

The Meat Institute's Stunning Guide

Published May 2024

Reviewed and published by the Meat Institute Animal Welfare Committee



Nourishing Today
Sustaining Tomorrow

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Humane Stunning Recommendations (by species and class)

For the firearm recommendations in the chart below, while less muzzle energy than what is recommended may be effective, these recommendations should ensure that the firearm muzzle energy is adequate to effectively stun the animal types outlined below.

Animal Type	Recommended	Details				Not Recommended	
	Primary Method	Captive Bolt Parameters				Primary Method	Details
		Tool	Estimated Penetration Depth (inches)**	PSI *Recommended Air Compressor Capacity of 250 PSI. These recommendations assume that the gun is properly maintained and good operator technique is being performed	*Cartridge Strength *Cartridge strength recommendations are for all hand held captive bolts		
Cattle							
Fed cattle 1000 – 1750 lbs	Firearm	A minimum of 1000 ft-lb muzzle energy <i>Examples: centerfire high powered rifle or shotgun</i>				Firearm*	.22 short rifle .22 long rifle
	Penetrating captive bolt	<ul style="list-style-type: none"> Cylinder Style Free flight (standard or long length) Cylinder style Retractable bolt (standard or long length) Pneumatic 	<ul style="list-style-type: none"> Standard bolt 2.8–3.25” Long bolt 3.8–4.3” • 2.25–3 	180–200 PSI	4 grain or higher	Non-penetrating captive bolt	Only allowed for religious slaughter and requires the animal be bled within 30 seconds
Fed cattle >1,750 lbs	Firearm	A minimum of 1,000 ft-lb muzzle energy <i>Examples: centerfire high powered rifle or shotgun</i>				Firearm*	.22 short rifle .22 long rifle
	Penetrating captive bolt	<ul style="list-style-type: none"> Cylinder Style Free Flight (long bolt) Pneumatic 	3.8–4.3”	190–200 PSI	6 grain	Non-penetrating captive bolt	Only allowed for religious slaughter and requires the animal be bled within 30 seconds
Cow/Bull	Firearm	A minimum of 1,000 ft-lb muzzle energy <i>Examples: centerfire high powered rifle or shotgun</i>				Firearm*	.22 short rifle .22 long rifle
	Penetrating captive bolt	<ul style="list-style-type: none"> Cylinder Style Free Flight (long bolt) Pneumatic 	3.8–4.3”	Cows: 190–200 PSI Bulls: 220–240 PSI	6 grain	Non-penetrating captive bolt	Only allowed for religious slaughter and requires the animal be bled within 30 seconds
Veal <400 lbs	Firearm	A minimum of 300 ft-lb muzzle energy				Firearm*	.22 short rifle
	Penetrating captive bolt	<ul style="list-style-type: none"> Cylinder Style Free flight (Standard or long length) Cylinder Style Retractable bolt (standard or long length) Pistol style retractable (standard length or long length) 	<ul style="list-style-type: none"> Standard bolt 2.8–3.25” Long bolt 3.8–4.3” • 2.25–3” • 2.25–3” 		2.5 grain or higher	Non-penetrating captive bolt	Only allowed for religious slaughter and requires the animal be bled within 30 seconds
	Electrical Stunning	Minimum of 1.5 amps, 250–400 volts, and recommend 3 phase stun: 3 second head-only phase, followed by a 15 second cardiac phase, and then a 4 second spinal discharge phase					

Animal Type	Recommended	Details				Not Recommended	
	Primary Method	Captive Bolt Parameters				Primary Method	Details
		Tool	Estimated Penetration Depth (inches)	PSI *Recommended Air Compressor Capacity of 250 PSI	*Cartridge Strength *Cartridge strength recommendations are for all hand held captive bolts		
Bison							
Immature Bison/ Heifers/Cows	Firearm	A minimum of 1000 ft-lb muzzle energy <i>Examples: centerfire high powered rifle or shotgun</i>				Firearm*	.22 short rifle .22 long rifle
	Penetrating captive bolt	• Cylinder Style Free Flight (long bolt) (using the poll shot)	• 3.8-4.3"		6 grain	Non-penetrating captive bolt	
Swine							
Market swine	Firearm	A minimum of 300 ft-lb muzzle energy				Firearm*	.22 short rifle 28 or .410 gauge shotgun
	Penetrating captive bolt	• Cylinder Style Free flight (standard or long length) • Cylinder Style Retractable bolt (standard or long length) • Pistol style retractable (standard length or long length)	• Standard bolt 2.8-3.25" Long bolt 3.8-4.3" • 2.25-3" • 2.25-3"		3 grain or higher	Non-penetrating captive bolt	
	Electrical Stunning	• Head only (acceptable) or head to heart (optimal heart position lower on the chest and right behind shoulder)(highly recommended) Head only requires a secondary step. • Minimum of 2 amps • Minimum 250-300 volts for 3-5 sec					
Sow/Boar	Firearm	A minimum of 1000 ft-lb muzzle energy				Firearm*	.22 short rifle .22 long rifle
	Penetrating captive bolt	• Cylinder Style Free Flight (long bolt)	• 3.8-4.3"		6 grain	Non-penetrating captive bolt	
	Electrical Stunning	• Head only (acceptable) or head to heart (optimal heart position lower on the chest and right behind shoulder)(highly recommended) Head only requires a secondary step. • Minimum of 2 amps, recommended 3-5 for boars • Minimum 250-400 volts for 3-5 sec					

Animal Type	Recommended	Details				Not Recommended	
	Primary Method	Captive Bolt Parameters				Primary Method	Details
		Tool	Estimated Penetration Depth (inches)	PSI *Recommended Air Compressor Capacity of 250 PSI	*Cartridge Strength *Cartridge strength recommendations are for all hand held captive bolts		
Sheep							
Hornless Sheep	Firearm	A minimum of 300 ft-lb muzzle energy					
	Penetrating captive bolt	<ul style="list-style-type: none"> • Cylinder Style Free flight (standard or long length) • Cylinder Style Retractable bolt (standard or long length) • Pistol style retractable (Standard length or long length) 	<ul style="list-style-type: none"> • Standard bolt 2.8-3.25" Long bolt 3.8-4.3" • 2.25-3" • 2.25-3" 		2 grain or higher	Non-penetrating captive bolt	Only allowed for religious slaughter and requires the animal be bled within 30 seconds
	Electrical Stunning	Head only (acceptable) Head to body (highly recommended) Minimum of 1.0 amps; 250-400 volts for 3-5 sec					
Horned Sheep	Firearm	A minimum of 300 ft-lb muzzle energy				Firearm*	.22 short rifle
	Penetrating captive bolt	<ul style="list-style-type: none"> • Cylinder Style Free flight (standard or long length) • Cylinder Style Retractable bolt (standard or long length) • Pistol style retractable (Standard length or long length) 	<ul style="list-style-type: none"> • Standard bolt 2.8-3.25" Long bolt 3.8-4.3" • 2.25-3" • 2.25-3" 		2 grain or higher	Non-penetrating captive bolt	Only allowed for religious slaughter and requires the animal be bled within 30 seconds
	Electrical Stunning	Head only (acceptable) Head to body (highly recommended) Minimum of 1.0 amps; 250-400 volts for 3-5 sec					
Goats							
Hornless Goats	Firearm	A minimum of 300 ft-lb muzzle energy					
	Penetrating captive bolt	<ul style="list-style-type: none"> • Cylinder Style Free flight (standard or long length) • Cylinder Style Retractable bolt (standard or long length) • Pistol style retractable (Standard length or long length) 	<ul style="list-style-type: none"> • Standard bolt 2.8-3.25" Long bolt 3.8-4.3" • 2.25-3" • 2.25-3" 		2 grain or higher	Non-penetrating captive bolt	Only allowed for religious slaughter and requires the animal be bled within 30 seconds

Animal Type	Recommended		Details				Not Recommended	
	Primary Method	Tool	Captive Bolt Parameters				Primary Method	Details
			Estimated Penetration Depth (inches)	PSI *Recommended Air Compressor Capacity of 250 PSI	*Cartridge Strength *Cartridge strength recommendations are for all hand held captive bolts			
Goats (continued)								
Hornless Goats (cont.)	Electrical Stunning	Head only (acceptable) Head to body (highly recommended); Minimum of 1 amp; Minimum of 250 volts for a recommended 3-5 seconds						
Horned Goats		A minimum of 300 ft-lb muzzle energy				Firearm*	.22 short rifle	
	Penetrating captive bolt	<ul style="list-style-type: none"> • Cylinder Style Free flight (standard or long length) • Cylinder Style Retractable bolt (standard or long length) • Pistol style retractable (Standard length or long length) 	<ul style="list-style-type: none"> • Standard bolt 2.8-3.25" Long bolt 3.8-4.3" • 2.25-3" • 2.25-3" 		2 grain or higher	Non-penetrating captive bolt	Only allowed for religious slaughter and requires the animal be bled within 30 seconds	
	Electrical Stunning	• Head only (acceptable) Head to body (highly recommended); Minimum of 1 amp; Minimum of 250 volts for a recommended 3-5 seconds						

*For more information on firearms that are recommended, see the *Firearm Muzzle Energy Recommendations*

Always Remember:

***Restraint:** Appropriate restraint of the animal's head and body is essential to ensure the efficacy of these methods.

***Back Up Method:** If the first stun attempt fails, a back-up method should be in immediate proximity, that employees are trained to use, and is well-maintained.

***Appropriate Method:** These recommendations are not intended for classes of animals at weights not specified on the table

***Electrical:** Ensure animals have access to water and that skin is damp prior to electrical stunning.

***Firearm Effectiveness:** Parameters influencing firearm effectiveness include: the target, skull mass, angle, and distance from animal.

***Firearm Safety:** In the plant, consider the possibility of ricochet and ensure that there are no people in line of fire.

Electrical Stunning Placement

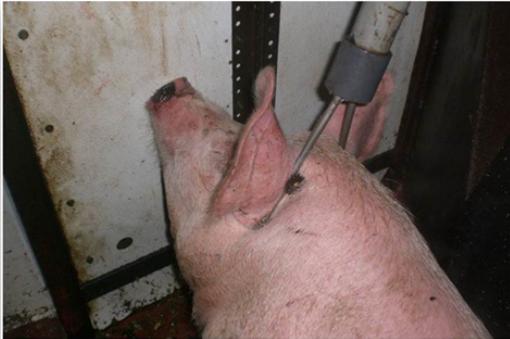
Head and Heart

The head and heart, two-step, cardiac arrest stunning method is HIGHLY recommended – First apply the tongs to the head for a minimum of two seconds for market pigs and three seconds for sheep to induce insensibility, then immediately reapply the tongs to the chest for a minimum of an additional two seconds for market pigs and three seconds for sheep.

When a wand with two stationary electrodes is used, they may be placed in the hollow behind the ears or on the forehead (in some countries), for at least two seconds for pigs and three seconds for sheep. Stunning tongs and wands must never be placed on the neck because this would cause the current to bypass the brain, nor should they be placed on sensitive areas such as inside the ear or in the eye. Stunning tongs and wands should only be used for head and heart placement.

Head Placement

Stunning Pigs with a Best & Donovan Stunner



Heart Placement

When employing the two-step head to heart cardiac stunning method, the heart placement should be right behind the elbow of the animal on the more ventral part of the ribcage.

Stunning Pigs with a Best & Donovan Stunner

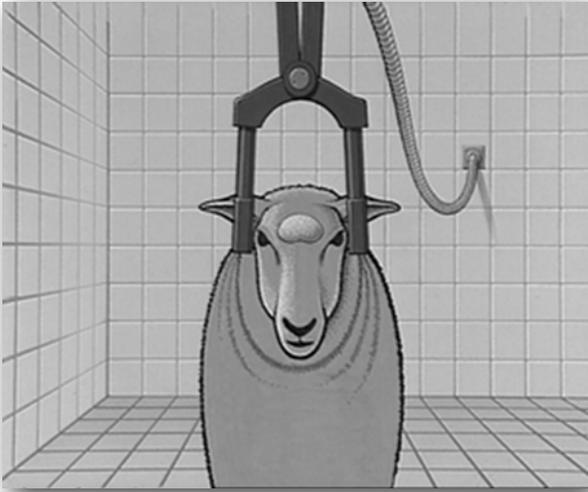


Electrical Stunning Placement

Head Only

With head only stunning the animal WILL return to sensibility quite quickly in as little as 15 seconds, bleed out should occur in less than 10-15 seconds which can be difficult to achieve depending on the facility set up. Head and heart stunning allows for a longer stun-to-stick time and is what is recommended for market size and mature animals. With head-only stunning with scissor-type tongs, the electrodes may be either placed on the forehead or top of the head and bottom of the head or clamped around the sides of the head like earmuffs. Electrodes also may be placed in a “top to bottom” position on top of the head and below the jaw. See diagrams below:

**Canadian federal rules prohibit placing electrodes on the forehead or top of the head and bottom of the head. In Canada, electrodes should only be placed around the sides of the head. Head-to-back stunning is also permissible.*



Head to Body

Humane Slaughter Association Placement Photos:

[Head Only Stunning Web Page](#)

[Electrical Stunning of Red Meat Animals PDF](#)

Head Placement

Locate the wand as close to the ears as possible, in the thin crevice. Longer, wider tips help to facilitate secure contact on the head of larger animals.

When a saddle-type wand is used, the current is passed simultaneously from the animal's head to a second electrode that is applied to either the back or the side of the body. This will simultaneously induce both unconsciousness and cardiac arrest.

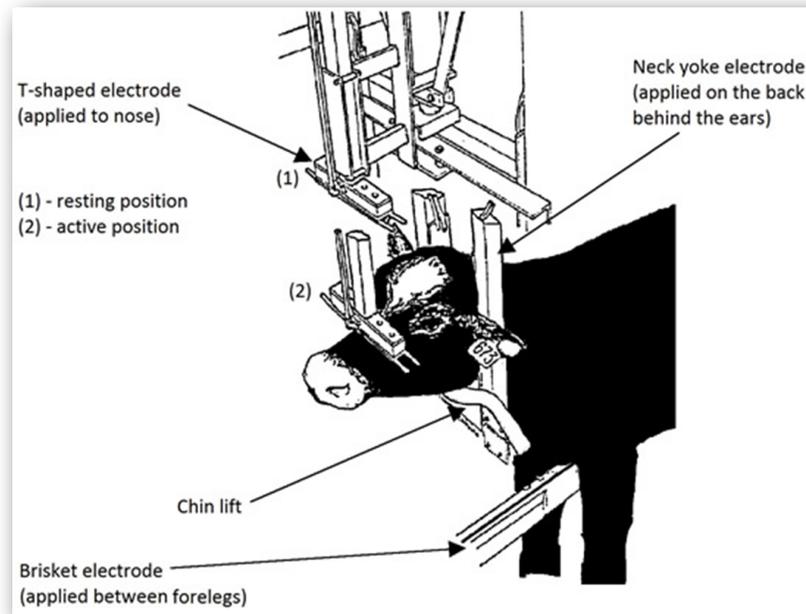


Electrical Stunning Placement

Veal Electrical Stunning

Adapted from <https://www.hsa.org.uk/electrical-stunning-of-red-meat-animals-equipment/head-to-body>

Electrical stunning of veal can be achieved through three phases sequentially: a 3 second head-only phase to stun, followed by a 15 second cardiac phase to induce cardiac arrest, and then a 4 second spinal discharge phase to reduce clonic convulsions. Equipment for cattle should restrain the animal around the neck, chin, and rump to position the animal for accurate electrode placement. An electrode will then contact the nose and current will flow from the nose to the neck yoke, stunning the animal. A second electrode will then be placed on the brisket and a further current will flow through the body and stop the heart. The type and magnitude of the current delivered varies, depending on the equipment used. The third phase, nose-to-rump, which disrupts spinal reflexes, is used so that the animal lies motionless once it is released from the restrainer.



Humane Slaughter Association Veal Electrical Stunning Figure:

[Head to Body Stun Kill](#)

[Electrical Stunning of Red Meat Animals PDF](#)

Captive Bolt Recommendations

Tool	Cartridge Strength (Grain)	Overall Penetrating Rod Length (inches)	Estimated Penetration Depth* (inches)	Bolt Velocity (Feet per second)
Pistol Standard Length	2	7.4"	2.25"	117
	3		2.5"	152
	3.5		3"	157
Pistol Long Bolt	2	8.135"	2.25"	115
	3		2.5"	146
	3.5		3"	151
Cylinder Style Retract.	2	8.477"	2.25"	124
	3		2.5"	159
	3.5		3"	161
	4		3"	185
	4.5		3"	195
Cylinder Standard Length FF	2	7.066"	2.8"	132
	4		3.25"	190
	5		3.25"	190
Cylinder Long Length FF	2	8.066"	3.8"	128
	4		4.3"	190
	5		4.3"	190
Cylinder SHD Long FF	4	8.066"	4.3"	190
	5		4.8"	190
	6		5"	207

NOTE: These values are based on .25 caliber power loads. The overall penetrating rod length is the length of the entire stunning rod (piston end to sharp end).

*The estimated penetration depth is based on the inclusion of sleeves/bumpers, see page 11 for an example. This is not the same depth as the manufacturer maximum penetration depth that does not include sleeves/bumpers.

Captive Bolt System Examples



Free flight* captive bolt system example that may be used in cylinder style stunners

*Free flight has increased travel distance compared to retractable captive bolt system

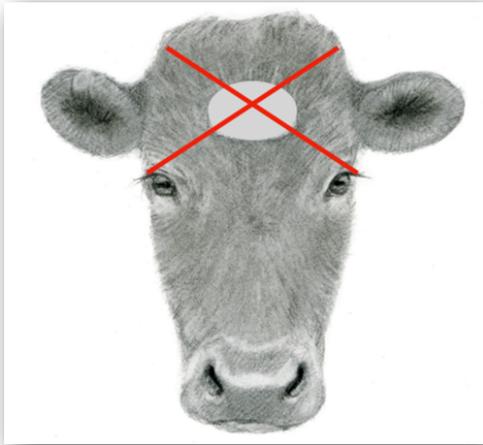


Retractable captive bolt system that may be used in cylinder or pistol style stunners.

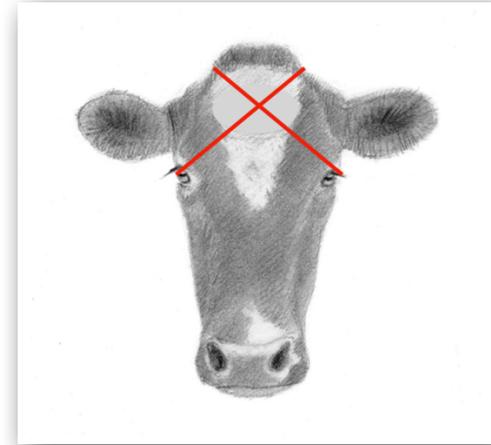
Captive Bolt Stunning Placement Figures

The "X" intersection on the forehead indicates the proper placement position.

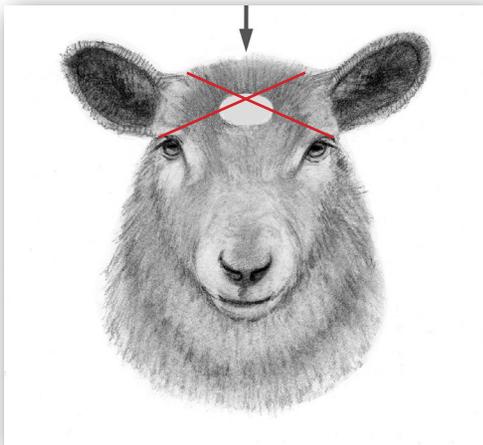
Beef Cattle



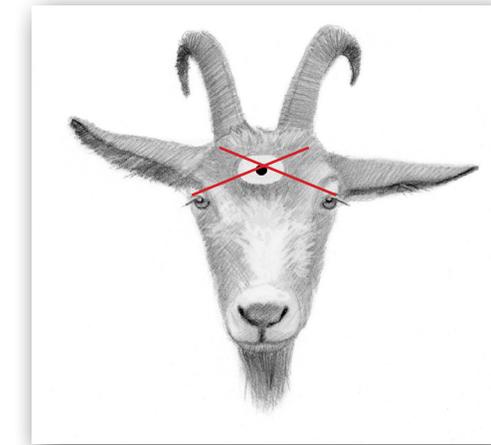
Dairy Cattle



Sheep (Horned or Hornless)



Goat (Horned or Hornless)



Captive Bolt Stunning Placement Figures

The arrow or dot indicates the proper placement position.

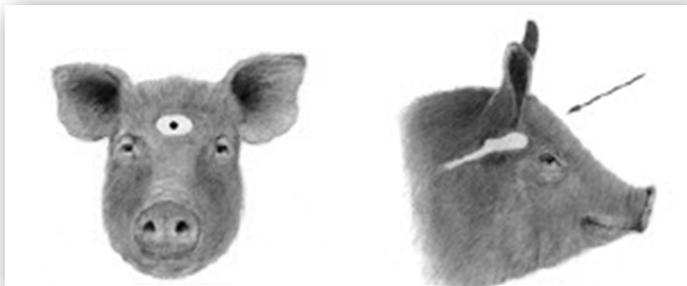
Bison Poll Shot



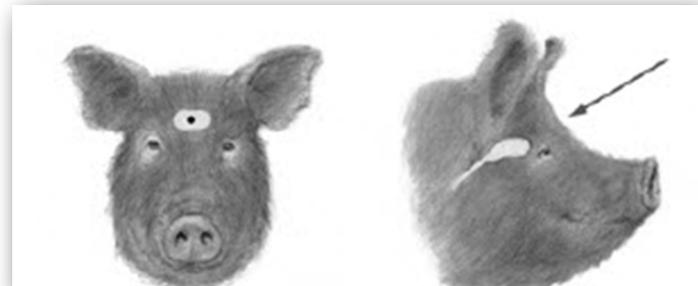
Bison Frontal Shot



Market Swine



Mature Swine



Firearm Muzzle Energy Recommendations

It is recommended

For animals **under** 400 pounds, you use a firearm that provides 300 ft/lbs of muzzle energy.

For animals **over** 400 pounds, you use a firearm that provides 1,000 ft/lbs of muzzle energy.

Be careful not to choose a gun that is too powerful as this may result in pass through of the bullet.

Muzzle Energy Calculators

http://www.ballistics101.com/muzzle_energy_calc.php

<https://shooterscalculator.com/bullet-kinetic-energy.php>

Common Firearm Chart

Cartridge/Firearm	Muzzle Energy in Foot Pounds	Recommendation
Rifles		
.22 Long Rifle Rim Fire	117	Not recommended
.22 Win Mag	338	Animal UNDER 400 lbs
.223 Remington	1,296	Animal OVER 400 lbs
30-30 Winchester	1,902	Animal OVER 400 lbs
.308	2,648	Animal OVER 400 lbs
30-06	2,841	Animal OVER 400 lbs
Shotguns		
.410 109 with slug	650-780	Animal UNDER 400 lbs
20 Gauge with slug	1,865-2,080	Animal OVER 400 lbs
16 Gauge with slug	1,990-2,320	Animal OVER 400 lbs
12 Gauge with slug	2,100-2,364	Animal OVER 400 lbs

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Sheep/Goats

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