NATIONAL ANIMAL WELFARE STANDARDS

AT

LIVESTOCK PROCESSING ESTABLISHMENTS

PREPARING MEAT FOR HUMAN CONSUMPTION

BACKGROUND INFORMATION AND RATIONALE

National Animal Welfare Standards for Livestock Processing Establishments Preparing Meat for Human Consumption, 2. Working Manual

M. K. Edge, T. Maguire, J. Dorian & J.L.Barnett.
2005

Available from: **www.amic.org.au**
Australian Meat Industry Council
PO Box 1208, Crows Nest,
NSW 1585

General Inquiries: 02 9086 2200

ISBN

AMIC Meat Industry Conference

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1.0 PREFACE

These animal welfare Standards have been developed to assist industry to continually improve animal welfare outcomes for Australian livestock at Livestock Processing Establishments. These animal welfare Standards comprise of two documents:

1. **Animal Welfare Standards for Livestock Processing Establishments:**
   Agreed industry Standards that are based on Model Codes of Practice, international and national guidelines, current practice and scientific literature.

2. **Animal Welfare Working Manual:**
   Practical documentation to assist in the implementation of the Standard, which contains performance indicators, checklist questions with associated targets and background information. This is aimed to assist processors in implementing the above animal welfare standards and can be utilised for training purposes.

It is intended that animal welfare standards be incorporated into livestock processing quality assurance systems (Approved Arrangements). The scope of the Standards directly concerns the management of livestock from the point of receival and unloading at the Livestock Processing Establishment to the point of slaughter, for human consumption.

Livestock Processing Establishments already address issues associated with food safety and meat quality using approved arrangements. The addition of animal welfare principles to these systems provides for a comprehensive and practical approach. Thus, this working document contains a series of performance indicators, checklist questions and associated targets that can aid processing establishments in the integration of animal welfare components into their current systems.

The development of the Working Documentation was a collaborative approach with a range of stakeholders, listed in Appendix 2.

2.0 MISSION STATEMENT

The overall goal of the meat and livestock industry is to deliver high animal welfare standards that are integrated across the production chain to ensure the welfare of livestock from birth to slaughter. The mission of the livestock processing industry with regard to the welfare of animals is to ensure acceptable animal welfare standards are implemented and effectively verified.

3.0 PURPOSE

To provide a framework for the definition of Standards that provide agreed animal welfare outcomes for the processing of Australian livestock.

These animal welfare Standards aim to:

- Support the existing standards and guidelines in the livestock processing industry including:
  - AS 4696-2002 Australian Standard for the Hygienic Production and Transportation of Meat and Meat Products for Human Consumption. CSIRO publishing web address, under food production: http://www.publish.csiro.au/.1
  - OIE Terrestrial Animal Health Code 2005: Guidelines for the Slaughter of Animals for Human Consumption. OIE World Organisation for Animal Health web address: http://www.oie.int/
  - Provide consistency with published commercial guidelines, for example the American Meat Institute Foundation's Good Management Practices for Animal Handling and Stunning, 2005 Edition. http://www.amif.org/FactsandFigures/AMIF-animalwelfare1. htm.
- Support the Model Code of Practice for the Welfare of Animals at Livestock Slaughtering at Establishments. SCARM Report 79. CSIRO publishing, 2001. http://www.publish. csiro.au/
- Clearly define the Standards, with associated indicative targets, for incorporation into quality assurance systems.
- Promote the humane and considerate treatment of livestock, and the use of good husbandry and management practices to improve the welfare of livestock at processing establishments.
- Provide information for all people responsible for the care and management of livestock at Livestock Processing Establishments on their responsibilities.
- Provide assurance to customers of meat and meat products from Australian livestock that these Standards are met.

4.0 APPLICATION OF THE BACKGROUND MATERIAL WITHIN THE ANIMAL WELFARE WORKING MANUAL

This manual provides additional information to support the implementation of the National Animal Welfare Standards for Livestock Processing Establishments. The Working Manual contains three separate components, performance indicators, checklist questions and background information to the Standards.

This document provides the third component of the Working Manual – background information and references.

Thus, the Working Manual contains:

1) Performance indicators:
The performance indicators are based upon principles in the Standards that describe how the outcomes can be achieved. The performance indicators describe the actions or procedures that need to be undertaken to demonstrate that the outcomes of the Standards have been met.

2) Checklist questions and associated targets
The checklist questions relate to the performance indicators and their purpose is to provide a tool to develop Standard Operating Procedures or Work Instructions and for monitoring and verification purposes. The targets indicate the level of performance expected and will assist in continual improvement. The targets will assist processors in determining 'what to aim for' when considering animal welfare. The targets were derived from the Code of Practice for the welfare of livestock, scientific literature, existing customer requirements and good practice parameters based on industry procedures.

3) Background information and references
Technical information is provided to support the principles in the Standards. This information combines current industry good practice with scientific rationale in 6 sections corresponding with the Standards, and an additional section (7) that contains relevant information for livestock selection, sale and transport.

This part of the manual may be utilised for staff induction and training purposes, or may be utilised as a reference for Livestock Processing Establishments that are developing or revising their quality assurance program.

Overall, the Working Manual was developed to provide:

- Guidance on the actions and procedures required to satisfy the principles of the intended outcomes.
- Support for the development of appropriate work instructions and Standard Operating Procedures for practical use.
- Guidance for the development of associated auditing and verification activities.
- A management tool for monitoring activities.
- Assistance in training and as a reference for staff.

5.0 SUMMARY OF ANIMAL WELFARE STANDARDS FOR THE LIVESTOCK PROCESSING ESTABLISHMENT

A summary of the Standards for livestock at processing establishments, followed by the outcome intended for each Standard is below:

Standard 1. Planning and contingencies
Adequate planning is carried out for management of stock on a daily basis and contingencies are in place for emergencies to minimise risks to animal welfare.

Standard 2. Maintenance and Design of Equipment and Facilities
Facilities and equipment are designed, maintained and operated to ensure minimal interference or stress is incurred by livestock.

Standard 3. Staff competency
All personnel responsible for the management of livestock or handling livestock are competent in their tasks and fulfil the requirements of these Standards.

Standard 4. Management and humane destruction of weak, ill or injured livestock
Weak, ill or injured livestock are identified and promptly treated in a humane manner.

Standard 5. Management of livestock to minimise stress and injuries
Livestock are routinely managed to minimise stress and injuries.

Standard 6. Humane slaughter procedures
Procedures for humane slaughter, including restraint, stunning and slaughter of livestock, are carried out to minimise stress and in an efficient and effective manner.

STANDARD ONE

PLANNING AND CONTINGENCIES

STANDARD 1. PLANNING AND CONTINGENCIES

Background information and rationale

Standard 1 of the 6 animal welfare standards for the processing industry is based on the operational aspects of processing, with a focus on integrating animal welfare principles and systems into current quality assurance practice(s), as well as general operations and management including contingency planning and scheduling. The overall outcome is that adequate planning is carried out for the management of livestock on a daily basis and that contingencies are in place for emergencies to minimise risks to animal welfare. Some of the principles that underpin this standard relate to meat business policy and the systems that are required for management. The information in this section provides background on the following performance indicators specified for Standard 1:

1.1 Management includes a commitment to animal welfare within the establishment's quality policy.

1.2 Relevant Standard Operating Procedures and Work Instructions that contain animal welfare considerations for the daily management of livestock on the premises are developed and made available to personnel as necessary.

1.3 A system is in place for ongoing verification and review of practices that impact on animal welfare.

1.4 Appropriate slaughter and transport arrangements are made with consideration for the class and condition of livestock. Scheduling is routinely conducted.

1.5 Written agreed contingencies outlining procedures to be followed in the event of delay, establishment breakdown, extremes of weather and industrial disputes are developed and these actions are implemented.

1.6 Competent persons are available or on-call to conduct the designated tasks.

1.7 All personnel responsible for the management and/or handling of livestock are assessed and recorded as being competent in their designated tasks.

1.8 Management procedures are in place to ensure all personnel on the premises conduct their activities to minimise risks to animal welfare.

1.9 Contractual arrangements with livestock suppliers include provisions for animal welfare and a system is in place to provide feedback on adverse outcomes.

1.1 Quality assurance at the processing plant

All Australian livestock processing establishments that produce meat for human consumption are required to comply with the requirements specified in The Australian Standard for the Hygienic Production and Transportation of Meat and Meat Products for Human Consumption (AS 4696:2002) (The Australian Meat Standard).

The Australian Meat Standard requires establishments to develop and implement an Approved Arrangement which covers each stage of production and is underpinned by a Hazard Analysis Critical Control Points (HACCP) based process control framework.

The Approved Arrangement must also document management and production practices including:

- The policy objectives of the Establishment.
- The organisational structure, the provision of resources and training of personnel.
- The system that is in place to verify that the undertakings made by the Establishment are met and the results of the verification activities are documented.
- The corrective and preventative measures that are to be implemented should undertakings not be met.
- The undertaking of internal audit and management reviews.

It is intended that the 'National Animal Welfare Standards for Livestock Processing Establishments Preparing Meat for Human Consumption'1 are implemented by establishments via incorporation into the operational framework established by the 'Approved Arrangement'.

HACCP (hazard analysis critical control point) is internationally recognised as an efficient quality assurance system and provides a way of identifying hazards, minimising associated risks and providing instructions and guidelines for management practices.

The requirements of Standard 1 are designed to fit within the establishment's existing quality system and simply require the addition of animal welfare. For example, this Standard requires that statements are to be developed outlining the establishment's commitment to animal welfare, a system be put in place to verify practices that impact animal welfare and that supporting standard operating procedures relating to animal welfare are to be developed. The checklist questions below provide detail of some of the requirements relating to quality assurance under the current Approved Arrangement for Standard 1:

There is a quality policy that includes the establishment's commitment to animal welfare
Animal welfare considerations are included in the establishment's Standard Operating Procedures and Work Instructions
A system is in place to verify and review practices that impact on animal welfare
Assessments are made and recorded for personnel responsible for the management or handling livestock to verify they are competent in their tasks

The quality policy statement allows the establishment to describe its commitment to meet particular objectives and standards. These generally include customer requirements, business goals, food safety and including these Standards, animal welfare objectives. The quality policy is stated as part of any quality assurance system, and it is important that all personnel in the business are familiar with these business goals. Livestock processing establishments are already very familiar with the role of QA in tracking and verifying their practices for continual improvement, as well as providing supporting information in the form of Standard Operating Procedures and records for verification. This Standard simply requires that animal welfare be part of these quality assurance considerations. Animal welfare is increasingly becoming recognised as a quality characteristic, in addition to its importance for market access; globally animal welfare is now part of the larger product quality framework that centres on food safety123.

Standard Operating Procedures can be developed utilising the performance indicators and checklist questions provided in the quality manual2 of the Standards for animal welfare. In addition, a "how to" guide for livestock processing establishments has been developed to further assist processors in developing the appropriate quality assurance material to support and demonstrate these Standards. The "how to" guide3 is available on the AMIC website (www..amic.org.au), and details how to utilise the Working Manual and incorporate its principles into the existing plant quality assurance documentation under the Approved Arrangement.

1 Document 1: Animal Welfare Industry Standards

2 Document 2: Animal Welfare Standards Working Manual

3 Document 3: How to Guide - all are available on the AMIC website: www.amic.org.au

1.2 Record keeping and internal auditing

Records, internal audits and regular monitoring are all essential management tools and a major part of any quality assurance system. Record keeping reflects good practice. While the issue of setting targets is not addressed in the 'Code of Practice for Livestock at Slaughtering Establishments', nevertheless, it is good management practice and permits a prompt identification of problems and hopefully solutions to any problems. Thus, targets are provided in Part 2 of the Standards, the Working Manual, to aid in assisting processors in identifying "what to aim for" when considering good animal welfare practice. The targets can be utilised for internal audit purposes, to develop appropriate monitoring of practice, as well as support for the development of "critical limits" for any existing HACCP or quality assurance system for the establishment. These Standards require that a system is in place to verify practices that impact animal welfare and records can often assist with this process. Thus, the inclusion of the following checklist question:

> A system is in place to verify and review practices that impact on animal welfare

If a problem is identified, the next step is to attempt to fix it. Identifying cause(s) and educating oneself, if necessary, to be able to identify and fix a problem is an important step in improving staff knowledge and should assist in preventing a recurrence of the problem. It is not in a staff member's, company's or industry's interest if poor stockpeople remain in the industry. In other words, if you think there is a problem, even though it may not be your direct responsibility, it is your responsibility to try and do something about it. It is neither fair nor good practice to leave the problem to someone else to identify and solve.

It is recognised that there are several interdependent steps in livestock processing. For example, the processor is dependent on the 'quality' of livestock received following transport, and under inappropriate conditions, this might contribute to higher than expected losses or more commonly, reduced meat quality through bruising or dehydration. For these reasons, records, over time, can be used to help identify some of the possible cause(s) of losses or reductions in quality. Records are also essential to demonstrate compliance for audit purposes. In addition, one of the requirements of these Standards is to provide feedback to other service providers, in particular contractual arrangements with livestock transport companies must include provisions for feedback on the quality and management of each consignment of livestock. Thus, the inclusion of the following question:

> Contractual arrangements with livestock suppliers include provisions for animal welfare and a system is in place to record and provide feedback on adverse outcomes

In summary, record keeping is an essential management tool for providing support to processors by providing a means of identifying and evaluating performance according to set targets within individual businesses. Records also play a vital role in identifying losses or quality problems.

1.3 Contingency planning

It is essential that processing establishments have emergency livestock management plans in place to safeguard animals in the events of weather extremes, delays or breakdown of equipment, stunning practices, industrial disputes and general care in lairage. Each establishment needs to assess the potential risks or vulnerabilities with respect to animal welfare and ensure that appropriate actions are detailed and that these actions are carried out as required. For example, if there was a breakdown in the processing line and livestock could not be slaughtered until the problem was rectified, and then plans for feeding, watering and managing livestock in the interim need to be well established. If there was a delay in livestock arriving at the plant that caused livestock to be delivered out of hours, plans need to be in place to ensure that the livestock can be unloaded by a competent person and placed appropriately with water until the next shift resumes. Facilities for feeding and watering and plans to obtain feed and additional water should be in place to cater for the needs of the maximum number of livestock at the establishment at any one time.

Other circumstances, including loss of power or protection from fire and flood should also be part of the establishment's contingency plans. Daily emergencies, such as any failures in stunning procedures need to have in place prompt contingency actions such as the use of on-hand manual, back-up stunning equipment for kill floor operators. Thus, the following checklist questions are included in Standard 1;

Written contingencies are developed and actions carried out (as required) for the following:
- delays or breakdown
- use of back-up stunning equipment
- industrial dispute
- obtaining and providing feed, water and shelter as required

It is also good practice to have some plans in place to provide transport operators with some guidance, for example, it might be outlined that in certain weather conditions, where unloading cannot commence, trucks can keep driving or if they park at the plant, there are watering facilities (and shade) available to keep livestock cool until they are able to be unloaded.

1.4 Industrial disputes

In the event of an industrial dispute or extension of the time to kill, sufficient protocols must be in place to ensure the correct management of livestock in emergency situations. These protocols must include the steps to be taken in the event of a delay to ensure that the welfare of livestock is not compromised in any way. These protocols must be readily available to all staff involved in the management of livestock for transport, sale or slaughter (where the processing plant contracts transporters or buyers). Plans need to be devised for management to be able to inform all transporters, agents and livestock suppliers to delay sending livestock to the processing plant in the event of an industrial dispute or an overload of animals present at the site. Transport vehicles that are already in transit are to be made aware of handling procedures for livestock in the event of a dispute or delay and directions should be provided for transporters to redirect livestock to alternative processing

plants or holding areas. Livestock that arrive on site can be re-directed to other holding facilities if there are no holding pens available and this needs to be done whilst observing the maximum allowable periods off feed and water. In addition to these procedures, a processing plant might need to be able to provide sufficient feeding equipment and feed for the largest number of animals likely to be on-site in the event of a delay.

1.5 Scheduling

A requirement of the 'Code of Practice for Livestock at Slaughtering Establishments' is that livestock should be scheduled for slaughter as soon as practicable, unless provided with feed and water. In particular, calves, lambs, pregnant animals and animals that are in poor condition should be slaughtered as soon as possible. The 'Code of Practice for the Welfare of Cattle' identifies that bobby calves are to be slaughtered within 24 hours of leaving the property of origin. Some State/Territory Codes, for example, in Victoria, add that calves present at the processing premises must be scheduled for slaughter in precedence of other livestock arriving and that the schedule must take into account the time spent in lairage. In summary, good practice indicates that the scheduling of livestock should take into consideration the condition of the animals, duration and distance of travel and the age and species of the livestock in question. Prior to livestock arrival, adequate planning should occur to ensure that slaughter arrangements for each expected consignment of livestock can occur in sequence, that there is sufficient space and resources available to manage the livestock on arrival at the premises, and that contingencies are in place. Upon arrival of livestock, the condition and transport arrangements of the animals should be noted at unloading and the time recorded to ensure that accurate scheduling can occur taking these aspects into consideration, thus reducing any possible risk to animal welfare. Thus, the inclusion of the following checklist question in Standard 1:

> Appropriate slaughter and transport (if transport is the responsibility of the establishment) arrangements are made with consideration of class and condition of livestock

Scheduling is an important daily task to ensure good animal welfare outcomes by slaughtering livestock as soon as possible and having systems in place for those consignments to be held in lairage when required for a period of time. The practicality of feeding and keeping large numbers of livestock highlights the importance for appropriate kill scheduling to prevent detrimental effects on animal welfare. In addition, processors should work with transport operators to ensure that the scheduling is appropriate for both parties to be able to meet these requirements in a practical manner.

STANDARD TWO

MAINTENANCE AND DESIGN OF EQUIPMENT AND FACILITIES

STANDARD 2. MAINTENANCE AND DESIGN OF EQUIPMENT AND FACILITIES

Background information and rationale

Standard 2 of the 6 animal welfare standards for the processing industry is based on the maintenance of facilities to minimise any possible injury or interference to any livestock held or that are moving through the processing establishment. The overall outcome is to ensure that facilities and equipment are well-designed, maintained and operated to ensure minimal interference or stress is incurred by livestock. Some of the principles that underpin this standard relate to generic maintenance of facilities at the processing establishment. The information provided in this section provides background on the following performance indicators:

2.1 Facilities are free from protrusions that can cause injury, are clean and in good working order.

2.2 Flooring and ramps are designed to minimise slipping, falling and injury.

2.3 Facilities are available to separate and treat weak, ill or injured animals as required.

2.4 Facilities for water are available and operational.

2.5 Facilities for feeding are to be available and operational as necessary.

2.6 Design of holding and lairage facilities minimises susceptibility of livestock to heat or cold stress and provides sufficient space for livestock to be held.

2.7 Restraining equipment is designed to ensure that animals can effectively be restrained for stunning.

2.8 Stunning equipment is effectively stored, maintained and fully operational, and appropriate for the species and class of livestock.

2.9 Back-up stunning equipment is available and operational.

2.1 The design and construction of facilities and equipment

As most processors are aware, well-designed facilities not only aid animal movement through the plant and reduce the labour required, but stress is also markedly reduced in livestock when animals can move calmly without any blockages or physical objects in their path causing them to baulk. There have been many research papers published on facility design and the factors that aid or impede animal movement. The most successful designs are those that take into account the behavioural characteristics of livestock, for example stock will baulk at contrasts of light and dark, changes in flooring level and texture, sight of people and other animals, high pitch noises, unusual objects and flapping items. This document highlights the following important considerations when examining the adequacy of facilities:

1) Facilities and equipment are designed and maintained for the class and species of animal to be held and encourage smooth movement of animals through the plant

2) Facilities are free from protrusions that can cause injury, are clean and in good working order

3) Flooring and ramps are designed to minimise slipping, falling and lameness

The first consideration, regarding the design and maintenance of facilities is an important factor influencing animal movement and consequently stress. Design features that aid cattle movement, such as the use of solid fences in high traffic areas can dramatically aid movement of livestock. Solid fences prevent livestock from seeing people, vehicles and other distractions. Observations of cattle in a variety of facilities showed that some cattle became more agitated in the portion of the race from which they could see out. If cattle can only see a single way out, up the race, baulking will be avoided. Solid fences are useful in areas such as single file races, loading ramps and crowd pens. Grandin (1997) showed benefits of curved races that take advantage of cattle's natural tendency to circle the handler. It was shown that no time was required to; move cattle through curved races than straight races and that curved races actually reduced the amount of time spent moving cattle by 50%. Circular crowd pens and curved races with solid fences provide for faster and smoother flow of animals, avoid distractions and allow the natural following behaviour of cattle to occur. There are a number of good examples of these types of facilities in Australian processing plants already and if handling problems are identified or animal flow is not as efficient as it could be, it is worthwhile investigating and improving facility design.

Baulking is a common problem in processing handling systems and is often linked to fear and stress. Baulking interrupts the flow of animals and can lead to excessive handling by the stockperson. Some of the common causes of baulking include:

- changes in flooring material, drains, gratings
- contrasting shadows and lighting or sunlight on the flooring
- protrusions and distractions, including pipes, hoses or other objects on fences or the floor
- open gaps in sides of races or areas where livestock can see below them
- steps and discontinuity between ramps and flooring
- noise and other impediments, such as people moving above or below livestock.

All facilities need to be designed to avoid animals becoming injured, slipping or falling. Facilities should be maintained and regularly inspected to allow livestock to be handled in a manner that prevents injury and minimises stress whilst on the premises. This includes maintenance on high traffic areas when required, for example gates and flooring, and removing any items that are causing animals to pause or baulk, to ensure maximum efficiency in animal flow through the plant.

The second consideration is important as walking surfaces and the walls of ramps and raceways that contact livestock need to be kept smooth to avoid injury and bruising. Sharp corners can be padded, gates tied back and other protrusions can be removed to avoid contact with cattle. Bruises are likely to occur when animals hit objects of small diameter, and gates can seriously bruise animals if they become jammed between the end of the gate and the fence. One way to monitor bruising is to review carcass statistics over time and if bruising is high but the facilities do not contain any protrusions, then feedback to the transporter and producer may be needed to improve meat quality.

The third consideration, non-slip flooring is important to avoid any injury to livestock through slipping and falling. Flooring in lairage areas, ramps and races must be non-slip and well maintained. Animals need to be observed during all phases of handling and movement and where slipping occurs, steps can be taken to correct

the situation. Slick floors and slipping can increase injury, bruising and stress. Research on appropriate flooring suggests that concrete floors should be grooved, in square or diamond patterns. It is important that the grooves are not too deep (i.e. no more than 2 cm), as lameness might occur as observed in some plants, particular when the livestock have been transported a long distance and are not used to standing on concrete. If lameness is regularly observed in large cattle or pigs, advice should be sought on the cause and feedback provided to producers. Other actions that may assist to reduce lameness are having information on the place of origin of the livestock and if they were not kept on concrete or similar flooring, ensuring that they remain off the concrete at the plant for as long as possible, if this can be achieved. If pens become unsuitable because of increased slipping, etc., they should be decommissioned until re-surfaced or interim steps should be taken, such as using sawdust or matting.

Studies of the stride length of cattle when moving have shown that ramps with steps of at least 450 mm long and with no more than a 100 mm rise promote the easiest unloading, i.e. a ramp slope of 20 degrees. Similarly for pigs, 20° is preferred, otherwise ease of walking for the animals may be reduced. For calves, it is preferable to have ramps that are slightly less steep, at around 12°, however where this might not be possible, gentle and patient handling whilst unloading calves will enable them to carefully walk from the transport vehicle without slipping or falling. Furthermore, a slight curve, or other deviation, in ramp direction will improve the animals' willingness to move up the ramp and a level section at the top of the ramp of about 1.5 m long will give cattle more confidence to move onto the different flooring material presented on the loading ramp from the truck.

There is an abundance of research on the effects of facility design on animal movement and behaviour. Well-designed facilities, combined with gentle and patient handling have been shown to dramatically minimise animal stress levels, improve efficiency and maintain good meat quality. The following provides some additional background on other parameters to consider when examining facilities and their impact on animal welfare and management.

2.2 Lighting

Research indicates that animals prefer to move from a darker area towards a lighter one provided that light is not directed into their eyes. In practice, animals may refuse or baulk when forced to enter a dark area. The lighting inside and immediately outside the truck can have a marked influence on the ease of loading and unloading. Providing non-glaring light inside the vehicle can encourage cattle onto the truck and similarly, a well-lit unloading area or platform, that does not face into the sun, will ensure unloading is much easier. The need to use handling aids or electric goads at unloading may be an indication that lighting should be examined in the unloading facility.

A single shadow that falls across a race may prevent the flow of animals, with leading animals stopping or refusing to cross. Puddles of water, drains and bright or blinding sections of sunlight can have a similar effect. Races, ramps, stunning boxes and restrainers should be uniformly lit and free of distractions including drains and moving or flapping objects. Calm and quiet handling can be difficult if animals are stopping in groups. Races with solid sides, to prevent animals from seeing other distractions, have been shown to be effective in maintaining animal flow. Research in the US with a solid and an open sided race indicated that cattle became much more agitated in the race from which they could see out. An enclosed design is useful for sections of the race that lead from lairage to the stunning and restraint facilities. Stockpeople need to regularly observe stock movement to identify problems in animal movement and be able to take action to improve the situation.

2.3 Noise

Livestock generally have very sensitive hearing. They tend to be more sensitive to high frequency noises than people and especially high frequency sound at around 7000-8000Hz. There is also evidence that livestock can have lower hearing thresholds than people, which means that sounds that might not bother people can in fact hurt the animal's ears.

Reducing noise will aid in animal movement and in particular, reducing high pitched noises, like whining from hydraulic pumps, air whistling from ventilation systems or fans and clanging and banging from gates, chains and machinery will assist in calming livestock and improving their willingness to move. There will always be some noise associated with processing plants, so simple practical measures are the best option to reduce noise, including rubber pads on gates, ensuring that motors and conveyors are designed to minimise noise and when installing any new systems, placing emphasis on noise reduction.

2.4 Lairage facilities that provide protection from weather extremes

2.4.1 Pigs

Environmental (high) temperature can greatly affect the stress level of pigs during transport and lairage and consequently meat quality. Studies have shown that in lairage, the frequency of PSE occurring when pigs were held in lairage for 0.5 hours compared to 3 h, was affected by temperature, with PSE being lower in pigs held at temperatures of 20 °C and higher at 35 °C. This suggests that at lower temperatures, pigs had a better recovery rate from the stress incurred during transport and unloading when held in lairage during moderate temperatures. Therefore, in practice, additional stress from high temperatures needs to be taken into consideration if pigs are not slaughtered soon after arrival. For optimum meat quality and welfare, pigs kept under mild temperatures can remain for a rest period, while pigs under a hot environment (35 °C) should be slaughtered within 0.5 h of arrival where possible or be allowed to fully recover with adequate food and water.

There should be sufficient space to unload pigs upon arrival and if for some reason, there is a delay; transports should continue driving until pigs can be unloaded to ensure that they do not remain on a stationary vehicle where heat can build up. In high temperatures (i.e. above 27°C), lairage pens should have sprinklers or sprays with droplets that are coarse enough to wet the skin of the animal (penetrating the hair); fine sprays that do not effectively cool the animals will only contribute to high humidity, becoming critical at 80% for pigs. The use of water sprays or misting systems to cool pigs in hot environmental conditions can reduce heart rates, respiratory rates and skin surface and rectal temperatures in pigs. Additional measures (e.g. fans) may be required in conditions of high humidity (80%)..

2.4.2 Cattle, Calves, Sheep and Goats

As for pigs, transport of cattle should occur early in the day or at night during extreme temperatures (classified as those temperatures that predispose livestock to heat stress). It is important that cattle are unloaded on arrival and do not remain in stationary trucks during hot weather. Water should be provided as soon as possible and shade provided for cattle standing in lairage pens where possible.

2.5 Vocalisation scoring as an indicator of animal welfare

Vocalisation scoring has been previously utilised as a measure of animal welfare in a number of research applications and is now being used as a practical measure of animal welfare in processing plants in the United States and Australia. The use of vocalisation as a measure for animal welfare has been reported by researchers

examining a number of species, however its application as a measure for audit purposes at processing plants, it was developed by Grandin (1998). In particular, Grandin also examined the use of vocalisations to audit animal welfare and the feasibility of this measure in light of the large variation in other auditing measures reported between auditors at different processing plants in the United States. Vocalisation are considered easy to measure, as animals will be classed as either vocalising or not vocalising, whereas other signs of distress, such as struggling are often more subjective.

However, it needs to be recognised that animals will vocalise in response to other vocalisations i.e. not all vocalisations are indicative of distress and reduced welfare. Also, when scoring vocalisations there may be some practical difficulties that relate to standardising the assessment between auditors and conducting appropriate training to ensure accuracy in determining the difference between the intensity of vocalisations in a lairage area containing large numbers of livestock.

When examining animal welfare outcomes, behaviour is the most obvious indicator that the animal is experiencing difficulty in coping with a problem and due to its practical application at the processing plant; behaviour is a widely used indicator of animal welfare. Short-term behavioural responses often include orientation reaction, startle responses and defensive or flight reactions. Vocalisations are an example of a startle response, with the intensity being related to the extent that the individual is disturbed. Research with both pigs and cattle has indicated that vocalisations are an indicator of stress. However there is still some disagreement relating to the definition of animal welfare and its assessment among scientists internationally. Therefore, a limitation exists at the first step: interpreting the scientific data on how animals respond to a particular practice in terms of welfare risks to the individual. Previous and ongoing difficulties in assessing animal welfare include: definition of welfare e.g. ethical versus science inputs, limited research, difficulties in measuring the physiological criteria of stress, a focus on animal emotions (that currently cannot be directly measured), and that animal welfare research requires a multidisciplinary approach. Thus in the development of animal welfare standards, careful consideration of the risks to welfare must be made in order to utilise the science to measure the impact of these risks. Further information on the assessment of animal welfare is provided in appendix 1 of this document.

There is substantial evidence that the measure of vocalisations can be applied in a practical way to pinpoint animal welfare problems in processing plants. In studies carried out by Grandin (1998), it was observed that in well managed processing plants, less than 3% of cattle vocalised when they were being moved through the forcing pen, leadup race and stunning box. It was observed that excessive electric prodding, slipping on the floor, too much pressure being applied by a restraining device and missed captive bolt stuns were associated with over 98% of vocalisations; these events were thus regarded as adverse to welfare during the handling of cattle at the processing plants examined. It was also shown that 90-95% of cattle could be moved through the processing system without the use of the electric prod and that prodders were the greatest cause of vocalisation in cattle.

Vocalisation scoring should only be used as specific points in the processing plant, namingly, the forcing pen, lead-up race and the stunning box. Cattle standing in lairage have been shown to vocalise to each other in the absence of any apparent disturbing event. Recording livestock as either vocalising or not vocalising is the simplest method to use, without counting the number of individual animal vocalisation nor calculating the intensity, as this can be difficult under commercial conditions. It might be useful to also monitor the vocalisations associated with livestock that are prodded, as this can give an indication of stress and will identify whether handling or facilities may need to be examined. Equipment has been shown to have an effect on vocalisations,

including head restraint devices, sharp turns in raceways and uneven flooring. Vocalisations are reduced, if immediately following head restraint, the use of captive bolt or ritual slaughter procedures are promptly used. Curved raceways with solid sides that facilitate cattle movement have been shown to be associated with fewer vocalisations, keeping the animals calmer and moving slowly and smoothly. Finally, reducing areas that cause cattle to baulk will not only improve the flow of livestock through the plant, but also to reduce the amount of handling and prodding that is required to move animals to the restraining area. By reducing steps, shadows and other physical impediments, handling and prodding is reduced, and subsequently, vocalisations are also reduced.

STANDARD THREE

STAFF COMPETENCY

STANDARD 3. STAFF COMPETENCY

Background information and rationale

Standard 3 of the 6 animal welfare standards for the processing industry is based on staff competency and the impact of stockpeople on animal welfare. The role of stockpeople is critical to good animal welfare and is frequently underestimated. The overall outcome is to ensure that all personnel responsible for the management of livestock or handling livestock are competent in their tasks and can fulfil the requirements of these Standards. Some of the principles that underpin this standard may relate to current management practice, for example staff training, supervision and general livestock handling practice. The information provided in this section will provide background on the following performance indicators:

3.1 All personnel handling and managing livestock are assessed and recorded as being competent in their specific tasks.

3.2 Personnel undergoing training or that are not yet competent are supervised by a competent person.

3.3 All personnel managing livestock on a daily basis regularly observe the animals, can identify and respond to behaviours and other signs that may indicate a problem for an animal and can take the appropriate action to rectify the problem.

3.4 All personnel are assessed as competent in the careful and appropriate use of goading implements and dogs.

3.5 Personnel involved in stunning are trained and are competent in recognising the effectiveness of the procedure (signs of insensibility for the species).

3.6 Personnel involved in stunning are competent to use stunning backup equipment.

3.7 There is a nominated person(s) competent in humane destruction and available as required.

3.1 Management responsibilities and staff training

While management (companies) have the overall responsibility for the welfare of the livestock at the saleyard/processing plant, this responsibility is frequently delegated to facility managers. Plants employ a number of people and it is the individual staff member and how they perceive their responsibilities that have the greatest impact on animal welfare. For, example, written instructions, routine inspections and highly sophisticated control equipment cannot always ensure that occasional mechanical breakdowns will not occur. Thus, staff should not only be competent in performing their allotted tasks, but also be aware of other areas where things can go wrong and also keep reminding themselves to keep an eye on areas they may be passing through even when it is not their responsibility.

Management has the responsibility to ensure that staff have all the information they require and to provide training and feedback on work performance in relation the welfare targets so that staff can continue to properly complete their work. In addition, management plays a key role in communicating a clear commitment to animal handling and animal welfare.

Management have a role in ensuring that:

- there is development of an animal welfare policy or mission statement (this is covered in Standard 1)
- providing information on good animal welfare practice to staff,
- providing induction training, ongoing training for competency and other opportunities to staff for continual improvement
- recognition for work well done
- ongoing monitoring and measurement of handling and other animal welfare practices including stunning.

MINTRAC (Meat Industry Training Council), deliver competencies in areas such as livestock handling and animal welfare, including stunning and slaughter practice. MINTRAC has competency units that are designed to underpin the aforementioned animal welfare standards and it is recommended that these competencies are taken by staff and supervisors with direct responsibility for handling livestock. For further information on these competency units, contact MINTRAC Toll Free: 1800 817 462 or via email: mintrac@mintrac.com.au.

3.2 Stockpersonship

The importance of competent stockmanship in proficient handling of livestock is critical to the welfare of the animals. Therefore ongoing induction and training procedures are important in making sure that all staff are aware of their specific job roles as well as the overall operation of the facility. Establishment staff that work with livestock should have an awareness of areas such as biosecurity, livestock behaviour and handling, and the physical aspects and needs of the livestock. An understanding of the factors that affect welfare, such as stress from transport, conditions in lairage, temperature, humidity and human behaviour can assist staff in better managing livestock, identifying any problems and making appropriate changes or improvements.

The operators of processing facilities must be able to manage staff absence without affecting the welfare of the livestock within that facility. Should staff be away from work, a written protocol of their position requirements and daily necessities should be documented for replacement personnel, or, at least, a discussion with the replacement personnel needs to occur. In addition it is good practice to always provide protocols that detail emergency procedures, important activities and the expectations of outcomes to be achieved.

Processors can ensure through efficient scheduling, that there are personnel available for the receival of livestock at the plant and that procedures are in place to manage livestock arrival and placement in lairage. Processors can also ensure there is effective communication between themselves and their transporters or buyers so that the standards expected of livestock arriving at the plant are clear to all. In situations where a problem may occur, it is a recommendation of these Standards, that feedback be provided to transport personnel or vice-versa to the producer, saleyard or feedlot, when possible. This process assists to manage a whole of chain (farm, transport and processing) approach to the management of animal welfare and minimise the risk of problems that can occur as a result of change in ownership of the livestock.

Another area of importance when considering the subject of stockpersonship, is the effect of handling of livestock on meat quality. The meat industry is concerned about the occurrence of pale, soft, exudative (PSE) or dark, firm and dry (DFD) or dark cutting meat in livestock; these are quality attributes affecting buying behaviour

outcomes. PSE and DFD are more common in pigs and dark cutting meat occurs more commonly in beef cattle. PSE pork occurs due to the pigs experiencing acute stress immediately prior to slaughter, which in turn causes an increase in the rate of post-mortem muscle acidification. Under normal circumstances, muscle pH post-slaughter declines gradually for 6-8 hours until rigour mortis sets in, however if a pig is stressed prior to slaughter, muscle glycogenolysis in increased resulting in an increase in muscle temperature and consequently a faster rate of fall in muscle pH post-slaughter. This is the cause of PSE conditions in meat, and can be brought on by acute stressors such as negative animal handling and transport, as well as other factors such as high temperatures, mixing of unfamiliar animals, etc.

The effect of stockperson handling of livestock and the resulting meat quality has been the subject of extensive research. For example, Grandin (1980; check re appendix 2) reported higher incidences of PSE pork in pigs that had experienced repeated contact with electric prodders and D'Souza (1988a; check re appendix 2) found that the use of electric prodders to move pigs immediately prior to slaughter had a deleterious effect on pork quality through increased incidence of PSE. It is debated, however, in studies that did not find as highly significant an effect from the use of prodders on meat quality, that the previous experiences of pigs to electric prodders may have an effect. Given that there is not widespread use of prodders on farms in Australia, (in fact this is dramatically reducing), it is likely that the responses of pigs to the use of electric prodders at the abattoir or during transport would result in acute stress. Indeed, there is no evidence that pigs habituate to the use of electric prodders/goads.

Research has also demonstrated a relationship between the attitudes and behaviour of the stockperson, subsequent pig behaviours and production parameters. In a study carried out on lairage employees in the pig industry, where personnel were studied when moving and handling pigs from lairage to the stunning area, attitudes, perceived behavioural control, personality and the subsequent behaviours of the pigs were examined. The results indicated, much like similar work conducted on farm, that negative attitudes and actions of animal care staff can have quite marked effects on the stress and fear levels of the animals, with consequent deleterious effects on welfare and production efficiency.

STANDARD FOUR

MANAGEMENT AND HUMANE DESTRUCTION OF WEAK, ILL OR INJURED LIVESTOCK

STANDARD 4. MANAGEMENT AND HUMANE DESTRUCTION OF WEAK, ILL OR INJURED LIVESTOCK

Background information and rationale

Standard 4 of the 6 animal welfare standards for the processing industry is for the appropriate management of any weak, ill or injured livestock at the processing plant. The overall outcome is to ensure that any weak, ill of injured livestock are immediately identified and managed appropriately and promptly. The information in this section provides background on the following performance indicators:

4.1 Consignments of livestock are assessed upon arrival and any weak, ill or injured livestock are identified.

4.2 Livestock identified to be weak, ill or injured are assessed by a competent person and the appropriate action is promptly taken.

4.3 When livestock are identified to require humane destruction or emergency slaughter, the procedure is carried out promptly and effectively.

4.1 Inspecting livestock upon arrival and identification of weak, ill or injured livestock

Processing plants operate at fast line speeds, thus cannot afford interruptions in the supply of livestock. Lairage holding pens ensure that there are sufficient reserves of livestock, as well as providing the added advantage of allowing livestock to rest and recover from transport and drink water if they are dehydrated, both of which in some situations can improve meat quality.

For the plant to maintain good livestock throughput, livestock that are presented for slaughter should be:

– clean, healthy, in good body condition and free from any blemishes

– fasted (for food safety purposes), unstressed, easy to handle

Upon arrival at the livestock processing plant, animals should be inspected during the process of unloading and penning in holding or lairage areas. The Australian Standard (AS4696) and the Model Code of Practice require that any ill, weak or injured animals are identified as quickly as possible upon arrival and are segregated and treated or humanely destroyed. Moribund or non-ambulatory animals (animals that are unable to walk or stand, or exhibit signs of distress or insensibility, with little chance of recovery) should be humanely destroyed on the spot. It is an animal welfare requirement that non-ambulatory (downer) animals are euthanased on the spot and a requirement of many customers that buy Australian meat products that these animals are not permitted to enter the production chain. Any non-ambulatory livestock should be euthanased on the truck as soon as possible.

Farmers and other livestock suppliers usually bear the financial loss if any livestock die during transport to the abattoir. Whilst the farmer or supplier do not have direct control over mortality during transport, adequate preparation prior to transport, ensuring unloading in temperate conditions and dialogue with the transporter and customer where possible are their responsibilities to ensure that animal welfare is being appropriately managed. Essentially the farmer or livestock supplier must determine whether the animals are “fit for transport” and even more importantly, “fit for the intended journey”. It must be assessed whether the animals are fit, able to walk unaided, healthy and unlikely to suffer or be in a worse condition as a result of the journey. There is information

relating to the fitness for loading in the "Fit to Load" handbook, produced by WA State Department of Agriculture and also available from the RSPCA and Meat and Livestock Australia, as well as principles outlined in the 'Codes of Practice for Livestock Transport'.

Providing feedback from the processing plant to the livestock suppliers is a good way to ensure that animal welfare expectations and outcomes are realised in the exchange of livestock. The development of across-chain animal welfare quality assurance programs with similar principles and elements is continuing to enable sectors of industry to meet and verify their animal welfare outcomes. National animal welfare industry standards for livestock transport (road and rail) can be obtained from the Animal Welfare Science Centre (www.animal-welfare.org.au) and the Australian Livestock Transport Association, (www.alta.org.au).

Lairage staff and drovers unloading animals should be able to identify any animals that are weak, lame, injured or have difficulty moving and take the appropriate action. Animals that are likely to recover after rest may be separated and those that are of condition that permits slaughter on the production chain should be placed for emergency slaughter, as determined by a competent person.

All animals undergo an ante-mortem inspection prior to being cleared for slaughter, either on arrival or any time within 24 hours of the scheduled slaughter. It is important that animals are inspected both upon arrival and during the ante-mortem to ensure that any weak, ill or injured animals are identified. Subsequent inspections must then take place for any animals that have been separated for rest or treatment to determine any further action that needs to be taken. Regular inspections of all animals in lairage should be carried out at least daily to identify any animals that may become weak, ill or injured.

Hence, the inclusion of the following checklist questions in the Working Manual:

Consignments of livestock are assessed upon arrival and any weak, ill or injured animals are identified
Livestock identified to be weak, ill or injured are assessed by a competent person and appropriate action is promptly taken
For livestock identified to be humanely destroyed or placed for emergency slaughter, the procedure is carried out promptly and effectively
Weak, ill or injured stock that are to be treated or provided with additional rest prior to slaughter are placed in separate pens with food and water and in a position where they are observed at least 3 times per day
All other livestock are regularly observed to ensure any sick, weak or injured stock are identified, and if so, the animals are placed in separate pens and/or treated if required or are humanly destroyed as soon as possible

There should be a competent person available to carry out the procedure of humane destruction required for livestock at the plant. For destruction to be humane, the animal must immediately become unconscious and not regain consciousness. The ideal shooting position in the head depends on the species and class of animal. The ideal position is generally at a point determined by the intersection of two lines drawn from the inside corner of the eye to a point above the opposite ear (frontal method referred to in the Code of Practice for the Welfare of Cattle, Pigs, Sheep, Goats and Horses.

STANDARD FIVE

MANAGEMENT OF LIVESTOCK TO MINIMISE STRESS AND INJURIES

STANDARD 5. MANAGEMENT OF LIVESTOCK TO MINIMISE STRESS AND INJURIES

Background information and rationale

Standard 5 of the 6 animal welfare standards for the processing industry is based on the general management and movement of livestock held at the processing establishment prior to slaughter. The overall outcome is to ensure that livestock are routinely managed in a manner that minimises stress and injuries. Some of the principles that underpin this standard may relate to current practice, for example regular inspection of livestock held in lairage, handling practices, provision of feed and water, penning and washing livestock prior to slaughter. The information provided in this section provides background on the following performance indicators:

5.1 All livestock are observed to have easy access to drinking water and feed (if feed is required) in holding facilities and yards.

5.2 Livestock are penned at densities that allow for free movement in accordance with the class of livestock.

5.3 Personnel take appropriate steps to manage any aggressive or unfamiliar animals in holding facilities to avoid any injury that may be caused to livestock.

5.4 Livestock are handled and moved through the facility in a calm and quiet manner to minimise stress.

5.5 The use of goading implements for livestock handling is monitored to ensure the use is appropriate for the class of livestock.

5.6 Dogs used to assist in moving livestock are appropriately trained, used only on appropriate species of livestock and are muzzled when working.

5.7 Care is taken when manually washing livestock with hand-held high-pressure hoses to avoid sensitive areas of the animals.

5.8 Care is taken when washing livestock to minimise cold stress.

5.1 Transport from the farm, saleyard or feedlot to lairage

Research has shown that there are a number of stressors associated with loading, transport and subsequent unloading at the processing plant. These include handling, restriction of feed and water, temperature, change in environment, transport, mixing with strange animals and disturbed rest and routines.

As the scope of the Standards directly concerns the management of livestock from the point of receival and unloading at the plant to the point of slaughter, this information does not cover direct information on livestock transport. However, there are some important considerations relating to livestock transport that the processor needs to be aware of and some of these are detailed in Appendix 3 and briefly described below.

Livestock transport includes a series of unfamiliar and threatening events for livestock, beginning with assembly, loading, confinement, motion, unloading and penning in a new environment. In addition, exposure to cold, heat, humidity, noise, motion, unfamiliar animals and handling contribute to the levels of stress experienced by the livestock that are being transported. Transport may lead to injury, distress and in some extreme cases death, and requires careful management to ensure animal welfare is safeguarded. The process often coincides with a change

of ownership whereby the responsibility for the livestock may not always be fully recognised. From the processors' perspective, it is important that expectations of how the livestock are to be selected, transported and handled are communicated to transport operators and associated personnel, for example livestock agents and carriers. Where processors are involved in scheduling the transport of livestock either by direct consignment or through agents at markets, scheduling needs to be carried out with consideration for animal welfare (see Standard 1, section 1.5).

It is important that processing establishments provide adequate feedback to their livestock suppliers and transport operators of their expectations in relation to animal welfare and also on the incidence of bruising or other meat quality defects that may relate to stress, for example PSE, DFD or dark-cutting meat. High financial losses are incurred by the livestock industry as a result of bruising during transport and handling that can attributed to facility design, stocking density, vehicle construction, rough driving or handling and inadequate management of livestock and when mixing unfamiliar animals. Economic incentives can reduce the incidence of bruising; for example, it has been demonstrated that cattle sold by live weight had twice as many bruises than cattle sold on a carcass basis. Processors can, in some instances, also organise the scheduling and marketing of livestock to be carried out in a manner that will reduce the impact on animal welfare and meat quality; for example, livestock marketed to minimise the number of times that they are handled, restrained and transported. Several studies including Eldridge (1984) who examined cattle and Cockram and Lee (1991) who examined sheep, have shown that livestock directly consigned from farm have less bruising than animals from saleyards, indicating that direct consignment reduces the risk of injury.

Handling of pigs in the USA was shown to improve greatly when exporting to Japan, as Japanese graders rejected up to 40% of pork loins due to PSE, providing a strong economic incentive to improve handling. Thus, a reduction in the use of electric prodders and other simple changes in handling and lairage procedures, including washing practices and resting periods enabled 10% more pork to be exported to Japan.

Export livestock processing establishments and feedlots involved in live animal export can contribute to reducing the impact on animal welfare and meat quality by ensuring that livestock to be exported are prepared appropriately. Livestock that are feedlotted prior to export by ship require adequate acclimatisation and training to eat pelleted feed prior to transport. Grandin (1983) reported that low death losses are possible if sheep are properly prepared prior to transport by ship.

In general, prior to arriving at the livestock processing establishment, animals will have been subjected to variable periods of feed and water restriction, transport and handling. Animals sold through saleyards are more likely to have experienced longer periods of feed and water deprivation and increased handling and transport than those animals sold and delivered direct to the livestock processing establishment. At the processing establishment, the changes that can have the greatest impact on reducing the stress that might be incurred during transport involve handling practices and management in lairage and the movement to the slaughter floor.

5.1.1 PROCESSING ESTABLISHMENTS AND CONTRACTED AGENTS, BUYERS AND TRANSPORT SERVICE PERSONNEL

The key principle for processors that contact buyers, agents or transporters is to ensure that livestock which are not deemed fit for the intended transport journey to the plant are not be purchased and/or loaded for transit. It is important that animals selected for transport (where under the processors instruction) are:

a) fit

b) not dehydrated

c) able to walk freely on and off the truck/train

d) have not injury or significant bruising

e) stress is minimal

f) are not deprived of feed or water longer than maximum curfew times (36 hours for cattle, with extended time (if weather conditions and journey conditions are suitable i.e. not extreme heat) of 48 hours and no longer- this includes time spent mustering/waiting for sale.

For livestock where the vendor organises and pays for the transportation (eg weight and grade purchases), it is the vendor (or agents) responsibility to ensure fitness for transport. A number of processing customers have started to request that their processing establishments provide guidance or mechanisms to remind producers/transporters of their obligations- even in instances where the processor is not responsible or does not own the animals at the time of transport.

For consignments of livestock where the processor organises the transportation, it is the livestock buyer's responsibility to ensure that cattle are fit for the intended transport journey. In many cases around Australia, processors are organising guidelines for their contracted agents, buyers and producers and in many cases transport personnel. Although processors do not always have control over all situations involving purchase, sale or changeover in ownership of livestock, it is good practice to provide clear messages where possible so that the same understanding of animal welfare requirements are carried out across the whole of the supply chain.

5.2 Unloading at the processing plant

Prior to livestock arrival it is important to ensure that facilities are operational and there is sufficient space for livestock due to arrive. Livestock may be held in lairage pens before, during and after transport and overnight prior to slaughter. It is normal practice to provide animals with a rest period in lairage to recover from the effects of transport, to improve meat quality, provide a period of food restriction that decreases gut fill and to allow for a continuous flow of animals to the slaughter line. It has been shown that if lairage conditions are good, increasing rest with water can reduce the incidence of high pH at slaughter, thus reducing the incidence of dark-cutting beef in cattle. In some circumstances, however, the beneficial effects of resting in lairage can be nullified by prior pre-slaughter handling, extremes of weather, and other stressful events, including pre-washing and in some commercial plants, particularly pork plants, by slaughtering animals as soon as they arrive. It has been shown in a number of studies that in general the stress effects on livestock that result in reduced meat quality are cumulative. For example individually for sheep, under-nutrition, shearing, transport and pre-slaughter washing did not show a significant effect on stress and muscle pH, however when combined, there was reported to be a marked increase in stress levels of the sheep and in muscle pH, resulting in poorer meat quality.

The key issues from an animal welfare perspective are to ensure that livestock are unloaded calmly and quietly, have shelter, water and where required, feed available and sufficient space to be able to access the water and lie down if being slaughtered the following day. As the effects of pre-slaughter stressors in livestock are cumulative and evidence suggests that meat quality defects can be reduced if lairage is managed appropriately, it is important to ensure that livestock are provided with the optimum conditions for recovery prior to slaughter.

There should be a competent person available to receive and unload the livestock. In some cases, where livestock consignments may arrive at night or after hours, arrangements need to be in place to ensure that the owner or transporter is aware of where the livestock are to be placed and there should be pens made available to unload stock. In addition, contact details should be available for the plant in the instance that an animal arriving at night may require euthanasia if the transporter is unable to carry out the procedure upon arrival (may not have equipment or competency). In general, good practice actions include the following:

PRIOR TO THE RECEIVAL OF LIVESTOCK:

- water should be available in pens
- sufficient space should be available for consignments due to arrive
- facilities should be operational and there should be no items that could cause baulking as livestock are unloaded and no protrusions in lairage pens or associated raceways.
- scheduling to be conducted with consideration of animal welfare (i.e. weather extremes, age and condition of livestock, time off feed and water)
- if the responsibility of the processor, livestock must be appropriately selected and prepared for the intended transport and time in lairage

UPON THE RECEIVAL OF LIVESTOCK:

- animals should be unloaded as soon as possible
- animals should be inspected upon unloading and any ill, weak or injured animals identified and separated and treated, or humanely destroyed.
- there should be sufficient pens and laneways available to ensure livestock have room to move and are not mixed inappropriately with other unfamiliar groups or species
- livestock should be unloaded quietly and calmly by competent stockpeople
- lairage facilities, ramps and raceways should be free from protrusions and foreign objects and lighting should be property located and diffuse to avoid dark shadows or bright spots that cause animals to baulk
- Livestock should be allowed sufficient rest prior to slaughter
- Pressure washing to be conducted with care
- Handling practices need to be carried out in a manner that minimises stress, particularly in the lead up to the restrainer

As outlined in Standard 4, regular inspections of livestock held in lairage should be carried out on a daily basis to ensure that any animals that may become weak, ill or injured are identified and the appropriate action is taken. Standard 4 provides information on the unloading and ante-mortem inspection of livestock, including the appropriate actions for treating or euthanasing weak, ill or injured livestock.

As part of the preparation for slaughter, washing of animals may also be carried out depending on the species and condition of the livestock, legislative requirements in the State/Territory and registration conditions of the livestock processing establishment. Care should be taken when manually washing livestock with high pressures hoses to avoid sensitive areas of the animal and to avoid cold stress. For feedlot animals, washing may be extensive to ensure excess dirt is removed from the animal's coat and commonly, pressure washing machinery is installed in the lead-up to lairage to complete this process. The pressure of washing facilities should be managed to ensure cleanliness of the animals without causing any distress. Hence, the inclusion of the following checklist question in the Working Manual:

Care is taken when manually pressure-washing livestock to avoid sensitive areas and cold stress.

5.4 Weather conditions and access to water

For processing plants with outside yards or paddocks for cattle and sheep, or plants that have feedlots to source their cattle, extremes of weather may impact on animal welfare. Extreme weather refers to weather that can pre-dispose livestock to cold or heat stress. Adverse weather includes low temperatures with wind and rain combined to impose a severe chill factor, the sudden onset of prolonged wet and windy conditions, and heatwave conditions of prolonged severe heat and/or humidity. Livestock during transport can be exposed to extreme weather conditions (i.e. they may be more thirsty on arrival in hot weather), as well as animals in holding pens at the plant.

Cattle can tolerate extremes of heat and cold if they are acclimatised and have adequate feed and water. Steps can be taken to minimise the effects of climatic extremes and other factors producing either cold or heat stress. Providing shelter in yards, paddocks or holding pens is a common method to reduce these effects. It can be shown from simple observation that where shelter is provided (either natural or man made), animals will seek the appropriate shelter for the prevailing conditions. Providing shade is the most common method to reduce extremes of heat and consequent heat stress. In hot grazing climates where shade is available, cattle have been observed to use it all day long and only leave the shade in the late afternoon to seek water and feed; in hot conditions most grazing is at night. If no trees are available, then cattle will camp next to water such as dams or creeks during the day and feed at night. Other methods of reducing the effects of heat stress may include providing alternative means of cooling, for example, increased water availability, or misters or sprays in the holding yards. For pigs, sprays in lairage and on some transport vehicles are used in Australia to reduce the incidence of heat stress. During transport, drivers can take measures to manage risks to welfare during extremes of weather, including parking in the shade, keeping the vehicle moving to allow airflow, driving in cooler parts of the day, and reducing stocking density. During extremes of weather, livestock held in lairage and outside paddocks or yards can be provided with water to avoid further dehydration.

Even in temperate climatic conditions, livestock that have been transported reasonable distances may succumb to dehydration, particularly bobby calves. As water is not provided during transport, livestock can only drink upon

arrival at the plant, therefore it is important to ensure water is available at all times. When livestock are dehydrated, their skin loses pliability; this can be tested by lifting a fold of skin and if the skin feels thicker, is harder to lift and does not fold back into position when released, dehydration has occurred. Dehydration can result in stickier meat that is dry and has a higher water holding capacity. The meat in some cases might be slightly darker and have a higher pH. In addition, livestock that have become dehydrated may drink to excess when they have access to water in lairage, leading to wet carcass syndrome, where the carcass has a wet, shiny appearance, and the meat has a poorer shelf life and a generally sloppy appearance. Therefore, it is important that livestock are managed to reduce any effect of dehydration, including scheduling transport at cooler times of the day, reducing stocking density, allowing livestock to recover with access to water in lairage facilities and providing shelter where possible. Particular care should be taken with younger livestock including bobby calves, to ensure that they have access to water. In some cases, calves may not have sufficiently learnt to drink from a trough, depending on their rearing conditions (i.e. whether they were trained to drink from a teat or bucket). It has been shown that more calves are likely to drink and even drink more upon arrival in lairage if water is provided via a calfeteria. It has also been shown that provision of electrolytes can assist the recovery of calves from transport. This can be one way of ensuring calves recover if transported longer distances or if slaughter has been delayed for a short period due to breakdown.

5.5 Livestock behaviour

Studies examining the behaviour of livestock in lairage have reported that animals often do not completely recover from transport even within 24 hours. Lambs exhibit increased drinking and eating behaviour during the first few hours following transport that return to normal by 14 hours in lairage, but lying behaviour remains high even after 24 hours of recovery in lairage. Lying behaviour in sheep has been shown to increase gradually until about 40% of sheep are lying down 3 hours following transport and lying behaviour increases when more space is provided in lairage. Cattle do not always rest in lairage as it has been shown that cattle require at least 2 hours in lairage before lying behaviour commences and between 3-10 hours before most of the group will lie down. Cattle from saleyards tend to take longer to settle down compared to cattle from farms.

5.5.1 CALVES

Bobby calves are a by-product of the dairy industry and are usually 4-5 days old when slaughtered. The dressed carcass is of low value, the meat having a small portion size and usually sold for ground meat for hamburger patties, the skins for leather goods and the remaining carcass components for other products, including rennet for cheese making. For bobby calves that are to be transported, it is important that they receive adequate amounts of colostrum (at least 2-4 L) in the first 12 hours after birth and fed appropriately for subsequent days. Calves need to be fed within the 6 hour period prior to the start of transport. This will assist in preventing them becoming weak through lack of feed and ensure that they are able to withstand the rigours of transport, and allowing them to be more easily moved onto and off the truck. Calves have not developed following behaviour by the time they are sent for slaughter, therefore can often be difficult to move in groups, even when well fed. This can be worse in some calves that are induced and are physiologically and behaviourally immature as a result. Stockpeople unloading calves need to be patient, as forcing calves to move quickly can often lead to calves falling and slipping or simply not responding to the handler trying to move them. Young calves are often difficult to shift and tend to stand in groups rather than move, so that dealing with them is often time consuming and frustrating for personnel involved. Studies have shown that bobby calves are less able to respond and adapt to the stress of transport than older calves, due to their immaturity. This signifies the importance of correct handling procedures, especially in situations that involve restraint, movement or re-grouping. Therefore, in the

absence of loading facilities on farm, calves should be carefully lifted and placed on the truck. At the plant, unloading procedures may also contribute to stress and bruising in calves since at higher ramp slopes many exhausted calves are reluctant to exit from the truck and fewer remain upright during unloading than older livestock.

Studies have shown that the behaviour of calves following transport can be variable, in that calves can be thirsty and seek water or hungry and seek food, and that for some calves the main priority is to lie down. In transported calves, studies examining the post-transport water intake compared with that pre-transport, found that post-transport water intake was much lower, suggesting that the calves did not drink additional water to replace the water deficit accumulated during transport. This can be detrimental, as calves receive liquid feed, therefore when fasted, they can easily succumb to dehydration. Calves have often not learned to drink from troughs by the time they are transported, so often they do not rehydrate well during lairage. Scours can worsen the level of dehydration; therefore if calves are scouring at the time of selection for sale, they should ideally not be transported. As previously discussed (5.3.1), providing water via calfeterias may improve the rehydration of calves recovering in lairage, as calves will drink more from teats due to their previous rearing experience.

Calves presented for sale must:

- be at least four days old (in their fifth day of life) and have a withered, dry navel cord;
- have been fed within 6 hours prior to transport
- be at least 23 kg in liveweight*
- be able to rise, walk and stand on their own and be bright, healthy and alert

*Fresians, being larger calves tend to more easily achieve the weight requirement than Jersey calves by the 5th day of life.

The National Vendor Declaration (NVD) for bobby calves outlines the requirements for drug residue status of each animal and animal welfare. Bobby calves must be tagged prior to sale for reasons of traceback, disease control and meat quality. The official bobby calf ear tag is required on selection for sale and calves that are not for immediate slaughter should also be tagged with an NLIS tag.

Time in lairage for bobby calves should be kept to the minimum practical. Ideally they should be the first slaughter of the day. Calves must be fed once every 24 hours, taking into account the time they were last fed.

5.5.2 PIGS

It has been shown that lairage time for pigs should be kept to a minimum, allowing enough time for a reduction in stress effects following transport. In addition, any mixing of unfamiliar pigs should be kept to a minimum, with pigs kept in smaller groups where possible. Time in lairage for pigs, as with most animals, can vary, however general practice is that pigs are slaughtered on the day of arrival following a rest period of 2-6 hours. This period of rest in lairage is believed to lead to a recovery from the stress of transport (reducing cortisol concentrations, which are a hormonal measure of stress) and consequently the production of better meat. Geverink et al. (1996) indicated that average lairage time for pigs in Dutch abattoirs varied from 1-2 hours, Belgian abattoirs averaged at 1.5 hours and Danish abattoirs, 1 hour. It has been found that holding pigs for too short a period does not allow them sufficient time to recover from the stressors of transport, confirmed by Warris et al. (1992), who found

that a period of 2-3 hours was necessary to sufficiently reduce cortisol concentrations. Current practice in many abattoirs in Australia usually involves similar rest periods, although in some instances, pigs are unloaded and immediately slaughtered. This can be good practice, particularly during hot weather, as shown by Fraqueza et al. (1996, where it was demonstrated that during temperatures above 35 C, pigs should be slaughtered within 30 minutes of arrival. In such cases, it is very important that facilities are designed for ease of animal flow from unloading to the restrainer and that pigs are handled as gently and quietly as possible. Therefore, the optimum rest period for pigs will be determined by factors relating to duration of transport and stress incurred during transport, climatic temperature, behaviour in lairage and handling practices.

The majority of fighting in unfamiliar pigs occurs during the first 30 mins of lairage and pigs have been shown to settle down after 1 hour of penning. Fraqeusa (et al (1998), found that the critical phase of aggression occurred during the first 30-40 minutes when pigs were placed in lairage and decreased to zero following this period, with occasional, sporadic encounters; these results have been supported by a number of other studies. Mixed animals will fight to determine a new dominance order and fighting gives rise to an increased incidence of skin damage and prevents resting behaviour. Pigs in particular, when mixed, will show increased fighting and agonistic behaviour, thus it is important to avoid mixing of unfamiliar groups to reduce consequent bruising and reduced meat quality. Group size can be a contributing factor as mentioned above, where group sizes that are large (40-60 individuals) have been observed to reduce resting behaviour, as animals which fight disturb other animals that are resting. It has been demonstrated that dividing pens into groups of 15 individuals can reduce aggression and promote resting behaviour, despite the fact that pigs may be from different farms. The ideal of course, would be no mixing of different or unfamiliar groups, however in practice this is not always possible.

5.6.3 SHEEP AND CATTLE

Transport is a moderate to severe stress for sheep in comparison to some other routine husbandry stresses sheep experience. When mustering and yarding sheep prior to slaughter, it is important to keep this to cooler parts of the day where possible, muzzle any working dogs, allow sheep to move at their own pace, avoiding downhill gateway smothering and not allow sheep to be kept in lairage for more than 24 hours (or time in accordance with curfews from farm – 36 hours) following transport without feed and water. Sheep are generally easy to handle if facilities are well designed and staff and dogs are competent. Sheep exhibit good following behaviour, move quickly and with little effort from the stockperson if raceways and pens are clear. Drought-affected sheep may be more difficult to move if they are energy depleted following transport. If sheep are able to drink when they arrive in lairage, their recovery is fairly good, particularly if they have sufficient space to lie down.

Water deprivation in cattle, as with other species, will cause dehydration, loss of carcass weight and other changes in meat quality. Some studies have shown that similar to other livestock, cattle may take more than 24 hours to recover adequately from transport. Cattle will drink within the first hour of being in lairage pens, particularly those that have been transported longer distances or that are from saleyards or feedlots compared to those from farms. Cattle will begin to settle in lairage within the first 3 hours, spending less time standing, walking and drinking and more time lying. Mixing of bulls in lairage tends to lead to agonistic behaviour and can be a major cause of dark-cutting beef, even when the period of mixing is only relatively short.

5.6 Stocking density and resting time in lairage

Determining the appropriate stocking density requires consideration of a number of variables, including weather conditions, access to water and feed facilities, the intended time to be spent in the holding area, the type, breed and sex of the species and the recovery required by the livestock prior to slaughter. The current Model Code of Practice for livestock at slaughtering establishments indicates that calves, pigs, sheep and lambs should be socked at around 0.6 m2 per head, depending on other factors, including time in lairage and weather conditions. The main objective is to allow for livestock to have adequate rest and recovery from transport prior to slaughter, thus access to water and preferably space to lie down is the optimal practice, unless lairage time is short term (i.e. not overnight). For cattle, specific stocking densities are provided in the Code of Practice, 1.9m2 per head, or other space requirement as determined by State or Territory legislation.

Thus, stocking density will vary in accordance with weather conditions, pen shape and access to water and lying time for recovery required. In particular, livestock should be placed in pens in accordance with species, size and class. For example, groups that should not be mixed include;

- young calves,
- females with suckling offspring
- hornless / horned cattle
- animals of significantly different size
- females in advanced pregnancy
- mature entire males.

The decisions about requirements of animals for space, rest, food and water after arrival must be made by a competent person at the establishment. For carcass quality, it is generally best to provide rest periods of at least 2 hours between arrival and slaughter if possible, with the exception of bobby calves and sucker lambs. For livestock that are stressed or that have travelled longer than 6 hours or so, longer rest periods are desirable, and for those animals that have travelled longer than 24 hours and been without feed or water or are suffering from stress or exhaustion, they should be rested for 24-96 hours if possible.

5.7 Bruising, injuries and animal handling

Bruising can be regarded as evidence of reduced welfare, most commonly associated with poor handling of livestock. Most processing plants monitor the level of bruising, particularly where this requires trimming and there is information available on the aging of bruises and resulting colours that can indicate when the bruise would have occurred. Sites of the animal for bruises vary with different facilities and handling systems; however in beef, they are commonly on the hips, hindquarters and top of the back. For lambs, the hindleg and foreleg are common sites of bruising. For pigs, bruises can be less common, but are mostly found on the hindleg region. Bruising is most likely to occur during transport. It is reported in both the literature and in practice that the animals need to be stocked reasonably in the vehicle to avoid slipping, falling and crashing into each other. Eldridge and Winfield (1988) reported that when stocking cattle at 0.9, 1.2, and 1.4m2 per head, cattle at the low density fell down during transport.

Bruising can occur during loading and unloading, particularly if livestock are rushed or they panic. Careful handling is required to move cattle from transport vehicles to avoid bruising, particularly as on most road-trains and B-double vehicles, cattle need to manoeuvre around to be able to walk down from the vehicle. Transport vehicles often need to be fitted with rubber flaps to ensure that livestock leaving the vehicle do not crash into the doors or slip between the ramp and the truck, which could cause the animal to injure itself.

In the processing plant, bruising might occur when livestock are unloaded, drafted, penned into lairage and if animals slip and fall. Gentle handling and well-constructed facilities can reduce bruising dramatically. Livestock need to be calmly and quietly moved throughout the plant, so that they do not push into each other or strike gates and fences. Another way to ensure bruising is reduced is provide rubber or foam padding around gate edges and posts, and also ensure that fences are constructed without any protrusions.

Bruises tend to be more common in livestock sold through saleyards, or livestock that have had several transport journeys to reach their destination, including a series of loading and unloading points. The increase in bruising in these instances mostly results from the increase in handling that has to occur, and thus the increased opportunities for bruising. In addition, bruising can be more common in unshorn sheep from wool-pull bruises, entire male pigs that are allowed to flight, stock in light condition or reduced body weights, cattle that mount each other, horned livestock, livestock stocked loosely on the truck and livestock that have travelled long journeys.

Bleeding an animal as promptly as possible is best practice for animal welfare, but can also reduce the severity of a bruise that may have occurred at or just prior to stunning. Bruising can lead to downgrading of meat and in some cases can be considered unfit for human consumption on hygiene grounds, particularly in poultry. In red meat species, however, the effect of bruising on subsequent meat quality and food safety attributes is less clear. Gill and Harrison (1982) showed that bruised tissue from red meat species has a low bacterial count and contrary to popular opinion, the additional blood in the tissue does not seem to affect the rate of bacterial proliferation if the meat becomes contaminated.

Other incidents that impact animal welfare and meat quality include bone damage, joint or ligament injury, injection site blemishes and fractures. The most important principle when there may be fracture or bone damage or any other serious injury is to euthanase the animal immediately or limit the animal's movement until the animal can be slaughtered. In no circumstance, should conscious animals that cannot walk or have severe injuries be taken through the normal slaughter line. Bone and joint injuries can occur in both live animals and also after stunning, when the carcass is convulsing on the slaughter line. Skin injuries can occur during mustering, loading, unloading and penning, and from contact with barbed wire, fighting, rubbing against facilities or contact with sharp objects and from injections.

5.8 General animal handling principles

MINTRAC (National Meat Industry Training Advisory Council) competencies cover aspects of animal handling at the processing plant, including the signs of stress and consequent impact on meat quality. Handling at loading, unloading and during movement to the crowd pen and restrainer can have a considerable effect on animal welfare and meat quality.

Well-designed facilities that facilitate animal movement, reduce the need for excessive handling. By eliminating items that may cause animals to baulk, such as flapping objects, visual barriers or distractions such as shadows, water puddles or other objects, animals will remain calm and move through the facilities with ease. The use of lighting, solid sides in raceways and flooring that does not contain uneven changes are all aspects of facilities that can aid animal movement, as outlined in Standard 1. Facility design, combined with an understanding of animal behaviour, will assist in reducing the amount of human intervention required to move animals through the facility.

Where handling difficulties are identified or have increased, factors that cause baulking or other facility design issues need to be re-examined and action taken to eliminate problems. There is literature on the design attributes of various systems, with focus on designs that facilitate animal movement in relation to animal behaviour; this is becoming critical as slaughter rates increase and processing establishments continue to expand. Advice on improving facility design may be sought as required from industry professionals, otherwise references on appropriate design of lairage facilities can be found at the end of this document.

In addition to the impact of facilities, stockpeople need to be familiar with the behaviours of livestock and allowing the expression of natural behaviours will assist the calm movement of the animals. For example, pigs are often exploratory and will investigate as they are moved from one surrounding to another. Cattle and sheep tend to exhibit following behaviour, thus can be easily and calmly moved in good facilities in a normal herd-like manner. Stockpeople also need to appreciate the effect of their behaviour on the livestock. Shouting, hitting, waving arms and moving too quickly can agitate or excite livestock, leading to more difficult handling.

5.9 Handling at the processing plant

Pre-slaughter handling includes unloading livestock, penning in lairage facilities and movement of the livestock through the lead-up race and chute to the restrainer for stun. The most difficult situation in pre-slaughter handling is the movement of livestock from lairage to the restrainer. Some difficulties that might arise may include:

- livestock refusing to enter the restrainer/stunning box, either because they can see people, hear noise, not see any exit, or there are shadows and changes in flooring causing them to baulk or hesitate
- livestock facing backwards (away from the sunning box) in the lead-up race; this is sometimes reduced by having one-way push through gates
- the stop-start action at the point of the restrainer and stunning box where crowding and hesitation can occur

Some processing facilities have less difficulty, particularly those with conveyor systems. These are detailed in section 6.1 of this document.

5.10 Movement from lairage to the slaughter floor

Movement to the slaughter floor is one process that can have major effects on animal welfare and meat quality. It has been demonstrated in a number of research studies that marked differences can occur between abattoirs with respect to stress levels and consequent meat quality as a result of differences in facility design and in the competence of the stockpeople handling the animals.

A long period of stress is usually associated with DFD meat (dark, firm and dry) and a short, intensive period of stress immediately prior to slaughter induces a more rapidly decreasing post mortem pH, resulting in PSE meat (pale, soft, exudative). Movement of pigs from lairage to the stunning area, in particular, lining up prior to the stun is very stressful for animals, and can result in PSE meat, and the stress levels increase with higher slaughter rates. Cockram and Corley (1991), reported a positive correlation between plasma cortisol concentration of cattle at the time of exsanguination and the time taken between moving the cattle out of the lairage pen and stunning; that is the longer the time, the greater the concentrations of this stress hormone.

5.11 The use of handling aids to move livestock

There are a number of implements available to assist in handling animals, the most important being aspects of the animal handler themselves, such as body position and movement, utilising the animal's flight zone, voice and the use of the stockperson's hands either behind or touching the animal to move it forward. Obviously some livestock are easier to move than others, therefore if other goading implements are required to move more stubborn animals, these should be used sparingly and not be the handler's primary driving aid. There are a number of goading implements used to move livestock, including flappers, rattles, pipes, boards and electric goads or dogs. Rattles and flappers are the most common for sheep, cattle and pigs and boards may be used specifically for pigs, similar to the practice on farm.

The best handling practice with respect to the use of goads is to have a 'resting' place for the goad on the wall or fence and place it there in between using it. In particular when using electric goads, if it is not in the person's hand at all times, the habitual action to use it on each animal is broken. In most establishments, the only place an electric goad would be needed is at the entrance of the restrainer/stunning box. Many well-managed plants have eliminated the need for the use of electric goads in holding pens and crowd pens. Certainly, plants that supply certain customers, particularly those in the US market are not permitted to use the goad on more than 25% of animals.

Electric goads are mainly powered by battery or controlled voltage from a mains power source. Electric goads should contain an off switch and not be constantly live. Most goads have a timed current flow that ensures it does not remain on for more than a few seconds whilst touching the animal. Battery operated prodders are preferred, unless voltage is well controlled.

Goads should not be required for pigs, calves and sheep. If they have to be used for pigs, they should be set at a much lower voltage to assist in reducing the incidence of PSE as a result of stress prior to slaughter.

5.12 Factors affecting the ease of handling of livestock

In addition to facilities and the handling practices exhibited by stockpeople, there are a number of other influences that can affect how easily livestock are to handle and move through the plant. The behaviour of individual animals or groups of animals will vary depending on breed, sex, temperament, age and experience in terms of rearing and previous handling. The behaviour of livestock in lairage may be highly influenced by previous experience and management at the farm. Calves and pigs are generally handled much more often during rearing, and become more familiar with humans, making them less fearful and easier to handle than some groups of cattle that may have only been managed extensively with little human contact. It has been shown that regular handling on farm and environmental variation may affect the magnitude of the animal's response to pre-slaughter handling. Studies examining pigs that were regularly patted or housed in pens provided with toys showed that

these pigs were less reluctant to move through a chute. Pigs that are easier to move are less likely to be subjected to rough handling, providing for improved welfare and meat quality, in addition to reduced workload for lairage personnel moving pigs to the restrainer.

It has been observed that some farms produce pigs that are consistently easy to handle while other farms produce pigs that are more difficult. Pigs that are difficult to handle tend to exhibit higher amounts of skin blemishes, darker muscle and higher ultimate pH at slaughter, all suggesting greater susceptibility to stress during loading, unloading and pre-slaughter lairage as a result of reacting more adversely to handling. Improvements in ease of movement and in post-mortem measures of stress have been shown by moving pigs between pens in groups on the farm for the month prior to slaughter. By moving pigs or providing them with exercise on the farm, pigs were interacting with stockpeople regularly and were less stressed, and because of their willingness to move were less likely to require increased handling during transport and lairage.

If pigs are rushed, they will become stressed and then often form a tight group. They may become unpredictable, trying to return to where they came from, or push each other thereby stressing other pigs. Pigs will not always move as a group; if there is a gap or another pathway, a pig will invariably find it and breakaway from the group. When pigs are moved in large groups, often the ones at the front will turn around and handlers commonly resort to exerting pressure on the pigs at the back in order to encourage the pigs at the front to move. Therefore pigs are often best handled in small groups and the level of noise (vocalisations) can often be a good indicator of the efficiency of the handling system.

Cattle have greater herding and following behaviour and in addition, the use of the flight zone is useful in encouraging the animal to move forwards. Cattle may struggle on rough surfaces, therefore handlers should be patient and allow the animals to move at their own pace. The ease of handling of livestock is affected by age, for example, bobby calves. Calves generally arrive energy-depleted, weary and reluctant to move down ramps into lairage. Young calves, lack the natural 'following behaviour' developed by cattle and are often difficult to move, tending to stand in groups rather than follow each other. Personnel or transporters handling calves may become frustrated, as moving exhausted calves can be time consuming, therefore it is important that handlers remain calm and patient to encourage calves to move.

5.13 Effects of stress on meat quality

Stress related conditions can result in the following meat quality defects as a result of post-mortem muscle metabolism:

- pale, soft, exudative meat (PSE)
- dark-cutting beef
- dark, firm, dry pork (DFD)
- tough meat, abnormal meat colour and excessive drip

When the animal is slaughtered, the muscles continue to metabolise energy, contract and produce heat. Some energy is utilised to produce convulsive, twitching and rigor contractions. The processes that cause the normal metabolic activities to cease include depletion of oxygen, depletion of energy substrate and inhibition of enzymes. When the animal is stuck, oxygen is depleted, leaving only the oxygen that remains in the tissues at

the time of sticking, until these reserves are used and consequently the depletion of energy and inhibition of enzymes occurs. If the animal is stressed prior to slaughter, the energy reserves are likely to be less, so depletion occurs more quickly after the animal is slaughtered and rigor sets in earlier. An important feature of muscle that is depleted of energy from stressed animals is that is has insufficient glycogen substrates to allow the muscle to acidify properly when the animal is slaughtered. Failure in this acidification process is measured from the pH of the meat 24 hours after slaughter and a high pH (greater than 6.0) indicates that the animal was stressed prior to slaughter and that the meat is likely to be dark-cutting (i.e. dark-cutting beef, or DFD pork). Dark cutting meat or DFD pork is darker in colour and more prone to microbial spoilage.

Dark-cutting beef is characterised by a darker colour, similar to that seen when the beef is cut and the surface allowed to dry out over a long period. Dark-cutting beef is usually rejected by the retailer, so parts of the carcass that have this condition are more commonly discounted to the manufacturing trade or sold at reduced price to the catering trade.

Some meat manufacturers (those producing pies, burgers, etc.) will accept dark-cutting beef provided it has been stored properly, as the higher water holding capacity allows for smaller losses of weight as drip from fresh and frozen meat and lower weight loss during cooking. Dark-cutting beef can be more prone to rapid bacterial spoilage, due to the high pH conditions, that allow bacteria to grow faster, thus shelf life can also be short. Bulls are more prone to dark-cutting beef than steers, heifers or cows and the major causes include, transport, stress from handling, mixing of unfamiliar animals, time in lairage, excessive exercise or aggressive behaviour and fasting.

For PSE meat, if the rate of post-mortem metabolism is accelerated due to stress prior to slaughter having depleted the energy reserves, then the pH 45 minutes after slaughter is likely to be lower than normal (less than 6.0) and the meat likely to be PSE meat. Commercial processing plants often utilise pH measures at 45 minutes post-slaughter as a means to classify pig carcasses for PSE. PSE can also be detected form the rapid onset of rigor, the amount of drip being released from the cut surface and is particularly common in stress-susceptible (SS) breeds of pigs. These pigs have a highly reactive muscle metabolism and are highly prone to becoming stressed. Thus, pigs often benefit from resting prior to slaughter, resulting in a higher initial pH, allowing the carcass to cool before the meat pH falls to a level where the risk of PSE is increased. Alternatively, there is a commercial service for producers to identify SS pigs and enable the gene to be bred out of the herd.

STANDARD SIX

HUMANE SLAUGHTER PROCEDURES

STANDARD 6. HUMANE SLAUGHTER PROCEDURES

Background information and rationale

Standard 6, the final of the animal welfare standards for the processing industry is based on appropriate procedures for humane slaughter, including restraint, stunning and slaughter of livestock. The overall outcome is to ensure that restraint, stunning and slaughter procedures are carried out in a manner that minimises stress and that procedures are efficient and effective. The information provided in this section provides background on the following performance indicators:

6.1 Livestock are restrained effectively with minimal stress and for minimal duration.

6.2 Livestock are stunned with appropriate and effective equipment, suitable for the species and class.

6.3 Procedures are in place to monitor that the animal is effectively stunned and confirmed insensible; corrective action is immediately taken if required.

6.4 Hoisting does not commence until the animal is confirmed insensible.

6.5 Livestock are effectively stuck as quickly as possible after stunning.

6.6 If reversible stunning is used, sticking is applied in a manner that ensures animals do not regain sensibility.

6.7 No animals are stuck without being effectively stunned unless approval is obtained from a controlling authority.

6.8 Dressing does not commence until the animal is irreversibly insensible.

6.1 Restraint

Restraint devices should be well constructed to ensure they do not cause livestock stress prior to stunning. Well-designed restrainers move slowly and exert optimum pressure to ensure the animal is restrained without shock or pain. The pressure required to hold the animal in a well designed restrainer is usually minimal if the restrainer supports the animal well and of a suitable size for the animals being held. If livestock vocalise, this can be an indication that the restraining device is causing pain or distress. The restraining device and stunning box should be designed to ensure that the animal's vision is blocked so that people or other objects cannot be seen and that there is adequate lighting to encourage livestock to enter. Conveyors can agitate livestock if they can see out from under the hold down cover before their back feet are off the entrance ramp.

Restraint devices have improved in design over the last 10 years and research is continuing to adapt restrainers to more effectively suit the type of livestock to be restrained. For example, V-conveyor restrainers for pigs and sheep can be effective, as the animal's legs protrude through the space at the bottom and the animal's body is supported at the sides, the gentle pressure allowing it to relax. The other type of conveyor system is the centre-track system, used in beef plants. In this system, the cattle ride astride a moving conveyor, allowing the stunner to stand close to the animal; this can be a good system for plants slaughtering more than 100 head per hour. Conveyors need to be designed and positioned to allow the animal to walk in with their legs in a natural position. Similarly, cattle restrainers, including the double rail centre track restrainers, are being adapted so that the conveyors fit the animal better, with curving to fit the brisket of the animal.

Restraint devices should hold the animal in an upright position and have controls that enable the operator to control the amount of pressure that is applied. This is particularly important when livestock of slightly different sizes are being stunned, unless the stunning box and restrainer are adjustable. Adjustable stunning boxes are preferred for operations that are stunning a variety of different sized livestock. In a conventional stunning box, the stunning accuracy can be greatly improved by the use of a yoke to hold the head. Yokes and automatic head restraint systems were developed in Australia and reduce the effort required to force the animal's head into the restraint. The yoke or automatic head restraint needs to be designed so that the animal will enter it willingly and it must be stunned immediately after the head is caught. Rear pusher gates can work well in this instance by eliminating the need for electric goads.

IN SUMMARY THERE ARE FOUR MAJOR PRINCIPLES WHEN EVALUATING A RESTRAINER:

- block vision. The animal must see a lighted place to move to, but solid panels or curtains should be used to prevent the animal seeing the slaughter floor or people
- slow, steady movement. Restrainer components that press against the animal should move slowly, not with any jerky, sharp movements
- optimum pressure. The device must restrain the animal tightly enough to be held for stun but without excessive pressure that would cause discomfort
- upright position. The animal should be held in a comfortable, upright position, without slipping or causing the animal to lose balance

IN PRACTICE:

- animals should enter the restrainer easily
- if they baulk, facility design or other distractions should be removed or repaired and lighting checked for effectiveness
- animals should be effectively restrained, without slipping, falling or losing balance
- restraint should enable effective placement of the stunning apparatus, and access by the stun operator
- the animal needs to be stunned as soon as the head is restrained.
- if the animal is vocalising, the restrainer should be examined as this can be an indication of discomfort/distress

6.2 Restraint and ritual slaughter

Ritual slaughter in Australia requires the use of a humane restraint device. When ritual slaughter is evaluated from a welfare point of view, the animal's reactions to restraint must be separated from the reaction to throat cutting without stun. The use of poor restraining equipment is probably more distressful than the throat (Grandin, (1994; Grandin and Regenstein, 1994. An innovation in ritual slaughter restraint involved the development of the ASPCA (American Society for the Protection of Cruelty to Animals) pen. The pen consists of a narrow stall with solid walls, an opening in front of the animal's head and a lift under the belly of the animal, preventing it from collapsing following the throat cut. Provided the animal is supported (not lifted off the floor) and the chin lift

(head holding device) does not cause pressure on the neck then the restrainer causes less distress than other designs for this type of slaughter. There are similar head holding devices available for use on V-restrainers and double-rail restrainers for cattle and calves.

6.3 Stunning

6.3.1 STUNNING EQUIPMENT FOR LIVESTOCK SPECIES

Competent operators, together with the use of stunning equipment that is appropriate to the species and fully operational will ensure that the stunning process is effective. In most countries, with the exception of markets that require ritual slaughter, livestock must be stunned before they are slaughtered for human consumption. This is done using five main methods, electrical stunning, captive bolts, percussion bolts, carbon dioxide or a free bullet. Stunning is performed to 1) induce instant loss of consciousness to minimise the chance of the animal feeling pain during and after sticking (exsanguination), 2) minimise the distress during sticking, 3) immobilise the animal to allow sticking to be performed easily and accurately, and 4) prevent the convulsions which occur during bleeding in unstunned animals.

Once the animal has been stunned it must be slaughtered and this can be achieved by sticking to induce cardiac arrest or in the cases of other species such as poultry, decapitation or neck-cutting (cutting of the major arteries and veins in the neck). The act of humane destruction of an animal at the processing plant usually requires firstly, restraint of the animal to prevent injury to employees and to enable the stunning device to be accurately placed on the head and applied effectively. Secondly, the animal is stunned to cause instant loss of consciousness and finally, the animal is 'stuck' (severing of major blood vessels) leading to exsanguination that results in loss of blood supply to the brain and irreversible brain death.

Operators responsible for stunning and stun equipment must ensure that:

- the animal is adequately restrained, then stunned as soon as possible
- stunning equipment is checked prior to each shift, regularly cleaned and maintained and stored appropriately
- the stunning equipment is operated properly and in accordance with the manufacturer's instructions
- the stunning equipment is applied correctly and that the signs of effective stun are recognised
- back-up stunning equipment is available for use as required (i.e. ineffective first stun)

When examining signs of an effective stun, in the case of mechanical and electrical stunning, the animal collapses immediately and should then be checked by another operator for signs of insensibility. An optimal process is one that leads to a rapid loss of consciousness and a level of unconsciousness that ensures the animal never regains consciousness before death intervenes via sticking (bleed out). Checking for corneal reflex involves touching the cornea and watching for an eyelid blink and a persistent negative response from the animal indicates a state of brain dysfunction and unconsciousness. Normal rhythmic breathing indicates the brain and spinal cord nerves are still functioning. Jaw tension is also used in combination with the above indicators, as a completely relaxed jaw can be a good indicator of brain dysfunction and unconsciousness. Signs of an effective stun for mechanical stunning, electrical stunning and carbon dioxide stunning are detailed below in sections (6.4.2, 6.5.3, 6.6.2) for the different types of stunning practice.

If all of the signs of an effective stun, including the absence of a corneal reflex are present immediately after the stun and the corneal reflex is still absent just before sticking, then it is reasonable to suppose that the stunning-sticking procedure is humane.

Furthermore, to ensure humane slaughter the duration of insensibility provided by the stunning method must outlast the period from stunning to sticking. Several studies have examined the interval between sticking and brain failure and it has been shown to vary considerably between individual animals. For cattle and calves in particular, the variation in time between sticking and brain failure may be due to an additional blood supply route to the animal's brain that is collateral to carotid arteries and because the carotids themselves are prone to occlusion when they are severed. For the method to be humane it is essential for both carotid arteries to be cut.

6.4 Mechanical stunning (captive bolt stunning)

A common instrument used to stun cattle including bobby calves is the captive bolt. A penetrating captive bolt is fired from a gun powered by either compressed air (prenumatically fired guns) or a blank cartridge. Cattle are stunned by the energy that the bolt imparts to the head and the main factors in determining the energy delivered by the bolt are its velocity and its diameter. The penetration of the captive bolt does not cause unconsciousness on its own, it is the energy that is delivered to the animal's head that is all important. The captive bolt does not immediately kill the animal at the point of stun, the heart may carry on beating for a short time, although it will stop if the animal was correctly stunned and breathing was arrested. Thus, there are differences in opinion as to whether the stun consistently produces permanent insensibility. Work completed by Blackmore (1988) established that that insensibility is immediate when a captive bolt pistol stuns animals in the correct position in the frontal region with a projectile of sufficient velocity and remains to be permanent. Other findings suggested that the captive bolt pistol produces rapid unconsciousness, however it is good practice to follow the procedure by further actions to ensure that the animal is rendered permanently unconscious.

Insufficient air pressure in prenumatically fired guns, cartridges that are under-powered in proportion to the size of the animal and poor maintenance of the gun all contribute to reduced velocity and inaccurate stunning. Research has shown that one of the most common causes of low efficiency scores for the use of captive bolt stunning was poor maintenance of the stunning equipment. Compressed air generators in prenumatically fired guns must be able to deliver the required pressure for an effective stun and the required air volume to keep up with processing (ideally the air generators should be able to run at least at 80% of their capacity during normal processing). Pressure gauges should be installed near the stunning box in the field of vision of the stun operator to monitor during processing. Pneumatic captive bolt guns should be operated at the pressure levels specified by the manufacturer. Another cause of failure to render animals unconscious with a single shot is poor ergonomic design of bulky prenumatic stunners. This can be improved with a handle extension on the stunner to aid positioning, and hanging the prenumatic stunner on an angle to aid the stunning operator to more easily hold the apparatus and access the appropriate stunning position on the animal.

Captive bolt guns must be cleaned and serviced, following manufacturer's instructions. Each facility operating with captive bolt stunners should actively follow a system for the maintenance of the captive bolt in order to maintain the maximum firing power and accuracy required to induce instantaneous insensibility. For guns powered by cartridges, the size of the expansion chamber for the exploding gases is critical in determining the velocity of the bolt. Cartridge driven captive bolt guns should be operated with the appropriate loads for the class of livestock to be stunned. If the gun is corroded or there is a build-up of carbon, the bolt will not seat back properly and the expansion chamber will be enlarged, consequently reducing the power of the gun.

Equipment needs to be maintained to manufacturer's specifications and checked before start of processing. It should be stored appropriately and bolt velocity checks should be carried out at regular intervals. Charges for cartridge driven captive bolt guns should be appropriately stored, keeping them dry, secure and separated into categories of strength and marked accordingly.

Research and practical experience have shown that the shooting position on the animals head is important in achieving an effective stun. The captive bolt should be aimed on the skull in a position to penetrate the cortex and mid-brain of the animal. The optimum position for cattle is the intersection of two imaginary lines drawn from the rear margin of the eyes to the opposite horn buds. Ideally the shot should be at the crossover point between the two imaginary lines drawn between the one of the eyes and the base of the horn on the opposite side of the head. This is normally called the 'frontal position' and the shot needs to be close to the intersection of the two lines in order to avoid mis-stunning (possible with any shot placed more than 2 cm from this point). Similarly, with sheep and pigs, the optimum shooting position is just above the eyes and directing the shot down the line of the spinal cord, whereas for horned sheep or goats, the optimum shooting position is behind the poll. The occurrence of a good stun are marginally less with a shot at the poll position rather than the frontal position, therefore if the poll position is to be used, it is essential that the bolt is directed forwards towards the brain and not downwards to the spinal cord.

To effectively shoot via the frontal position, the person responsible for stunning the animal must be able to stand in a position alongside or in front of the animals head that allows ease of access when the animal is in the head restrainer. Thus, the design of the stunning box and access of the people responsible for stunning are critical in achieving effective stunning. Restrainers, discussed in section 6.1, greatly assist in performing accurate stunning with captive bolt guns, however the animal must be stunned as soon as the head is restrained. The head of the animal should be restrained in such a way that it allows the operator easy access to a relatively immobile target, therefore ensuring that gun placement is accurate and that the first shot effectiveness is high; if this rate drops below 95% corrective action should be taken to investigate gun positioning or restraint facilities.

In summary, the following actions are good practice to ensure an effective stun:

- for cartridge powered and compressed air guns, the bolt velocity and length of bolt should be appropriate for the species and type of animal and maintained and stored in accordance with manufacturer's instructions
- captive bolt guns should be regularly cleaned and maintained in optimal working condition
- back-up captive bolt guns should be available in the event of an ineffective shot
- animals should be effectively restrained and the operator should have easy access to ensure the shot can be correctly positioned for an effective stun
- good operators do not need to 'chase' the shot; they position the gun with one aim to get a good, effective shot, placing the stunner squarely on the animal's head
- the operator should fire the gun in the correct position (i.e. frontal or poll position for animals without or with horns, respectively)
- animals should be monitored following stun (i.e. upon release from the restrainer) to ensure the signs of an effective stun are observed
- shackling, hoisting and sticking should occur as soon as possible

6.4.1 NON-PENETRATING CAPTIVE BOLT STUNNING (MUSHROOM HEADED GUNS)

It is important to use the recommended cartridge size for the size of the animal to be stunned, due to the need for a sufficient velocity of the percussion bolt. Only the frontal position should be used with these guns and due to the possibility of recovery of consciousness following a percussion stun, it is desirable that the stun-to-stick interval be as short as possible, ideally, less than 30 seconds.

6.4.2 SIGNS OF EFFECTIVE STUN (CAPTIVE BOLT GUNS)

When the animal is properly stunned it collapses to the floor with its hind legs flexed into the body. This is the 'tonic phase', where forelegs and hindlegs are immediately flexed and the muscles of the body go into a tonic spasm. Stunning is not effective with captive bolt guns if the animal's body is relaxed, if the animal makes kicking or paddling movements immediately after stunning, or if the animal shows signs of trying to stand up. Some kicking may occur after the initial muscle contraction phase and can occur after the animal is released from the restrainer prior to shackling; however this is not a welfare issue, provided that the animal has gone through the contraction (tonic) phase. As kicking can occur even when a stun is effective (i.e. brain function of the animal is depressed), this can be a safety hazard for slaughter men. Shackling and hoisting the animal as soon as possible after stunning, while the animal is in flexion (in the tonic phase), is the preventative measure to ensure worker safety.

The animal should not show regular rhythmic breathing movements after it has been stunned. This is best observed by looking at the animal's flank and if regular breathing is observed, the animal should be re-shot. Personnel need to be able to distinguish between normal rhythmic breathing and gagging or erratic inspiratory gasps. Touching the eyes or eyelashes and observing no response is a sign of an effective stun and the eye should be looking outwards and not be rolled into the head. The tongue should hang limp out of the mouth due to a relaxing of the jaw muscles following stun.

In summary, the following signs should be observed:

- the animal collapses immediately and does not attempt to stand up
- the body and muscles of the animal become tonic (rigid) immediately after the shot
- normal rhythmic breathing stops
- the eyelid is open with the eyeball facing straight ahead and is not rotated
- the corneal reflex is absent
- the tongue should hang limply out of the mouth

6.5 Electrical stunning

In general, during electrical stunning the device should be applied to the animal so that it spans the brain. The application of electrical currents which bypass the brain is unacceptable unless the animal has been stunned. If, in addition, it is intended to cause cardiac arrest (known as head to back stunning) the electrodes should either span the brain and immediately thereafter the heart (on the condition that it has been ascertained that the animal is adequately stunned), or span brain and heart simultaneously. Electrical stunning equipment should not be applied to animals as a means of guidance, movement, restraint or immobilisation, and shall not deliver any

shock to the animal before the actual stunning. Appropriate measures, such as removing excess wool or wetting the skin at the points of contact can minimise the impedance of the skin and facilitate effective stunning. Wetting the application sites on the animal before the electrode is applied and wetting the electrodes will reduce resistance, improve electrical contact with the animal and reduce the build-up of carbon on the electrodes. In addition, regular monitoring of amperage and cleaning of electrodes is important; electrodes should be cleaned at least once per day.

6.5.1 HEAD ONLY (REVERSIBLE) STUNNING

The following table shows the minimum current levels and stun duration necessary to elicit an epileptic fit and cause reversible unconsciousness (head only stun).

Species	**Minimum current levels** (amps)	**Minimum stun duration*** (seconds)
Cattle	1.5	2
Calves	1.0	2
Pigs	1.25	1
Sheep and Goats	1.0	1
Lambs	0.7	1

*applied for 3 seconds

These values were obtained using scissor-type tongs applied for 3 seconds and are the minimum recommended values for use in commercial abattoirs. These currents will only stun the animal, therefore prompt sticking is required within a maximum of 30 seconds, to ensure that the animal does not regain consciousness. Research shows that pigs will start returning to sensibility after 30 seconds when stunned by the head only method. Sheep may return earlier, thus sticking should occur within 20 seconds when stunning head only. Practically, the advantage in ensuring that stun to stick intervals are as short as possible, is that the animal's body will be rigid (i.e. the tonic phase) and can be stuck before it might kick.

Common causes of a return to sensibility after electrical stun (head only) include wrong positioning of the electrodes, current that is too low and poor electrode contact, and poor bleed out. Other factors that might contribute include dirty electrodes, insufficient wetness, electrode contact areas that are too small, animal dehydration or dirty animals and long hair or wool. Interrupted contact during a stun might also cause ineffective stunning and too long an interval between stun to bleed if too long can also result in return to sensibility.

6.5.2 HEAD TO BACK (CARDIAC ARREST) STUNNING

Head to back stunning is a two stage application of electric current, comprising of an application to the head by scissor-type tongs, then an application of current across the chest in a position that spans the heart. The front electrodes should be applied in line with the rear margin of the eyes and the rear applied on the back of the animal at the last two ribs. If the distance between the electrodes is too short, then there is a risk that the heart will not be spanned and a cardiac arrest will not be induced at stunning. When the method is correctly applied it will stop the animal's heart and from a welfare perspective sticking is less urgent, although it should still be promptly completed to achieve good bleed out. Head to leg and head to brisket arrangements can also achieve a cardiac arrest stun. Both the electrodes and the application site needs to be wetted to ensure good electrical contact, particularly for sheep, to avoid skin burns.

Cardiac arrest stunning causes death at the time of the stun, thus there is little chance that the animal could ever regain consciousness, except for other reasons such as the stunning equipment was either ineffective due to inadequate maintenance or the stun position was incorrect. There are other commercial advantages to stopping the heart at stun, including a reduction in blood splash and bruises that may have been inflicted near to the time of stunning. In addition, the carcass will show less kicking and will be able to be handled more safely. Recommended currents are 1.0A for lambs and for 1.25 A for pigs applied for 3 seconds to produce epileptical brain activity and induce a cardiac arrest.

When stunning electrodes are applied, the animal must immediately become rigid. If it escapes, or initial contact is ineffective, the animal will struggle causing further difficulty with placement. If this occurs in more than 1% of animals, either the position of the animal during stun needs to be improved so that the stunner operator can place the electrodes more accurately, or the equipment needs to be improved to overcome resistance from either the animal (e.g. dirty or long wool) or the electrodes which may need cleaning and/or the amperage checked.

Correct placement of the electrodes is critical in order to achieve an effective stun. If head only stunning is used, tongs need to be placed to ensure that the current passes through the brain; this is achieved by placement on the sides of the head or on the top or bottom of the head. For cardiac arrest stunning of pigs and sheep with a single current, one electrode is placed on the body and another on the forehead, side of the head, top of the head or behind the ear (not on the neck as this will bypass the brain). Electrodes must be fully energised only when in position, otherwise the animal is likely to vocalise. If vocalisations are occurring in more than 1% of animals, investigation into stunning practice needs to occur.

Studies suggest that the placement of electrodes is a critical factor in ensuring that the stun is humane. A successful stun is determined by current that passes through the brain; if electrodes are positioned caudal to the brain this may not always occur. The difficulty in practice, is that signs of a correct stun may appear to be present, such as animal paralysis, without the epileptical fit, when incorrect placement of tongs occurs. Acceptable stunning must involve electrode placement that ensures current flow through the brain, including an epileptiform state, detailed below.

Head to body stunning with the electrodes positioned 3 cm rostral or 3 or 6.5 cm caudal to the ear midline elicits an epileptiform-like state of brain wave activity. Using head electrodes, positioning at 3 cm and 6.5 cm caudal to the ear midline, an epileptiform-like state without cardiac fibrillation (head only stunning) is produced. In summary, the closer the electrodes are to the brain the more effective is the stun.

All establishments will have methods they prefer to manage electrical stunning. For example, some may find it easier to apply the electrodes without the need to support their weight, therefore application will be easier diagonally or downwards, rather than horizontally on the animal. Once electrodes are positioned it is often easier to apply pressure if the electrodes are reasonably heavy and head to back electrodes can be applied with greater pressure if they are held in both hands.

In summary, the following actions are good practice to ensure an effective stun:

– electrodes should be designed, constructed, maintained and regularly cleaned to ensure that the flow of current is optimal and in accordance with manufacturer's specification

- regular checks of electrical continuity and insulation should be carried out to ensure current flow to the electrodes is adequate and there is no current leakage
- electrical stunning equipment should be tested prior to application on animals using appropriate resistors or dummy loads to ensure the power output is adequate to stun animals
- electrodes should be cleaned between animals (as required) and after use to enable optimum electrical current flow to be maintained
- the equipment should, where possible, incorporate a device that monitors and displays stunning current delivered to the animals. There should be a visual indicator that operates during the stun and that is visible in the bleeding area
- the stunning equipment should be fitted with a trigger to manually initiate the stun while the current flow should be terminated automatically
- ideally the stun should be electronically monitored for the appropriate current level and stun duration and any fall below minimum levels should be indicated as a stun failure
- the animal should be effectively restrained and the operator should have access to ensure accurate placement of the electrodes
- a stunning current should be applied with one electrode on the back, above or behind the heart, and the front electrode forward of the eyes, with current applied for an minimum of 3 seconds
- the stunning equipment should be provided with adequate power to continuously achieve the minimum current levels recommended for stunning as indicated in the table below

Species	**Minimum current levels** (amps)
Cattle	1.5
Calves	1.0
Pigs	1.25
Sheep and Goats	1.0
Lambs	0.7

In all cases, the correct current level should be attained within one second of the initiation of stun and be applied for 3 seconds.

6.5.3 SIGNS OF AN EFFECTIVE STUN (ELECTRICAL STUNNING)

There are two ways to determine whether stunning practice is effective. The first is examining the animal response, which is detailed below. The second equally important way is to test and monitor the efficiency of the stunning equipment. To measure the current that an animal receives, an ammeter or current sensing circuit inserted in series with the stunning box at the time of stunning can be used. There are two ways to do this 1) if stunning equipment delivers a current at constant voltage, the current can be measured across a dummy load of between 100-400 ohm resistance. The measured current needs to be greater than the figures indicated in the table above. If the stunning equipment operates as a constant current or current-limited system, the current can

be measured in series with a standard resistance of between 100-400 ohm. The resistor needs to be capable of tolerating the stunning current without burning out and the circuit should be switched off when the resistor is being connected to the stunning electrodes.

Adequate electrical parameters for cardiac arrest stunning cannot be determined by clinical signs, as cardiac arrest masks the clinical signs of a seizure. At stun, the animal should collapse and become rigid in the tonic phase, with legs flexed immediately after the start of the current flow. Overall rigidity generally lasts for 10-20 seconds and it is best to stick the animal when in this phase, before any kicking occurs. If the animal shows any sign of kicking or paddling movements immediately the current is stopped, then the animal has not been effectively stunned.

Once the current is stopped, signs of the clonic stage of the epileptic fit develop where kicking and paddling movements occur, normally lasting for between 15 and 45 seconds. The presence of the tonic, followed by the clonic stage indicate that the stun has been successful. The clonic phase is normally less pronounced following head to back stunning than with head only stunning. Following these two phases, a quiet phase sets in, where the animal is still before the first signs of recovery will appear, such as breathing. At the establishment, the animal's flanks should be observed for normal or rapid rhythmic breathing movements, as opposed to gagging movements that are an indication of dying and are of a lower in frequency. Eye reflexes or movements cannot be used at this stage to assess the effectiveness of the stun.

6.6. Controlled atmosphere stunning

Carbon dioxide stunning is becoming widely used for pigs (and sometimes for poultry and sheep), where the system involves either a chamber or conveyor that is compartmentalised. Once the pigs are in the enclosed compartment, it is conveyed down into the stunner containing the CO_2. Machinery and equipment for CO_2 stunning is expensive and require specific structure of holding pens and chutes. CO_2 is supplied to the chamber by either cylinders of compressed gas or dry ice. Maintenance costs for CO_2 chambers are also high and require meters to be checked at least daily. CO_2 stunning has been criticised on welfare grounds as, in humans, it leads to a sense of breathlessness and is an unpleasant gas to inhale due to its pungency

The evidence for CO_2 being aversive in pigs is unresolved. While pigs refused to enter an atmosphere of 90% CO_2 for a food reward after a 24 hour fast, other research indicates that the animal is unconscious before this concentration of CO_2 is reached. Following exposure to 70% CO_2 for 15-20s, pigs will exhibit an excitatory phase with movements resembling escape behaviour and this is considered unacceptable by some. However, in practice although there may be some minor excitation by the animals upon entering the chamber, pigs generally do not vocalise, struggle or attempt to escape when they first contact the gas; if these behaviours occur this may indicate a serious problem and the system should be examined. However, it is normal for some convulsions after the pigs collapse. At higher concentrations, the excitatory phase may be absent due to induction of unconsciousness, however it is still possible that there is a slight window of time between unconsciousness and insensibility. It has been shown that pigs lose consciousness at concentrations of 90% and that the CO_2 chamber system itself may be less aversive than other systems, such as V-restrainers. Stressed pigs react more violently to being restrained, thus some of the aversiveness of stunning systems for pigs will depend on the handling and design at the processing plant. In practice, depending on the design of the system, pigs can often be very difficult to place inside the chamber of the CO_2 stunner. One benefit of CO_2 stunners is that pigs do not have to line up in single file; this takes advantage of their natural behaviour and assists the smooth flow of animals.

The concentration of CO_2 for stunning should preferably be 90% by volume but no less than 80%. After entering the stunning chamber, the animals are to be conveyed to the point of maximum concentration of the gas and be kept until they are dead or brought into a state of insensibility which lasts until death due to bleeding and cardiac arrest. Ideally, pigs should be exposed to this concentration of CO_2 for 3 minutes. The chamber in which animals are exposed to CO_2 and the equipment used for conveying them through it needs to be designed, constructed and maintained in such a way as to avoid injury or unnecessary stress to the animals.

The animal density within the chamber should be such to avoid stacking animals on top of each other. The conveyor and the chamber need to be adequately lit to allow the animals to see their surroundings and, where possible, each other. The chamber needs to be equipped to continuously measure and display data at the point of stunning the CO_2 concentration and the time of exposure, and give a clearly visible and audible warning if the concentration of CO_2 falls below the required level.

In summary, the following actions are good practice:

- the CO_2 chamber and the equipment used for conveying them need to be designed, constructed and maintained in such a way as to avoid injury or unnecessary stress to the animals
- the conveyor and the chamber should be adequately lit to allow the animals to see their surroundings and if possible, each other
- there must be alternative back-up stunning equipment for emergencies
- the chamber should be equipped to continuously measure and display the CO_2 concentration and the time of exposure. The chamber should also give a clearly visible and audible warning if the concentration of CO_2 falls below the required concentration and action must be taken immediately to fix the problem
- the design of the stunning operation must ensure that animals are loaded into the carriage and lowered in a manner that achieves an effective stun

6.6.1 INERT GAS MIXTURES FOR STUNNING PIGS

As inhalation of high concentration of carbon dioxide may be aversive the use of other gas mixtures are currently being examined. These mixtures include 2% by volume of oxygen in argon, nitrogen or other inert gases, and 30% by volume of carbon dioxide and 2% by volume of oxygen in mixtures with argon, nitrogen or other inert gases.

6.6.2 SIGNS OF AN EFFECTIVE STUN (CONTROLLED ATMOSPHERE STUNNING)

The efficiency of CO_2 and other gases is determined by scoring or observing insensibility. This is done once the animals leave the chamber, however similarly to electrical stunning, the operation of the chamber can also be monitored to ensure stunning is effective. Elevators in the chamber should not be overloaded, in other words there should be sufficient space for animals to stand or lie without being on top of each other.

When pigs are stunned with CO_2 to induce unconsciousness, some animals may exhibit slow limb movement or gasping, however there should be no spontaneous eye blinking, righting reflex or a response to stimulus applied to the nose (i.e. nose pinch). The legs, in a successfully stunned pig, may kick, but the head and neck should be floppy within 20 seconds. The tongue should hang out of the mouth and be limp.

6.7 Effective bleeding

Sticking is carried out to cause massive blood loss and death and is ideally carried out via a thoracic (chest) stick of the carotid arteries. However, if the stunning method causes cardiac arrest, severing all of these vessels is not necessary from the perspective of animal welfare. If all signs of an effective stun, including absence of the corneal reflex are present just prior to sticking, it is reasonable to suggest that the stun-stick process is within appropriate parameters and essentially humane. Checking the effectiveness of the stick itself is best done by observing the animals on the bleed rail and inspecting the sticking wound in animals showing any activity that could indicate sustained brain function. If the sticking is carried out correctly, there should be no signs of sensibility in animals on the bleed rail. Regular checks should be done to ensure animals do not regain consciousness after they have been stunned. If there are signs of consciousness the animal in question should be immediately re-stunned. After incision of the blood vessels, no scalding carcass treatment or dressing procedures should be performed on the animals until all brain-stem reflexes have ceased.

6.7.1 FOR REVERSIBLE STUN

After a reversible stun all animals should be bled by either cutting both carotid arteries or cutting the vessels from which they arise (e.g. thoracic stick).

After the head-only electrical stunning of bovines (all ages) it is necessary to follow up a neck cut with a thoracic stick because the blood loss from the neck cut alone is not sufficient to ensure the animal does not regain consciousness.

The maximum stun to stick intervals should not exceed the intervals in the following table:

Stunning method	**Species**	**Maximum delay for bleeding to be started** (seconds)
Head-only electrical stun	Calves	10
	Sheep	25
	Cattle	20
	Pigs	20
CO_2 (pigs)	Pigs	60 (after leaving the chamber)
Non-penetrating captive bolt (concussion stun)	All Species	30

6.7.2 FOR IRREVERSIBLE STUN

After an irreversible stun the stun-stick intervals are not critical from an animal welfare perspective. However, the aim should still be to keep them to the minimum practical. Appropriate monitoring at all stages between stunning and sticking ensures immediate detection and re-stunning of those few animals when returning brain function was evident. When a captive bolt irreversibly stuns animals, sticking has no role in terms of animal welfare; the primary function is to bleed out the animal. Therefore, with effective initial stunning and subsequent monitoring, specifying a stun-stick interval appears unnecessary. Furthermore, a number of surveys at abattoirs have indicated that it is possible to approximate and in some cases obtain 100% successful stunning from a single shot, together with a very low incidence of recovery.

In most practical applications an electrical head to body stun can be considered irreversible. However, in some fast moving production lines where animals are hoisted immediately after the stun the cardiac fibrillation which is caused by the current flow through the body can be reversed. In these situations the stun-stick interval for a reversible electrical stun should be adhered to.

6.7.3 ELECTROIMMOBILISATION

Electroimmobilisation is the application of a second current following electrical stunning to the animal after it has been stunned and before or whilst it is bled out. Its purpose is to control convulsions and avoid injury to staff. This procedure might be applied where large cattle are electrically stunned without inducing cardiac arrest (as in halal stunning). However, there have been concerns about the procedure masking any sign of return to consciousness. This could be evaluated by not applying the second current or switching it off as soon as the sticking procedure has been performed and closely examining the animal for any signs of return to consciousness.

APPENDIX

ASSESSMENT OF ANIMAL WELFARE

APPENDIX 1. ASSESSMENT OF ANIMAL WELFARE

Because of the widespread use of the term welfare in science, philosophy and the general community, definitions of welfare vary considerably. In addition, there are a number of definitions of animal welfare in the scientific literature and consequently this has produced differences in approaches to assessment and interpretation. A definition that is well recognised within scientific circles is "The welfare of an individual is its state as regards its attempts to cope with its environment" (Broom, 1986). The "state as regards attempts to cope" refers to both how much has to be done in order to cope with the environment and the extent to which coping attempts are succeeding. Attempts to cope include the functioning of body repair systems, immunological defences, physiological stress responses and a variety of behavioural responses. The extent to which coping attempts are succeeding refers to the lack of biological costs to the animal such as deterioration in growth efficiency, reproduction, health and freedom from injury.

Disagreement over what is important for the welfare of animals led to attempts to study and conceptualise animal welfare in more scientific ways. There are 5 broad approaches used by scientists in studying animal welfare:

- the "feelings-based" approach
- the "nature of the species approach"
- the 5 freedoms for animals" approach
- the "normal functioning-based" approach" or the "homeostasis-based" approach
- the "animal-choices" approach

The above definition provided by Broom underpins the 'functioning based approach'. This approach appears to offer science the best assessment of the welfare of animals. The other approaches in combination with this approach will further define welfare assessment. The functioning based approach expresses that although biological regulation in response to environmental change is occurring constantly, adaptation is not always possible. Thus, when homeostasis fails, there is damage, disease or even death. Therefore, difficult or inadequate adaptation generates animal welfare problems and this is the rationale for the homeostasis-based approach to assessing animal welfare.

Therefore, using such a definition, the risks to the welfare of an animal by an environmental challenge can be assessed at two levels:

- the magnitude of the behavioural and physiological responses
- the biological cost of these responses

These behavioural and physiological responses include the stress response while the biological cost includes adverse effects on the animal's ability to grow, reproduce and remain healthy. Utilising such a definition, we can therefore propose that welfare should be assessed at two levels:

- measuring the behavioural and physiological stress responses of the animal to the environment
- measuring the consequent biological cost to, or reduced biological fitness for, the animal

Short term assessment of animal welfare

Situations that lead to short-term welfare problems at the processing plant include human intervention and handling, prior transport effects, protection from inclement weather, firm footing, time off feed and water, mixing with other animals in lairage, restraint and slaughter per se. The consequences of these situations may be obviously adverse for the animal, for example severe injuries, or they may be masked and become evident only when specific tests are conducted. Attempts to cope may be adaptive and beneficial for the animal (e.g. assist in future exposure) or they may be harmful (e.g.. injury in attempting to escape). Some short term measures to consider include: behavioural measures, physiological measures (heart rate, respiratory rate and body temperature, adrenal axes and other hormones). Although mentioned above, physiological measures (stress, heart rate, respiratory rate and hormonal changes) are not discussed in this document due to the impracticality of applying this type of assessment at the processing plant, however some useful references include:

- Grory, N. (1998). Animal Welfare and Meat Science. CABI publishing, ISBN: 0 85 199 296.
- Grandin, T. (1999) Livestock Handling and Transport, 2nd Edition. CABI publishing, ISBN: 0 85 199 4091.

Physiological measures to indicate stress have been widely used when evaluating animal welfare at the processing plant and have also been utilised to determine effects of stress on other parameters, for example meat quality. This type of assessment is discussed in written background sections including animal handling, facilities and stunning throughout this document.

Short term measures of animal welfare

Behaviour is often the most obvious indicator that the animal is experiencing difficulty in coping with a problem and due to its practical application at the processing plant, this indicator of animal welfare is the focus of this section. Short-term behavioural responses often include orientation reaction, startle responses and defensive or flight reactions. The first behavioural response to an environmental change is the orientation reaction: the animal orients towards the change and with its sense organs (sight, smell, hearing, etc.) it will attempt to locate and evaluate the stimulus. Startle responses include postural changes, jumps and vocalisations and are more than orientation reactions and their intensity is related to the extent that the individual is disturbed. The response may also include cessation of previous activity (e.g. feeding or drinking). Startle responses are often followed by defensive or flight reactions. However the dividing line between the two is not clear. These latter reactions include avoidance (running away) or preparation for fight (growling, threatening stance, etc.). The intensity, duration and frequency of these responses can be used as an index of disturbance, although it is difficult to rank these behavioural patterns in terms of fear levels. However following cessation of normal activity, the delay in resuming this activity may be a useful measure of the disturbance. For example, if a feeding animal is exposed to a fear provoking stimulus, it is likely to stop feeding for a period and then re-commence feeding.

Pain is another indicator of welfare that is often indicated by a behavioural response. For example, Benson (2004) lists the following as indicators of acute pain resulting from traumatic, or infectious events: guarding of affected areas, vocalising on movement, mutilation such as excessive licking, biting or scratching, sweating, recumbency, heavy breathing, defensive reactions including freezing, aggressive reactions and avoidance learning. Benson (2004) also considers the following as indicators of chronic pain, which persists beyond the usual course of an acute disease or reasonable time for an injury to heal or chronic painful pathological process: limping or carrying limb, licking area of body, reluctance to move, changes in exploratory activity, loss of appetite, dysuria (painful urination), bowel lassitude, avoidance of pain-aggravating influences, seeking pain-relieving factors and environments, self mutilation, changes in sleeping behaviour and changes in feeding behaviour e.g. decreased food intake. While other conditions in animals, such as sickness, fear and chronic stress, may have similar behavioural indicators, any expression of such behaviours in animals at the processing plant is indicative of potential or actual welfare problems.

Notwithstanding the above list of behavioural indicators, many animals including sheep can appear to be stoic when in pain. From the perspective of evolution, it may be an advantage for species of prey such as sheep not to overtly show pain so as not to alert prey animals that they would be an easy prey. However, this increases the importance of competent stockpeople who can detect minor behavioural changes indicative of welfare problems. Nevertheless, particularly in the long term, changes in posture and time budgets of behaviour are likely to be indicative of pain or at least aversive procedures, since prolonged or repetitive stress arising from fear or pain is likely to be reflected in coordinated behavioural and physiological responses utilised by animals in their coping attempts.

Long term measures of animal welfare

Long-term measures of animal welfare are also not covered widely, due to the procedures at processing at plants being relatively short term. However, some long-term measures of animal welfare to consider include “biological fitness” variables (reproductive success, life expectancy and growth or weight changes) and physiological variables (cardiovascular and blood parameters, stress measures (chronic) and immunology) as well as behavioural measures.

Behaviour of animals at the processing plant as an indicator of animal welfare

There are a number of common classes of behavioural problems, some of which overlap in certain situations, when behaviour may be indicative of difficulty in adapting to an environmental challenge. The classes are as follows:

- problems with movement
  - – movement difficulties
  - – movement prevention
- behaviour associated with lack of resource
- behaviour associated with lack of social or sexual partner
- frustration of behavioural output
- lack of stimulation and over stimulation

The most common of these that may be exhibited at the processing plan include movement difficulties, which can have a number of causes, such as fatigue from transport, inappropriate flooring and facilities, previous lameness and the manner in which the animals are handled. Movement difficulties are mostly created by poor physical conditions such as inappropriate flooring or pathways (e.g. lameness associated with poor flooring, slipping on flooring and inappropriate ramp slopes). It is obvious that an individual that cannot walk has difficulties in coping with its environment. If the individual is capable of walking but, because the floor is slippery, it does not do so, or if it does not do so in a normal way, the same must be said. For example, on slippery floors, cattle have been shown to exhibit considerable pauses between lowering the head (and sniffing) until lowering their body down. This sequence can take as long as 20 minutes. Sometimes animals even changed order of movements and lay down rump first, instead of anterior part of body first.

Secondly, some of the behaviours that may be exhibited at the processing plant relate to a lack of resource, due to the animals being kept off feed and water for periods of time prior to slaughter. Behaviour associated with lack of a resource, may lead to animals showing characteristic behavioural responses. These responses often include movements associated with finding or obtaining the food, for example sucking behaviour in bobby calves. Some other responses in livestock species include stereotyped behaviours, such as bar-biting, drinker pressing and chewing. These may be indicative of general frustration, but some data suggests that the lack of food is a factor. Repetitive and stereotyped behaviours are more likely to be potential indicators of long-term welfare problems, rather than as a result of the environment at the plant itself. Nevertheless, they need to be addressed by slaughtering such animals as soon as possible and by feedback to suppliers to indicate a potential problem that needs to be identified and solved.

In summary, it is important to recognise some of the factors exhibited when there is a reduction in animal welfare. This understanding assists in the daily assessment of animals under the care of stockpeople. It is worth keeping in mind that the most serious risks to animal welfare are those situations involving long-term exposure or frequent exposure to a stressor that results in the animal experiencing a chronic physiological stress response. Nevertheless, it is also important to be able to determine and address acute stressors. One helpful way to assess this is utilising the magnitude of the response in practice to assess the intensity of the stressor. Finally, with both short and long-term stressors, there is a biological cost. In the long term there may be adverse effects on growth, reproduction, health, injuries and survival. All but the latter have no direct implications for livestock processors. However, the cost of short term stressors arising at the plant will be evident in meat quality and possibly quantity.

APPENDIX 2. REFERENCES