seconds, and slightly increasing $CO_2$ gas concentrations from 91% to 93% within the stun box chamber. There was also an occasion where there were too many pigs for the size of the stun box, and upon observation of pig behaviour during the stunning, the pigs could fall on top of each other, and in some cases their head could be higher than the ground level, which could be a reason for some pigs having a reduced stun effect. This especially seemed to occur during the stunning of sows which were much larger than the prime slaughter pigs.

In many cases pigs that displayed corneal reflex, either kicked or gasped as well. Therefore it was recommended to the abattoirs that any pigs showing gasping or kicking at any time during the stun to stick interval, and even after sticking, should be checked and re-stunned if required.

This study has shown that some cattle can rotate the eyeball immediately after stunning or after some 10 or 20 seconds, after which it centres, the pupil dilates and the animal shows symptoms of being properly stunned. The anatomical basis of the conscious state is also not well understood, and according to Finnie et al (1997) it depends on feedback loops of neural activity between the brainstem reticular activating system and the cerebral cortex (Finnie et al 2002). Gregory and Shaw (2000) discusses current scientific knowledge about whether penetrating captive bolt stunners applied to the frontal areas of the head reliably cause loss of consciousness in cattle, and how to assess the risk of recovery of consciousness. They mention that physical responses to some types of nociceptive stimuli can occur at both conscious and subconscious levels, and can add complications when attempting to establish whether an individual is insensible to pain. This study highlighted the fact that animals can display many different symptoms after stunning. Thus, in order to assess stun quality is a difficult task. Therefore, by implementing a protocol for investigating stun quality in cattle and pigs at slaughter, more consistency was achieved.

In conclusion, the results of the audit did identify certain problems in stun quality in some abattoirs. The abattoirs were then able to use this information and make changes which could be shown to improve animal welfare at slaughter.

## REFERENCES

Finnie, J.W. (1997) Traumatic head injury in ruminant livestock. Australian Veterinary Journal: 75: 204–208.

Finnie, J.W., Manavis, J., Blumbergs, P.C. and Summersides, G.E. (2002) Brain damage in sheep from penetrating captive bolt stunning. Australian Veterinary Journal: 80: 67–69.

Gregory N.G. and Shaw F. (2000) Penetrating captive bolt stunning and exsanguinations of cattle in abattoirs. Journal of Applied Animal Welfare Science: 3: 215–230.