Electrical and CO₂ Stunning, Handling, and Determining Insensibility in Pigs and Sheep

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Trouble Shooting
Handling

1. Distractions that cause balking
2. Slick floor causes agitation
3. Facility design problem
4. Employee training issue
5. Lame pigs
6. Pens not walked on the farm

Most Common Distractions

1. Reflections on water or metal
2. Air blowing towards approaching pigs
3. Moving people or equipment
4. Chute entrance too dark
5. Visual cliff in conveyor restrainer

Electric Prod Use on Pigs Was Reduced By Adding Lighting at the Restrainer Entrance

All handlers were well trained and only pigs that balked or backed up were prodded.
Indirect Lighting Works Best

This lamp is pointed in the same direction as the pigs

Pig Baulking at Metal Strip

Quiet handling in the stunning chute

= 10 % less PSE

<table>
<thead>
<tr>
<th>Blood Lactate</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggressive Handling</td>
<td>25 mmol/L</td>
</tr>
<tr>
<td>Quiet Handling</td>
<td>4 mmol/L</td>
</tr>
</tbody>
</table>

Benjamin et al., 2001
Humane Slaughter Regulations  
9 CFR.313.2

- Driving livestock “minimize excitement and discomfort”
- “Any use of such implements (referring to electric prods or other driving implements) which, in the opinion of the inspector is excessive, is prohibited”

Training Employees

1. Flight Zone Principles
2. Point of Balance
3. No Yelling
4. Move Pigs in Small Groups
5. Fill Crowd Pen Half Full
6. Get Electric Prods Out of People’s Hands

Big Question: When Does Tapping Become Beating?

- Video “Proper Use of Livestock Driving Tools with Temple Grandin”
- Demonstrates hitting an empty corrugated cardboard box. When it starts to crush, tapping has become beating.

Use Alternative Driving Aids
**Trouble Shooting Electric Stunning**

1. Excessive electric prod use due to distractions
2. Stunner settings
3. Employee training
4. Wand ergonomics
5. Line speed
6. Poor bleeding

**Both sides of restrainer must run at the same speed**

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**Two Types of Electric Stunning**

- **Head Only** – Must bleed within 15 sec.
- **Cardiac Arrest** – Must bleed within 60 sec.

**Head Only Reversible Stun Correct Position**
The extended wand tips and extra star wheels (spurs) assure correct stun wand contact with brain.

Locate wand as close to the ear as possible, in the thin crevice. Note that this wand has two sets of star wheels for small and large pigs. Longer, wider wand tips help to facilitate secure contact on the head of larger pigs.

Credit: Erika L. Voogd

For pigs larger than 200 pounds, extend wand tips to assure correct stun wand contact.

Extended tips with extra star wheels. Stainless steel star wheels (spurs) conduct better than carbon steel.

Credit: Erika L. Voogd

Procedure for Small Plants

After head only stunning, apply electrode to the heart to prevent return to sensibility.

Vogel et al., 2010

Insulate the stun box to prevent grounding during stun.

Truck rubber mats on floor and wall. Coated metal gate. Plastic lining in stun box area to insulate electrical current.

Credit: Erika L. Voogd
In small plants, many pigs that are head only stunned regain sensibility because the hoist is very slow. A simple solution to the problem is to apply the stunner to the head first and then apply it a second time to the chest to stop the heart (photograph courtesy of Erika Voogd).
EEG brainwaves used to determine that a proper stun induces a grand mal epileptic seizure

Minimum Stunner Amperage Settings

<table>
<thead>
<tr>
<th>Amps</th>
<th>Animal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25</td>
<td>pigs</td>
</tr>
<tr>
<td>1.00</td>
<td>sheep and cattle</td>
</tr>
</tbody>
</table>

Waveform of a good stun where the animal receives the full intensity and duration of the current

Waveform of a correct stun. Neville Gregory 2001

Waveform of bad stuns

Waveforms of poor stuns - Neville Gregory 2001
Blood Splash Caused By Poor Electric Stunning

Center Track Restrainer

May have less blood splash than a V Conveyor because there is less pressure on the body

Electric Stunning Troubleshooting
Blood Splash (manual and automatic)
1. Sliding wand during the stun
2. Hot wanding
3. Frayed wires inside the cords
4. Corroded switches
5. Water in switches or cords
6. Dirty electrodes
7. Animal grounds out through restrainer
8. Hold Down pushing down on the animal
9. One side of restrainer runs faster

Blood splash trouble shooting
Properly Stunned Insensible Pigs

Righting Reflex in a Fully Sensible Pig

Signs of Properly Stunned Insensible Animals After Captive Bolt or Gun Shot
- Instantly collapses
- No righting reflex
- No rhythmic breathing
- No corneal or palpebral eye reflexes

ALL MUST BE ABSENT

AVMA 2013, Verhoeven et al., 2015

Primary Indicators of Insensible Animals After Electrical or CO2 Stunning
- Loss of posture
- No righting reflex
- No vocalization
- No rhythmic breathing
- No focused eye movement
- All must be absent
Secondary Indicators of Effective Electrical CAS Stunning

- Floppy, loose head
- No response to nose prick
- No response to waving a hand in front of the eyes. Avoid touching the eyes
- A weak corneal reflex may be present in a few properly stunned, electrical or CAS animals. After captive bolt, corneal reflex must be absent

Differences in Reactions of Insensible Animals

- Nystagmus (vibrating) eye must not be confused with natural spontaneous blinking. Nystagmus is permissible after electric or CO₂ stunning. It must be absent after captive bolt.
- Gasping like a fish out of water must not be confused with true rhythmic breathing. Gasping is permissible after electric or CO₂ stunning. It must be absent after captive bolt.
- Corneal Reflex must be completely absent after captive bolt.

Interpreting Eye Blinks in Electrically Stunned Pigs

Under plant conditions, avoid touching the eye with fingers. Watch for normal blinks which look like blinks on a live pig. The following are not blinks:
1. Nystagmus – vibrating eye or lid
2. Eye clenched shut – pops open
3. Opens when touched but does not close

In captive bolt stunned cattle, nystagmus is a sign of a possible poor stun

Troubleshooting Return to Sensibility Signs in Electrically Stunned Animals

1. Insufficient amperage
2. Poor bleeding
3. Poor initial contact that results in insufficient time
4. Interrupted current which results in insufficient time
5. Wrong placement on the head
6. Stunning-to-bleed interval too long with head only stunning
Improving Stun Wand Surface Area Can Increase the Stun Efficacy

Prone bleed may reduce blood splash because the stun to bleed interval is under 10 seconds

Bleeding

Correct position for shooting swine with a captive bolt or a firearm. Many old diagrams show a position that is too low (diagram by J.K. Shearer)
Captive Bolt Stunners for Non-Ambulatory Pigs are Often Neglected
- Store cartridges in a dry place and bring to the yards, a one-day supply of cartridges
- If the stunner has been used, it must be cleaned and serviced at the end of the shift

Genetics May Affect Pig's Reaction to CO₂

Low Stress Group Handling With CO₂

Best Practice:
- Inspection port on CO₂ machine for observing anesthesia induction
Control of forward movements of crowd gate by a person prevents overcrowding.

Slight limb movements and gasping may occur.

Order of Events During Return to Sensibility in CO₂ Stunned Pigs

<table>
<thead>
<tr>
<th>Event</th>
<th>Average Time</th>
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<tbody>
<tr>
<td>Corneal reflex (touch eye)</td>
<td>42 sec</td>
</tr>
<tr>
<td>Rhythmic breathing</td>
<td>68 sec</td>
</tr>
<tr>
<td>Excitation</td>
<td>76 sec</td>
</tr>
<tr>
<td>Nystagmus (vibrating eye)</td>
<td>86 sec</td>
</tr>
<tr>
<td>Spontaneous natural blinking (don’t touch)</td>
<td>93 sec</td>
</tr>
<tr>
<td>Conscious movement (righting reflex)</td>
<td>171 sec</td>
</tr>
<tr>
<td>Attempt to stand up</td>
<td>387 sec</td>
</tr>
</tbody>
</table>

These events are very variable.

Danish Meat Research Institute, Holst (2001)

CO₂ returns to sensibility sequence

There is Zero Tolerance for Hoisting an Animal that is Showing Obvious Signs of Sensibility.

There is Zero Tolerance for:
- Skinning
- Scalding
- Dehairing
- Removal of any Body Part on an Animal that Shows any Sign of Partial Return to Sensibility.
### Numerical Scoring System for Cattle Minimum Acceptable Percentages

<table>
<thead>
<tr>
<th>Method</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Stunned with one captive bolt or gun shot</td>
<td>95%</td>
</tr>
<tr>
<td>Insensible</td>
<td>100%</td>
</tr>
<tr>
<td>Electric prod - Acceptable</td>
<td>25%</td>
</tr>
<tr>
<td>Electric Prod – Excellent</td>
<td>5%</td>
</tr>
<tr>
<td>Falling down</td>
<td>1%</td>
</tr>
<tr>
<td>Vocalizing</td>
<td>3%</td>
</tr>
<tr>
<td>Vocalizing with head holder</td>
<td>5%</td>
</tr>
</tbody>
</table>
www.grandin.com