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Australian Beef Carcass Appraisal System (ABCAS)



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The Australia Beef Carcass Appraisal System ranks beef carcasses on their overall merit, and gives feedback to producers about compliance to market specifications, the yield of saleable meat and the potential eating quality of the meat.

ABCAS combines the extensive experience of the NSW Department of Primary Industries in carcass judging and evaluation with the advanced technology of the world's most comprehensive grading system, Meat Standards Australia (MSA). Practices to improve and optimise meat quality have come directly from research by the Co-operative Research Centre (CRC) for Beef Quality.

ABCAS focuses on the factors that producers can control. In commercial grading, MSA accounts for many factors that affect eating quality but which the producer cannot control, such as pre-slaughter management, livestock handling, hanging method, chilling and ageing.

As far as possible, carcass competitions and educational activities should be structured in accordance with MSA grading requirements to optimise meat quality and demonstrate best practice. Please note that although ABCAS provides grading information on all carcasses, in many competitions they will not be eligible for sale as MSA-graded beef, either because they do not meet MSA licensing conditions, or because they cannot meet requirements for pre-slaughter management (e.g. no mixing of different mobs of cattle, and direct delivery from farm to abattoir).

Table 1 Point score overview

1. Market specifications (20 points)		3. * MSA eating quality (combined, 45 points)	
P8 Fat Depth	10	Ultimate meat pH – units	
Meat Colour	5	Ossification score 100 – 590	
Fat Distribution	5	Tropical breed content (TBC) 0 – 100 %	
Penalties	As required	Hump height mm	
2. Saleable meat yield (35 points)		AUS-MEAT marbling 0 – 6	
Rib fat depth	15	MSA marbling 100 – 1190	
Eye muscle area	20	Sex – male or female	
		Total 100	

* To receive eating quality points, carcasses must meet the minimum MSA carcass specifications:

1. Minimum of 3mm of rib fat
2. Adequate fat distribution
3. pH of 5.70 or less
4. Meat colour 1b and no greater than 3.

Class specifications and market categories

To assess market suitability, the basic specifications of a carcass are judged for compliance against the specifications of an appropriate market category.

It is very important as far as possible to describe each competition class as a particular market category so entrants know the target they are aiming for.

The following specifications are typical of the main markets and are presented as a guide only – individual butchers, supermarkets and processors may require slightly different specifications. If carcasses are being assessed for suitability for a specific processor, it may be necessary to **adjust the preferred weight and/or preferred fat specifications** in line with processor or market requirements, and **adjust the fat depth points scales to match**.

Table 2 Suggested market categories

Category	Carcass weight	P8	Preferred fat depth (mm)	
			10/11 rib	12/13 rib
A. Light domestic	100 – 180 kg	4 – 8 mm	4 – 6 mm	3 – 6 mm
B. Medium domestic	180.1 – 240 kg	6 – 10 mm	5 – 8 mm	4 – 7mm
C. Heavy domestic	240.1 – 300 kg	8 – 13 mm	6 – 10 mm	5 – 9 mm
D. Export (EU, Japan)	300.1 – 400 kg	12 – 17mm	8 – 13 mm	7 – 12 mm

1. Compliance to market specifications (20 points)

Most markets require carcasses to meet basic specifications of age (dentition), sex, weight and P8 (rump) fat depth. Dentition is usually checked in the live cattle, and is not part of the carcass assessment, while some markets specify only steers.

1.1 P8 fat depth (10 points) is measured on the hot carcass at the P8 site, over the rump, and is the method of describing fatness in the AUS-MEAT national carcass description language. It is commonly used to set market targets and for payment of premiums and discounts. Optimum P8 fat depth is the range set for each class (market category) in the carcass specifications.

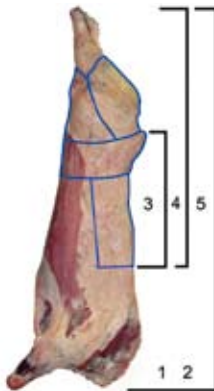
1.2 Meat colour (5 points) is recorded using AUS-MEAT standard meat colour chips in a range of 1a (very pale) to 7 (very dark purple). Colour strongly influences consumer appeal, with bright, pinkish colours in the range 1b to 3 being most acceptable to consumers. Carcasses must meet the MSA specification of meat colour 1b to 3 to receive eating quality points.



Colours displayed show the darkest colour of each grading and is a guide only, not a true representation

1.3 Fat distribution (5 points) Ideally, a carcass will have a thin, even fat cover over all the important cuts, especially over the rump and forward along the backline. This contributes to eating quality by slowing the chilling rate, and reduces weight loss due to dehydration as the carcass chills.

Carcasses will lose points for inadequate cover, or for heavy, waste deposits. Key areas for assessment of excessive fat deposits are the subcutaneous fat (especially over the ribs), intermuscular (seam) fat and internal fat in the cod, udder, ribs and brisket.



Points	Description
5	Meets minimum fat requirements with good even fat cover over entire body, without excess deposits of subcutaneous or seam fat
4	Meets minimum fat requirements with good even cover over the butt
3	Meets minimum fat requirements with fat cover over major primals, cube roll, striploin and rump
2	Lean carcasses or carcasses with uneven fat distribution. Also carcasses with some excess fat deposits or seam fat
1	Fails to meet minimum fat requirements or overfat carcasses with excessive fat deposits
0	Extremely lean or extremely fat, wastey carcasses

* Carcasses must have adequate fat cover over the highlighted areas to receive maximum points.

1.4 Fat colour is recorded for your information at the end of the eating quality section but has no direct impact on eating quality; excessive yellowing or softness may affect the saleability of the carcass. Fat colour is assessed on the internal seam fat at the quartered site using the AUS-MEAT chips and ranges from 0 (bright white) to 9 (very yellow).

There are no points allocated for fat colour but individual competitions may apply penalty points (max. 5) if a carcass exceeds fat colour 3 or if a market specification for fat colour is set.



Colours displayed show the darkest colour of each grading and is a guide only, not a true representation

1.5 Penalties may be applied to carcasses that:

- Fall outside the specified weight range (usually 1 point per kg outside)
- Exceed fat colour 3 or fall outside the specified fat colour range
- Show secondary sexual characteristics (bull or stag)
- Fall outside specifications for dentition
- Exhibit obvious defects, e.g. bruising, blood splash, injection site damage.

2. Saleable Meat Yield (35 points)

Saleable meat yield is the proportion of the carcass that is saleable as primal cuts and meat trimmings. It excludes bone and waste fat. High-yielding carcasses are preferred, and they are heavily muscled with a thin, even fat cover, but the fat depth and distribution must be adequate to meet quality requirements.

2.1 Rib fat depth (15 points) is a good indicator of carcass yield with over-fat animals having lower yields. It is measured in millimetres at the quartering site (usually 10/11th or 12/13th rib). Optimum rib fat depth is the range set for each class (market category) in the specifications. To receive eating quality points, carcasses must meet the MSA minimum standard of 3mm at the quartering site.



2.2 Eye muscle area (20 points) is a good indicator of the red meat content of the carcass. It is measured in square centimetres at the quartering site (10/11th or 12/13th rib) and points awarded according to the area measured in relation to the carcass weight. The larger the rib eye area in relation to the carcass weight the higher the points awarded.

3. MSA Eating Quality (45 points)

When Meat Standards Australia (MSA) grades a carcass, grading is based on the principles that:

1. The potential meat quality of an animal must be realised as far as possible by minimising stress between farm and slaughter, and by optimising chilling/electrical stimulation conditions during processing
2. There are known variable factors that affect the eating quality of individual muscles and adjustments are made for their effect.

The MSA grading model predicts eating quality of 40 muscles by 6 different cooking methods. It applies all our current knowledge about the factors affecting meat quality – which muscles they affect, by how much, and what interactions there are with other factors. These have been defined by a large research effort and more than 439 000 consumer product tests, involving some 62 800 consumers.

In the Australian Beef Carcass Appraisal System the MSA eating quality score is the average predicted MSA eating quality score of 11 major primal cuts, cooked by their optimum method. Scores have been scaled to deliver a maximum of 45 points for eating quality. If carcasses fail to meet MSA minimum requirements (see page 1), they are below the benchmark standard for high quality table beef and will not receive an eating quality score.

Eating quality variables and their effect

In commercial grading, once cattle have been slaughtered and have met processor requirements for eligibility, the grader enters information about each carcass and the MSA model predicts the eating quality of each cut (visit www.msagrading.com for further details). Predictions are scientifically based and validated by the extensive MSA consumer testing program.

Processor requirements include:

- Meeting the MSA pH decline 'window' – the rate of chilling and amount of electrical stimulation to optimise meat quality, determined by CRC research
- Cattle must be from a licensed producer / saleyard and must be accompanied by an MSA vendor declaration
- Direct consignment cattle must be killed the day after dispatch
- No mixing or drafting of different mobs of cattle.

Please note that the structure of some competitions may preclude the carcasses from commercial grading, in this case the assessments are provided for education and feedback.

3.1 Ultimate pH

pH is a measure of acidity / alkalinity levels of the meat. It is very important for keeping quality (shelf life) and is related to its cooking properties, colour and consumer acceptance.

After slaughter, the reserves of glycogen (energy) in the animals' muscles are converted to lactic acid, causing the pH to fall. As long as there is adequate glycogen present at slaughter, the pH will fall to within the normal range of 5.4 to 5.7. If there is not enough glycogen (due to stress or poor nutrition) then pH will remain above the acceptable limit of pH 5.70 and the meat is likely to be dark in colour, with poor keeping quality.

High pH meat is more difficult to cook to the right degree of doneness. At the same temperature as a cooked normal steak, it appears much rarer and if further cooked will lose its juices and become tough and dry.

- MSA rejects carcasses with pH over 5.70
- A slight downward adjustment is made to eating quality of all cuts from carcasses high in the acceptable 5.70 range
- To maintain high glycogen levels it is important to maintain a high level of nutrition and water prior to slaughter and minimise transport and handling stress.

3.2 Ossification (maturity) and carcass weight

Ossification score is a measure of physiological maturity of the beef carcass. Hot standard carcass weight (HSCW) is used in conjunction with the ossification score to identify carcasses with greater weight for maturity – faster grown cattle have better eating quality.

As beef cattle mature the cartilage present around the bones of the spinal column gradually change into bone (ossify). The rate at which this occurs is reasonably predictable but is affected by factors such as sex and nutrition. The scale of ossification runs from 100 to 590. Cuts from carcasses with lower ossification at the same weight are graded higher. Increasing ossification has a cut-by-cut effect with a high effect on some cuts (e.g. rump) and a low effect on others (e.g. oyster blade).

Ossification score is influenced by a number of other factors:

- Heifers tend to have higher ossification scores at the same age compared to steers
- Hormonal growth promotants (HGP) – treatment tends to increase ossification scores
- Nutritional setbacks or injury can increase ossification score, and this is not reversible.

Ossification score is assessed at three different locations on the sawn chine: the 5 sacral vertebrae (Tail), 6 Lumbar (back) and first 13 thoracic vertebrae (ribs).

MATURITY ASSESSMENT REGIONS

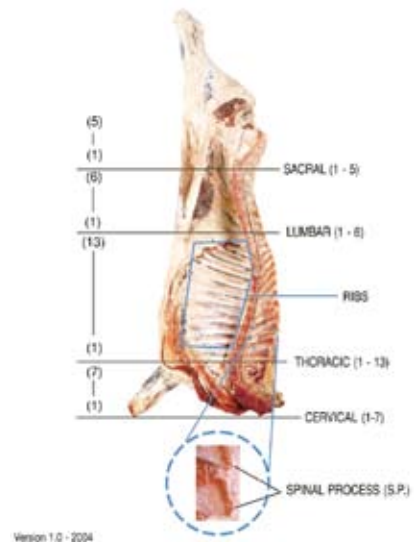


Table 3 –Example showing the effect of Maturity score on eating quality.

MSA ossification score	Topside MSA grade*
120	3
190	Ungrade

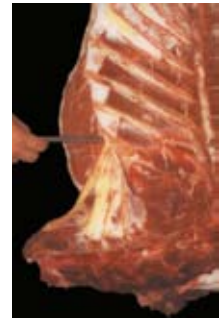
* Predicted consumer grades: 5 = premium; 4 = better than every day eating; 3 = good, every day eating; ungrade = unacceptable

The example shown in table 3 compares the topside of two good quality domestic trade carcasses, different only in their maturity score, with HSCW 240kg, male, AT hang, 270 MSA marbling, meat colour 1C, rib fat 7mm, pHu 5.55, aged for 5 days, cooking method grill, non HGP treated.

(Please refer to MSA Tips & Tools 06 ‘The effect of ossification on beef eating quality’)

3.3 Tropical breed content (TBC) % and hump height

MSA data clearly shows that cattle with tropical breed content have a higher risk of delivering ‘unacceptable’ beef to consumers. Research by the Beef CRC has found that these breeds do carry more genes associated with toughness, but if animals are well managed before slaughter and optimally processed, the differences are small.



MSA research has determined that the major negative effect is toughening of the striploin, cube roll, tenderloin and oyster blade – all high value grilling cuts. The effect is smaller in the cuts with higher connective tissue such as brisket, topside, outside (silverside) and eye round.

The percentage of tropical breed content is taken into account by the grading model in combination with other factors. All cuts from 100% tropical breeds can still meet acceptable MSA consumer standards if the cattle are within age and fat limits and optimum eating quality interventions such as tenderstretch hanging, and ageing of cuts, are applied.

In crossbred cattle the **hump height** is an easily measured indicator of the percentage tropical breed content (TBC %). Animals of the same TBC can show different levels of visible traits such as hump, pizzle and ear length. Analysis of MSA data has confirmed that when adjusted for carcass weight, hump height can also be used to estimate the ‘tropical breed effect’ on eating quality. Hump height is measured in increments of 5mm on the hump muscle (M. Rhomboideus) on the animals’ neck.

The tropical breed content (TBC) is supplied by the producer on the MSA vendor declaration or as the breed description on the competition entry form. Values are expressed as a percentage: 0, 12, 18, 25, 38, 50, 75, 100.

The grading model adjusts hump height for carcass weight and ossification, then checks this against the declared TBC% and applies whichever is the greater of the two eating quality adjustments.

(Please refer to Tips & Tools 05 ‘The effect of tropical breeds on beef eating quality’).

Table 4 – Effect of tropical breed content (tbc %) on eating quality

* Predicted consumer score on a scale of 0-100 where over 76.5 = 5 star, 65-76.5 = 4 star, 47-64.5 = 3 star and below 46.5 = ungrade (unacceptable)

Tropical breed content %	Striploin	
	MSA score *	MSA grade
100	42	Ungrade
50	48	3
0	55	3

The example shown in table 4 is for otherwise identical carcasses with varying tropical breed content. The basic carcass is HSCW 240kg, male, AT hang, 150 ossification, 270 MSA marbling, meat colour 1C, rib fat 7mm, pH 5.55, aged for 5 days, cooking method grill, non-HGP treated.

3.4 MSA and AUS-MEAT marbling score

Marbling is the intramuscular fat (IMF), which appears as fine flecks within the muscle. It is deposited unevenly throughout the body, increasing through the carcass towards the neck and decreasing towards the tail. As cattle fatten, deposits accumulate in all the main fat depots (under the skin, around the internal organs, between the muscles and inside the muscles) but some cattle have the genetic ability to favour the development of marbling within the muscles.

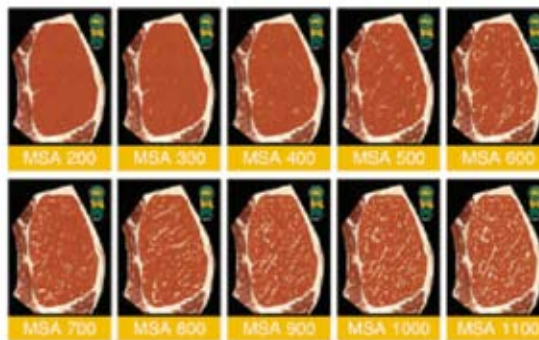
To maximise marbling, cattle must be on good nutrition, at least during the finishing stage, and well finished.

MSA research associates increased marbling to higher eating quality scores for many grilling and roasting cuts. The effect is greatest in the loin cuts (cube roll and striploin) but it is possible to achieve good eating quality without visible marbling.

The MSA grader assesses marbling on the exposed rib eye (eye-muscle) at the quartering site.

AUS-MEAT marbling is assessed on a scale of 0 to 6, reported in tenths within each score, and is based on the total amount of marbling within the eye muscle.

An MSA-specific marbling score is also given on a scale of 100 to 1190, in increments of 10, with emphasis on its fineness and how it is distributed. This is thought to relate more closely to eating quality.



MSA marbling standards 100 – 1190



AUS-MEAT beef marbling standards 0 – 6

(Please refer to MSA Tips & Tools 07 ‘The effect of marbling on beef eating quality’)

3.5 Sex

There are small differences in eating quality between steers and heifers, other factors being equal. Although small, the effect of sex is rather complex, with heifers having a lower eating quality in some muscles and higher in others compared to steers.

The biological basis for the sex effect is not clear at this stage.

Table 5 – Example of the effect of sex on eating quality

	Striploin MSA score	Topside MSA score	Rump MSA score
Male	55	36	51
Female	53	36	53

The example shown in table 5 compares otherwise identical steer and heifer carcasses with HSCW 240kg, AT hang, 150 ossification, 270 MSA marbling, meat colour 1C, rib fat 7mm, pH 5.55, aged for 5 days, cooking method grill, non HGP treated, 0% tropical breed content.

3.6 Rib fat

In ABCAS, Rib fat depth is primarily used as an indicator of saleable meat yield, but it also plays two roles in eating quality. Firstly, MSA requires a minimum of 3mm of subcutaneous fat at the quartering site with even fat distribution required over the entire body. This fat cover helps avoid eating quality problems caused by a rapid or irregular pattern of chilling (see fat distribution). Secondly, fatter carcasses have slightly improved eating quality, over and above that associated with marbling and in this case a small upward adjustment is made to the grilling cuts.

(Please refer to MSA Tips & Tools 14 ‘Fat distribution and eating quality’)

3.7 Other variable factors affecting eating quality

There are other factors affecting eating quality in the MSA model, but most are usually constant across competition groups, or are outside the producer’s control. The factors include:

3.7.1 Hang method

Tenderstretch hanging (from the pelvis) has a number of significant advantages over the traditional hanging from the Achilles tendon (AT or hock), including:

- Significant improvement in eating quality from most of the major high-priced cuts
- A reduced need for post-slaughter ageing to improve eating quality
- Significant improvement in eating quality of tropical breed types
- Counteracts the negative eating quality effects of hormonal growth promotants (HGPs)

(Please refer to MSA Tips & Tools 11 ‘How tenderstretch effects beef eating quality’)

3.7.2 Hormonal growth promotants (HGP)

HGPs have a negative effect on eating quality, especially in the grilling cuts. The detailed effects have been defined for the eating quality calculation in the MSA model.

(Please refer to MSA Tips & Tools 16 'The effect of IGP use on beef eating quality')

3.7.3 Milk fed vealer (MFV)

Unweaned calves produce beef with better eating quality compared to weaned calves of similar age and fatness. The MSA model adjusts scores for all cuts.

3.7.4 Saleyards

The extra stress of saleyard handling compared to direct transport from farm to abattoir has been shown to reduce eating quality. The MSA model adjusts scores across the carcass.

3.7.5 Ageing

Storing beef carcasses or vacuum-packed cuts for up to 21 days at 0-1°C improves tenderness. Improvement is greatest in AT hung carcasses, in those with higher tropical breed content and those treated with HGPs.

How to improve your score

The feedback from your score sheet provides a great deal of information and can identify areas for future improvement. When preparing cattle for a competition, remember that high scores come from three main factors:

1. Meeting the weight, fat, sex and dentition specifications of the class
2. High yield of saleable meat – optimum fat cover and heavy muscling
3. High eating quality – young and well nourished animal, not stressed, with marbling as a bonus



An 'average' young animal will achieve a high score if it is fed well in the final six weeks, it is not excessively stressed in the 24 hours before slaughter and it meets the correct weight and fat specifications. Very high scores are possible by retaining these features, increasing saleable meat yield and adding marbling. Yield has the greatest impact.

1. Meeting market specifications

Key indicators: HSCW; sex; dentition; P8 fat depth; meat colour; fat colour.

Meeting the weight/fat target is the key starting point for achieving a high score. Achieving a weight and fat target is a complex combination of management and animal factors – frame size, muscling, genetics – and nutrition. Heavily muscled or large framed cattle require higher level of nutrition (and/or a longer time) to put on the same fat depth.

Optimal meat colour comes from cattle that are younger, have high levels of nutrition and low pre-slaughter stress (see meat quality).

Ideal fat colour (firm and white) results from feeding a grain-based ration. Young, grass-fed cattle produce a creamy-white fat colour, which is highly acceptable for most markets. Deeper yellow fat is undesirable and comes with older, grass-fed cattle. Some feeds can change the characteristics of fat, for example, large amounts of lupins can produce fat that is soft and greasy.

2. Improving saleable meat yield

Key indicators: eye-muscle area (EMA), rib fat depth.

‘Yield’ is the weight of saleable cuts as a percentage of carcass weight. It is not to be confused with dressing percentage which is the ratio of carcass to live weight. High-yielding carcasses are heavily muscled with optimum fat depth.

Among cattle meeting market specifications and minimum quality requirements for grading, the greatest potential to improve your score is by increasing yield. CRC research confirms that high yielding carcasses contain significantly more beef.

- Ensure fat depth is within the optimum specifications – this will maximize your yield points with the particular animal. Over-fat carcasses require more trimming, resulting in lower yield
- To increase EMA points, and therefore yield, after fat depth is optimised, in future you will need to select a more muscular animal. Consider these points:
 - > Crossbreed, using high-yielding sire breeds
 - > Select bulls for moderate frame and heavy muscling, either visually or with help from BREEDPLAN EBVs for higher yield and EMA
 - > Heavily muscled cattle occur in most breeds, you don’t have to use large European types
 - > More muscular cattle usually put on less fat, especially if they are large framed – they may need more feed or longer preparation time to reach the target fat depth
 - > Females from heavily muscled bulls are just as functional for breeding, as long as you avoid the extremes.

3. Improving eating quality

Key indicators: pH, ossification score, tropical breed content, hump height, marbling, meat colour

The above key indicators along with other factors such as hanging method and ageing combine to produce the final eating quality score. As some factors interact with others, it is not possible to allocate points independently to each factor.

A score of zero in this section means the carcass failed to meet one or more of the minimum requirements for grading. This does not mean the beef has no value, but does mean its value has been severely downgraded against the industry's minimum quality benchmark.



- If you received zero in the eating quality section, use the individual feedback assessments to identify the reason. It may be pH over 5.7, meat colour over Chip 3, rib fat depth less than 3mm or inadequate fat distribution. Any of these factors will result in a complete loss of meat quality points, and should be given highest priority for correction in the future:
 - > High pH or dark meat colour are signs of pre-slaughter stress and low energy reserves at slaughter. Ensure as a minimum that nutrition is kept at a high level in the two weeks prior to slaughter, the animal has a quiet temperament and there is minimum handling and minimum time between farm and slaughter
 - > Inadequate rib fat or fat distribution – feed a better quality ration with sufficient energy or feed for longer prior to slaughter

- Once the carcass has met minimum grading requirements the best ways to maximize your eating quality score are:
 - > Ensure optimum pH (5.4-5.6) and meat colour (1b to 1c) by building up energy reserves before slaughter (good nutrition, minimum stress, avoid mixing with strange cattle, minimise handling, minimum time from farm to slaughter)
 - > Minimise the tropical breed content (hump height)
 - > Do not use hormonal growth promotants (HGPs)
 - > Increase marbling by using proven genetics (BREEDPLAN EBVs and GeneStar marbling)
 - > Ensure good growth, without setbacks, and a fat cover near the top of the optimum range



- > Aim for lower ossification score by faster growth for age

Apart from these animal factors, research by the Beef CRC and MSA has defined other significant factors that can be used to improve meat quality. These are either included in MSA grading requirements or the variable factors in the meat quality calculation. They include:

- Minimising pre-slaughter stress by conducting necessary pre-slaughter assessments well beforehand (say 2 weeks), and transporting cattle direct to the abattoir for slaughter without delay
- Ensuring chilling and electrical stimulation are operated by the abattoir to optimum specifications
- Hanging carcasses by tenderstretch to improve the eating quality of most major cuts and reduce the need for ageing
- Ageing cuts after slaughter to increase tenderness.

Further information

Meat Standards Australia www.msagrading.com

Beef CRC www.beef.crc.org.au

NSW Department of Primary Industries www.dpi.nsw.gov.au

It is important to remember that to receive eating quality points all carcasses must meet MSA minimum standards

1. Minimum of 3mm of rib fat
2. Adequate fat distribution
3. Ultimate pH below 5.7
4. Meat colour of 1b and no greater than 3

MSA website: www.msagrading.com

