Type ABVs explained

Genetics Backgrounder # 2 Updated November 2025

HIGHLIGHTS

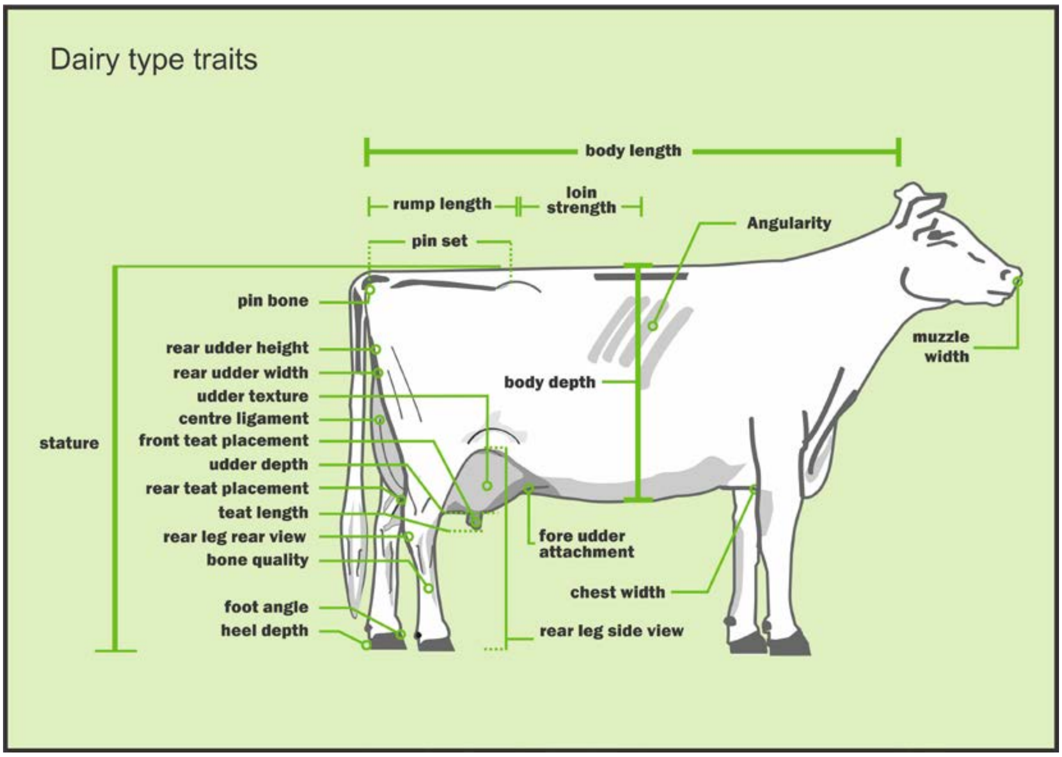
- DataGene publishes Type ABVs for 24 linear traits and 5 composite traits including Overall Type, Mammary System, Feet & Legs, Rump and Dairy Strength.
- Composites reflect the trait weightings and optimums for each trait set by breed organisations.
- For Composite Type ABVs, the average is 100 and one standard deviation is set to 5. To improve type composites, use bulls with ABVs more than 100.
- For individual Type ABVs, consider the optimum for that trait, the average linear for that trait, and the direction for breeding.

Dairy Australia

DataGene Solutions for Herd Development

Type matters

Type refers to a cow's structure – how she's put together – and is sometimes referred to as conformation. A cow's type affects her functional performance in the herd, which in turn influences how long she lasts in the herd. This is why type is a breeding priority for many Australian dairy farmers. For example, a cow with poor udder structure may be culled because it is difficult to attach cups to her in the dairy. The diagram shows the various physical features of a Holstein cow that are referred to as type traits in Australia. Traits are similar across breeds.



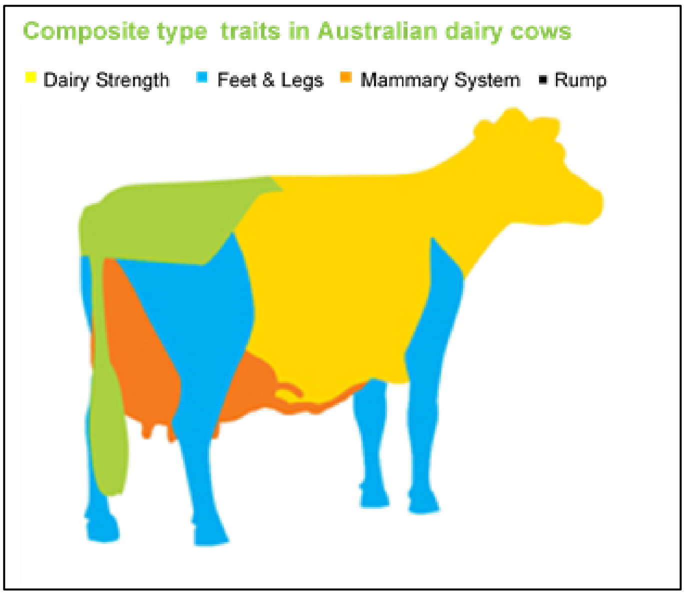
Breeding for improved type

Australian Breeding Values (ABVs) for type traits provide a tool for dairy farmers to breed for improved type in their herds. Type ABVs are published for Holsteins, Jerseys, Red Breeds and Guernseys. Genetic evaluation of type is not available for Brown Swiss cattle due to a small dataset in Australia.

DataGene publishes ABVs for 24 individual type traits, which are sometimes referred to as 'linears'.

Dairy farmers are often more interested in a group of traits which combine to affect a cow's functional performance in the herd. An ABV based on a combination of traits is referred to as a 'composite' trait. DataGene publishes ABVs for 5 composite type traits: Mammary System, Feet & Legs, Dairy Strength and Rump. The Overall Type ABV is a combination of all traits, so is also technically a composite. At this stage, the only composites published for Jerseys are Mammary System and Overall Type.

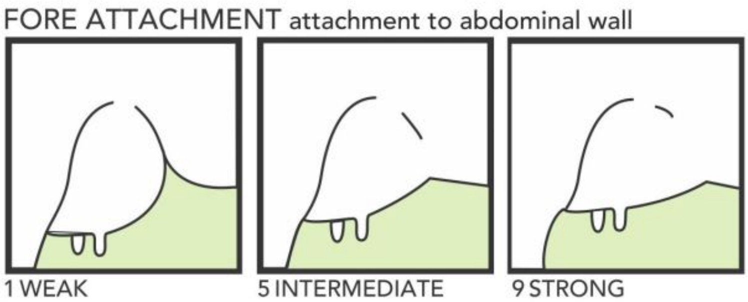
There are some variations in the composites provided to each breed as a result of differences in classification systems.



Using Type ABVs

Type ABVs are expressed against the breed average, which is set at 100 with a standard deviation set to 5; for example, an ABV of 105 is 1 standard deviation above average (refer Appendix 3).

For many traits, an ABV of more than 100 indicates an animal that is greater than the breed average for that particular type trait. Take for example, fore udder attachment. A stronger fore udder attachment is desirable because it has a strong association with longevity in Holstein and Jersey cows (Pryce, 2014). The 'optimum' or 'ideal' is therefore very strong fore attachment.



- ✓ To improve this fore udder attachment: choose bulls with an ABV of greater than 100.

The same applies to the 4 composite traits (Mammary System, Feet & Legs, Dairy Strength and Rump) and Overall Type.

Australian breed associations set the optimums for each type trait. For more details on type trait optimums refer to Appendix 2, 3 and 4.

Intermediate optimums (ideals)

More is not always better. For some traits the optimum is an intermediate score.

An example is rear teat placement, which refers to the placement of rear teats relative to the centre of the quarter. Rear teat placement affects the ease with which cups can be attached in the milking shed. Neither extreme is desirable: cups are difficult to attach if rear teats are too close or too wide. The optimum position is intermediate. A bull with a Rear Teat Placement ABV of 100 is breed average but the optimum for the trait may be different.

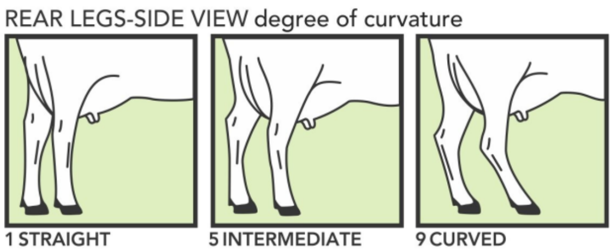
Since December 2025, DataGene has enhanced the way it expresses six traits with intermediate optimums:

1. Pin Set
2. Rear Set
3. Udder Depth
4. Teat Placement Fore
5. Teat Placement Rear
6. Bone Quality

The way these ABVs are calculated has not changed. The change in expression just makes it easier for breeders to recognise animals that are close to the intermediate optimum. The change involved including a letter after the breeding value. The letter indicates if the ABV is within the optimum range (O) or an alternative letter indicating the trait direction. Refer Appendix 3 for more details.

The following example shows how Rear Leg Set ABV is expressed in Jerseys:

- 90 S (indicates Straight).
- 96 O (indicates Optimum)
- 100 C (indicates Curved)



In Jerseys, to breed for optimum rear leg set select bulls within the range of 95 O to 97 O.

The table below describes how DataGene expresses type traits with intermediate optimums.

Expression of type traits with intermediate optimums
(from Dec 2025)

Lower breeding values ⟷ Higher Breeding values

	Letter	Description	Optimum	Letter	Description
Pin Set	H	High	**O**	L	Low
Rear Leg Set	S	Straight	**O**	C	Curved
Bone Quality	C	Coarse	**O**	S	Sharp
Udder Depth	D	Deep	**O**	S	Shallow
Fore Teat Placement	W	Wide	**O**	C	Close
Rear Teat Placement	W	Wide	**O**	C	Close

The table below describes the ABV definitions of intermediate optimums for various traits by breed.

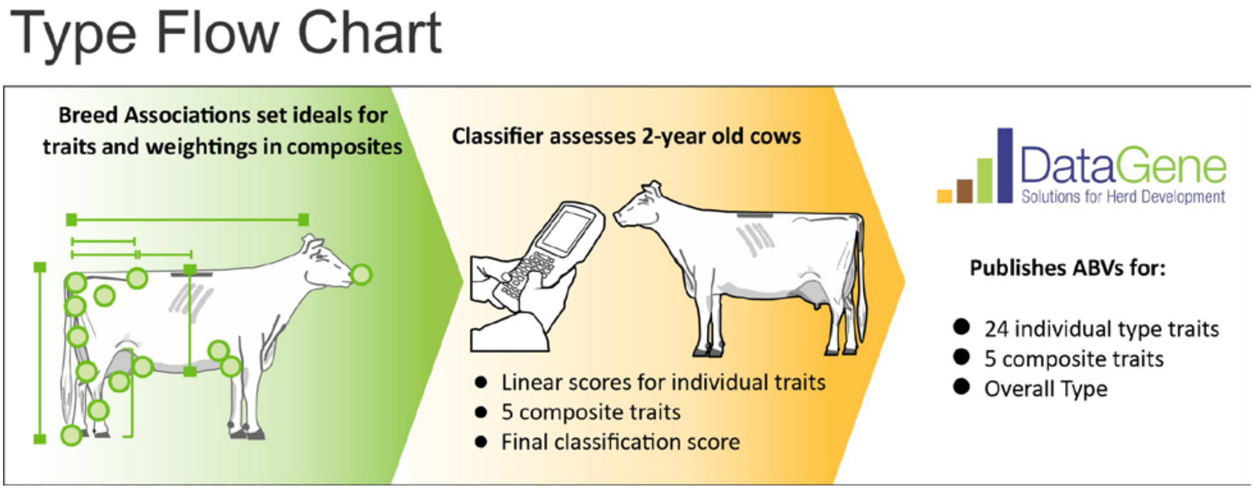
Intermediate optimum ABVs by breed
(from Dec 2025)

	Holstein	Jersey	Aussie Red
Pin Set	107-114	97-104	101-104
Rear Leg Set	95-97	95-97	93-95
Bone Quality	102-104	103-105	102-104
Udder Depth	100-105	101-107	100-102
Fore Teat Placement	101-109	99-101	99-102
Rear Teat Placement	85-93	97-99	90-95

Information behind type ABVs

Type is recorded by trained classifiers who visit farms and assess cows individually based on the biological range of each type trait.

Each individual trait is assessed against the linear ranges of that trait then that score is compared to the 'optimums' set by the breed association and recorded by the classifier. Results for individual traits are referred to as Linear Type scores. The optimums taken together describe how the ideal cow is put together.



Calculating composites

Classifiers combine the linear trait scores to calculate composite scores (rump, mammary, feet and legs and dairy strength) by applying a weighting to each trait. These, in turn, are combined into a score for overall type. These composite classification scores contribute to the ABV calculation (along with data from other sources including pedigree, Interbull, genomics etc).

The following tables shows the linear traits that contribute to each composite type ABV. Breed associations set the relative weightings of linear traits in each composite. Two composite type traits are published for the Jersey breed.

Traits included in composite Type ABVs from 2020 for Holsteins, Red Breeds and Guernseys For animals scored after 2007, the classification composite has the most influence on the ABV	
Mammary ABV	Mammary score, udder depth, teat length, fore attachment, fore and rear teat placement, rear attachment height and width, udder texture, central ligament
Feet & Leg ABV	Feet & Leg score, foot angle, heel depth, rear set, bone quality, rear leg view
Dairy Strength ABV	Dairy Strength score, stature, muzzle width, body depth, chest width, angularity and loin strength
Rump ABV	Rump score, pin set, pin width and loin strength
Overall Type ABV	Final score, old overall type, mammary composite, feet & leg composite, dairy strength composite, rump composite

Traits included in composite Type ABVs for Jerseys	
Mammary ABV	Udder depth, udder texture, fore attachment, rear attachment height, rear attachment width, centre ligament, rear teat placement, front teat placement, teat length
Overall Type ABV	Final score

Overall Type

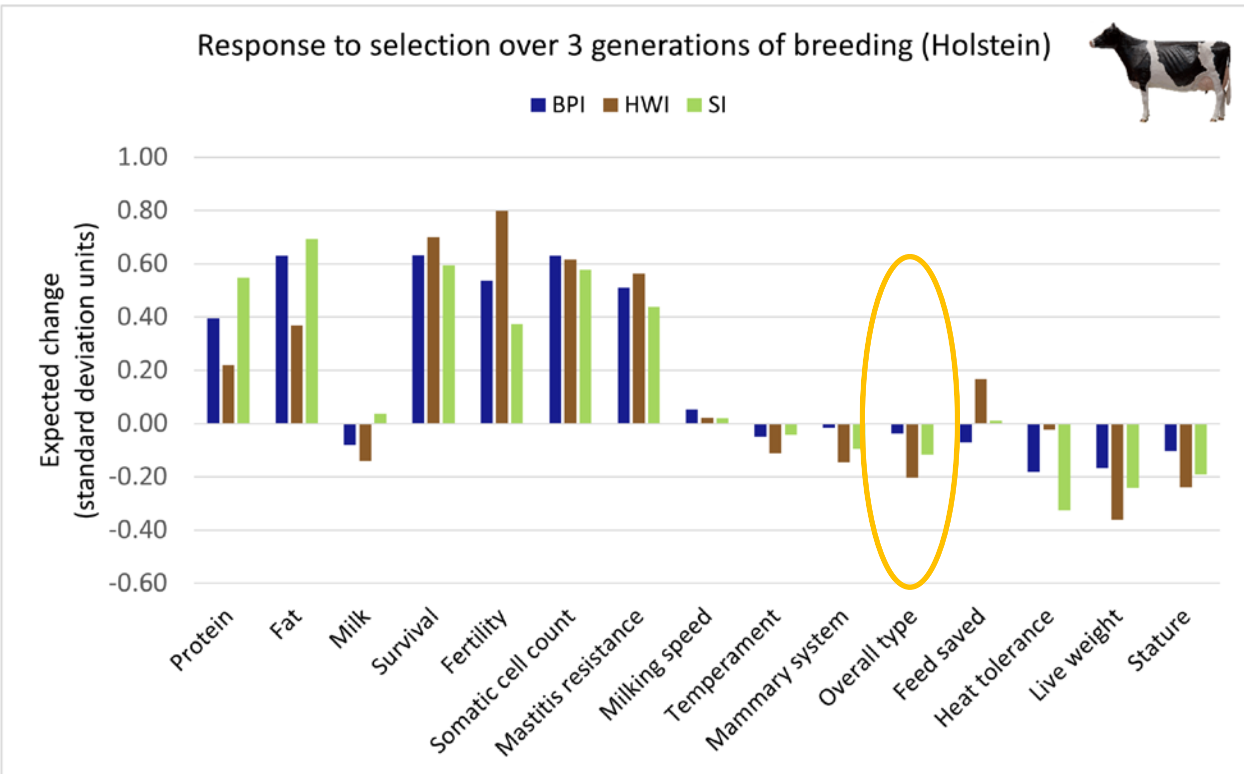
The Overall Type ABV is based on Final Score and a combination of the four composite type ABVs, where available. The weightings in Final Score are set by breed associations.

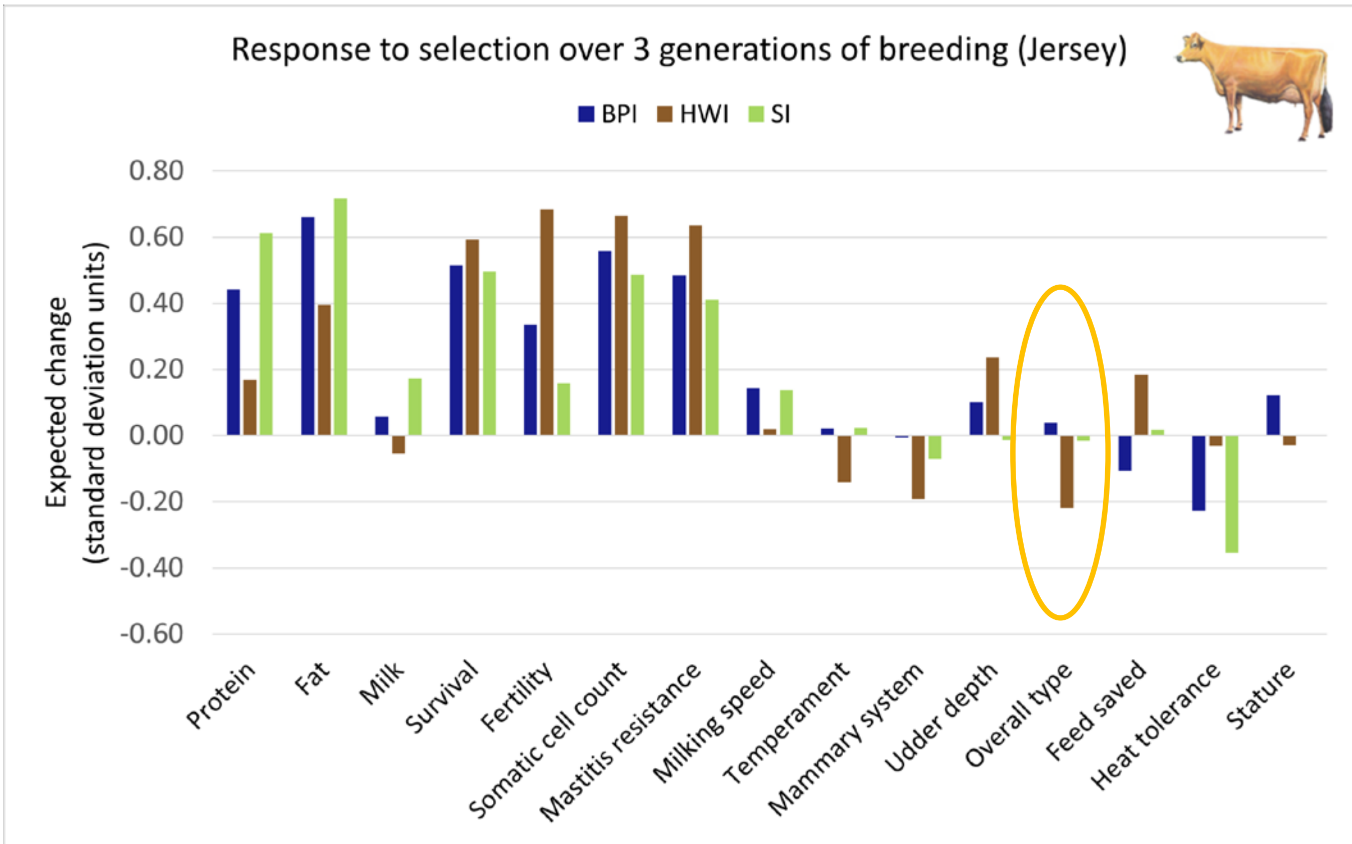
Composite	**Holstein**	**Jersey**	**Aussie Reds**	**Ayrshires**	**Illawarra**	**Guernsey**
Mammary System	40%	35%	40%	40%	40%	40%
Feet & Legs	25%	10%	25%	15%	25%	25%
Dairy Strength	25%	40%	25%	35%	25%	25%
Rump	10%	15%	10%	10%	10%	10%

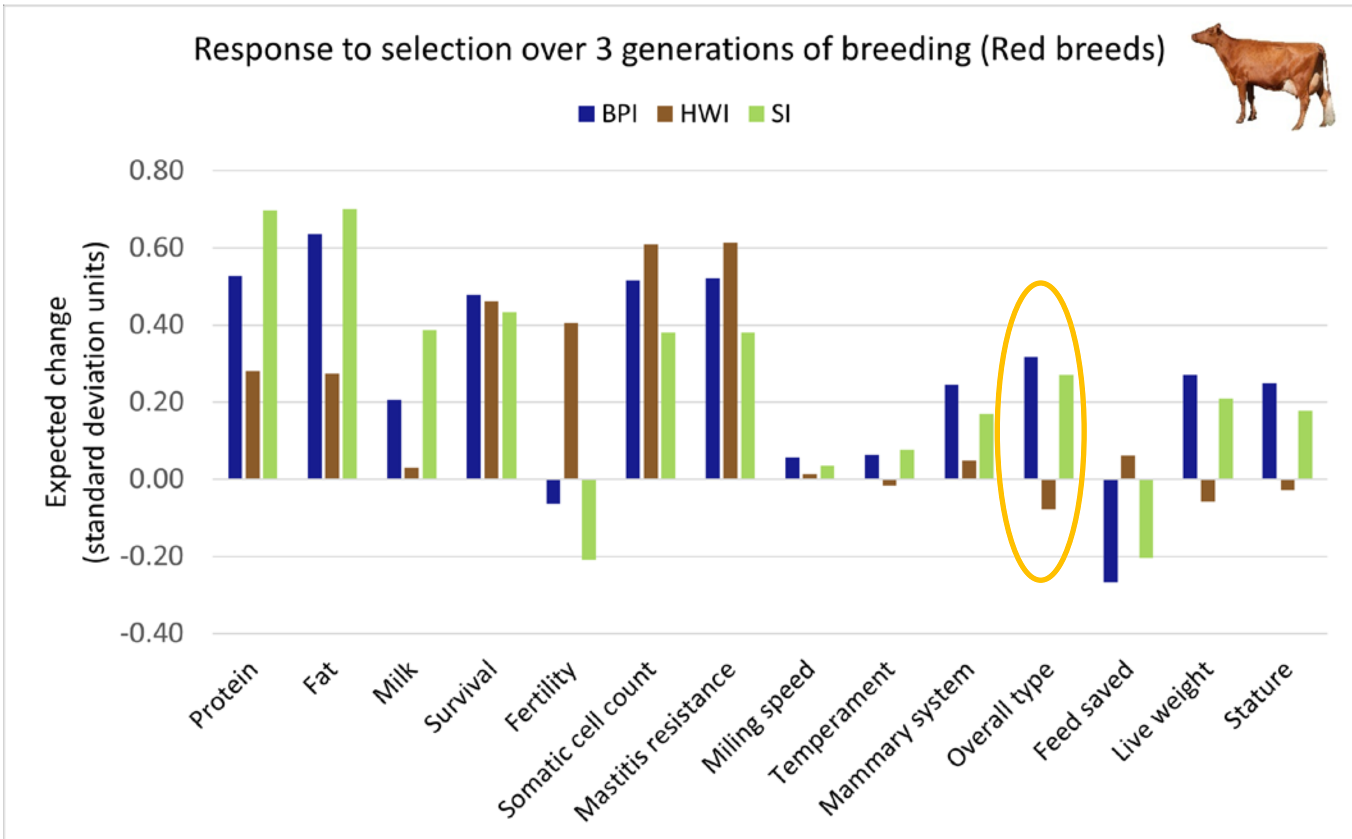
For the Jersey breed, Overall Type is calculated from Final Score supplied by breed organisations. Mammary System ABV is calculated as an index of six mammary traits which include udder texture, fore attachment, rear attachment height and width, central ligament and front teat placement.

Indices: BPI, HWI, SI

Overall Type, Mammary System, Udder Depth, Pin Set are included in Australia's three indices: Balanced Performance Index (BPI), Health Weighted Index (HWI) and Sustainability Index (SI). The following breed-specific charts show the expected type response to selection from using the BPI,HWI and SI.

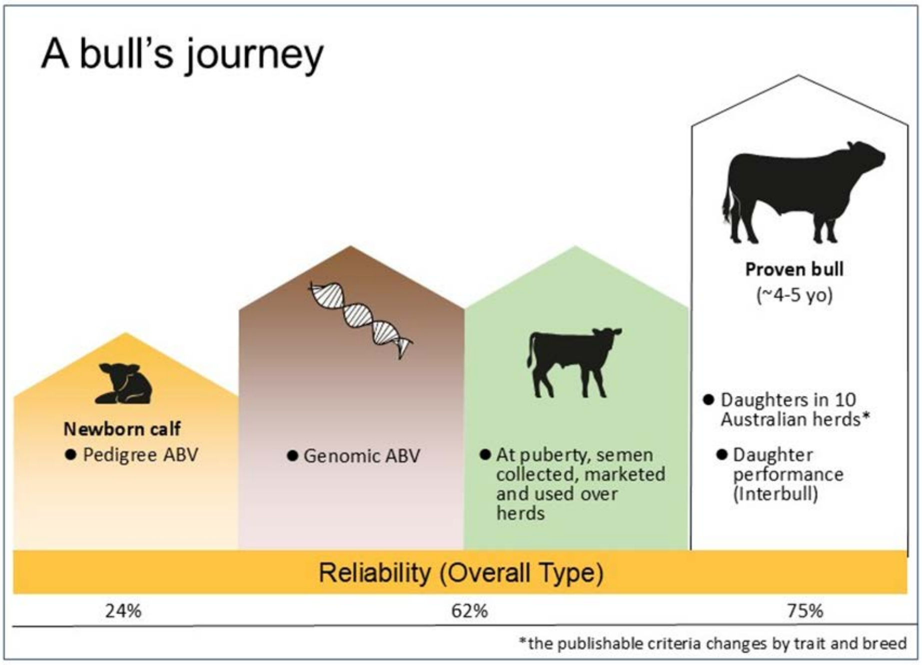



Response to selection over 3 generations of breeding (Jersey)
BPI HWI SI
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
Expected change (standard deviation units)
Protein
Fat
Milk
Survival
Fertility
Somatic cell count
Mastitis resistance
Milking speed
Temperament
Mammary system
Udder depth
Overall type
Feed saved
Heat tolerance
Stature


Response to selection over 3 generations of breeding (Red breeds)
BPI HWI SI
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
Expected change (standard deviation units)
Protein
Fat
Milk
Survival
Fertility
Somatic cell count
Mastitis resistance
Miling speed
Temperament
Mammary system
Overall type
Feed saved
Live weight
Stature

Sources of information for bull ABVs

Through a bull's life, information used in genetic evaluation changes. Before he has any progeny, only pedigree and genomics are used for his breeding value. A bull may have daughters overseas so Interbull information will be used in any trait where multi-country evaluations are available. Overall Type, Mammary System, Feet & Leg Composite ABVs and many linear traits include contributions from Interbull for bulls with daughters overseas. As Australian daughters enter the milking herd, their information will begin to influence his breeding values. With enough Australian daughters, the most of a bull's breeding value comes from these Australian records.



Acknowledgement

The improvements to Type evaluations are the result of DairyBio research. DairyBio is a joint initiative between Agriculture Victoria, Dairy Australia and the Gardiner Dairy Foundation. In particular, we thank Prof J Pryce and Dr M Haile Mariam for their research.

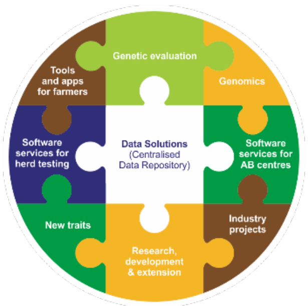
We thank Rohan Butler, Holstein Australia for investigating average scores. Holstein Australia also supplied some of the graphics.

We also thank breed associations, farmers, herd recording centres and software providers who supply data used in genetic evaluations.

More information

Pryce, J (2014) Long lasting cows, a report to the 2015 NBO steering committee

Holstein Australia's classification system   Jersey Australia classification system



About DataGene

DataGene is an independent and industry-owned organisation responsible for driving genetic gain and herd improvement in the Australian dairy industry. DataGene performs pre-competitive herd improvement functions such as genetic evaluation, herd testing and herd improvement software development and data systems. DataGene is a Dairy Australia and industry collaboration. www.datagene.com.au Ph 03 9032 7191
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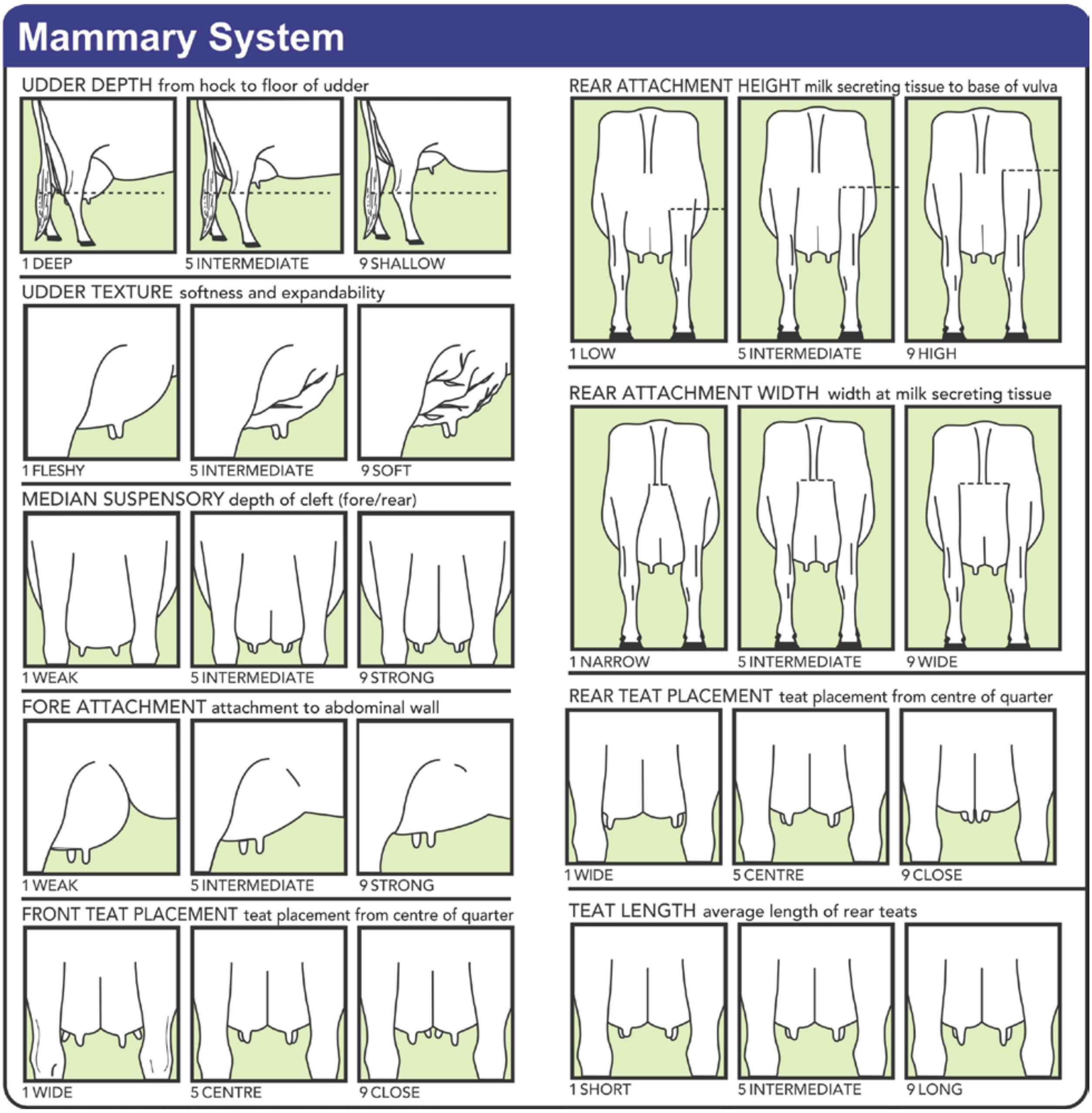
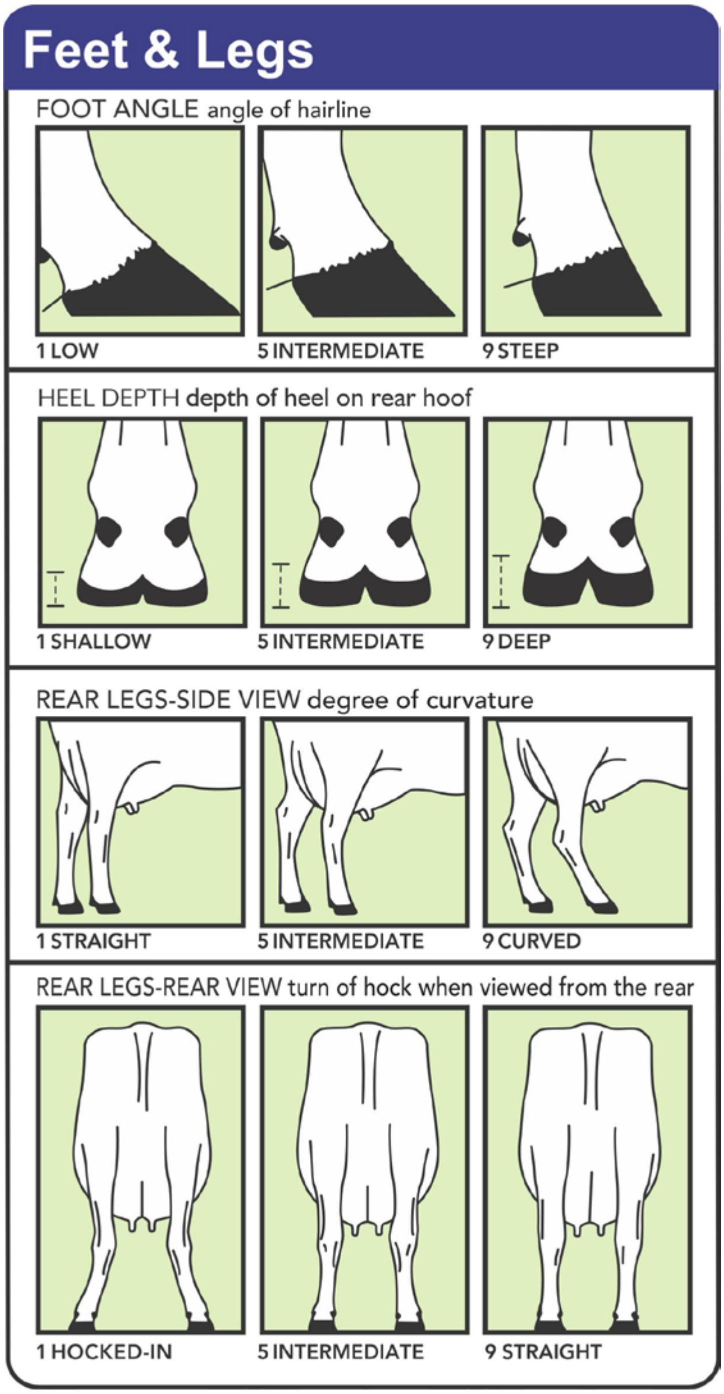
Appendix 1: Glossary of terms

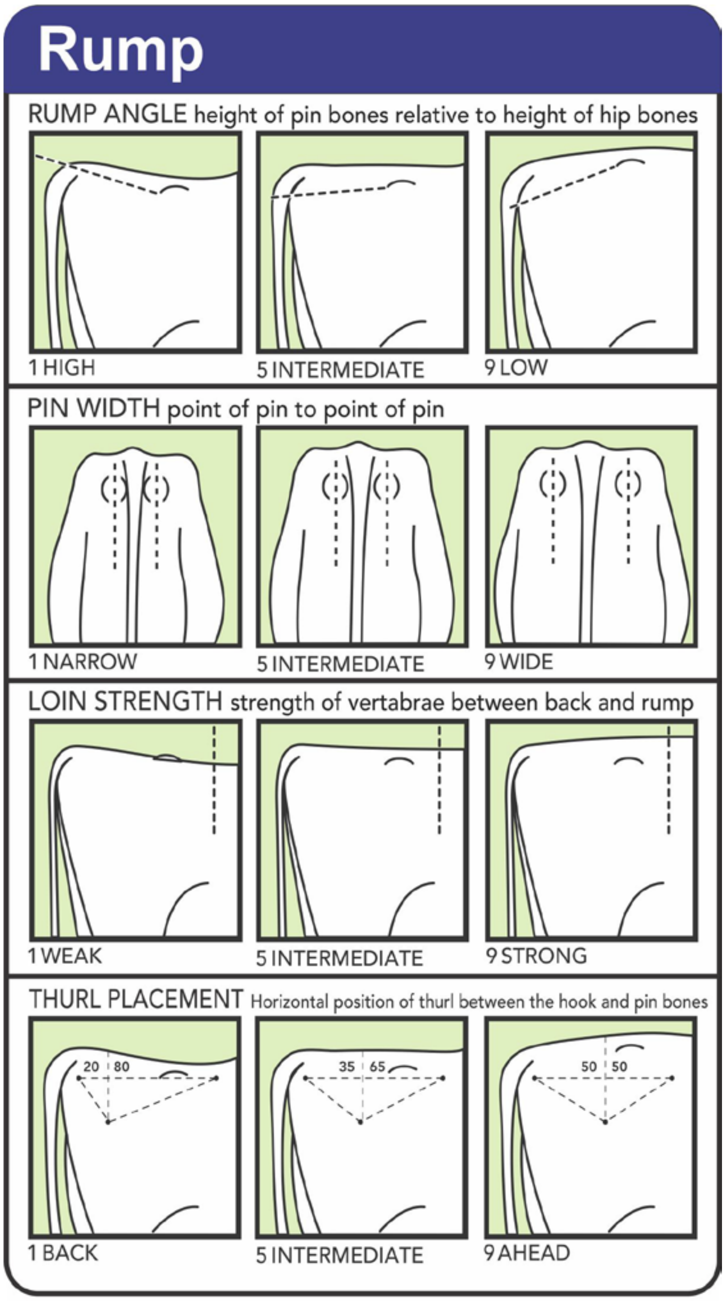
Classifier	A trained person who visits the farm to assess the type traits of cows against the optimums set by breed associations.
Classification score	An overall score for type based on all linear scores. Used by breed associations and DataGene.
Composite trait	A combination of individual traits that together affect the functional performance of a cow. For example, rump is a composite of pin set, pin width and loin strength. It helps to consider these traits together as collectively they influence calving ease and fertility.
Conformation	Features of the physical structure of cattle that influence functional performance in a dairy herd. For example, the angle of a cow's rump (pin set) affects fertility, calving ease and positioning of the feet and legs.
Interbull	The organisation responsible for exchanging dairy cattle genetic evaluation data between countries.
Trait optimums	The preferred physical characteristics of a type trait, as set by breed associations. For example, the optimum udder depth for Holsteins is intermediate (5-6 on a scale of 1 to 9) Refer to Appendix 1.
Linear trait	A linear type trait is an individual physical feature and describes the biological range for a trait. For example, udder depth is a linear trait.
Linear score	A linear score is a measure given to describe a linear trait by a classifier. For example, Holstein linear traits are scored on a scale of 1 to 9.
Weighting	Weighting refers to the relative emphasis given to individual traits in a composite during the classification process. For example, Udder Depth contributes 13% to the mammary system composite trait. Weightings are set by breed associations.

Appendix 2: Trait diagrams

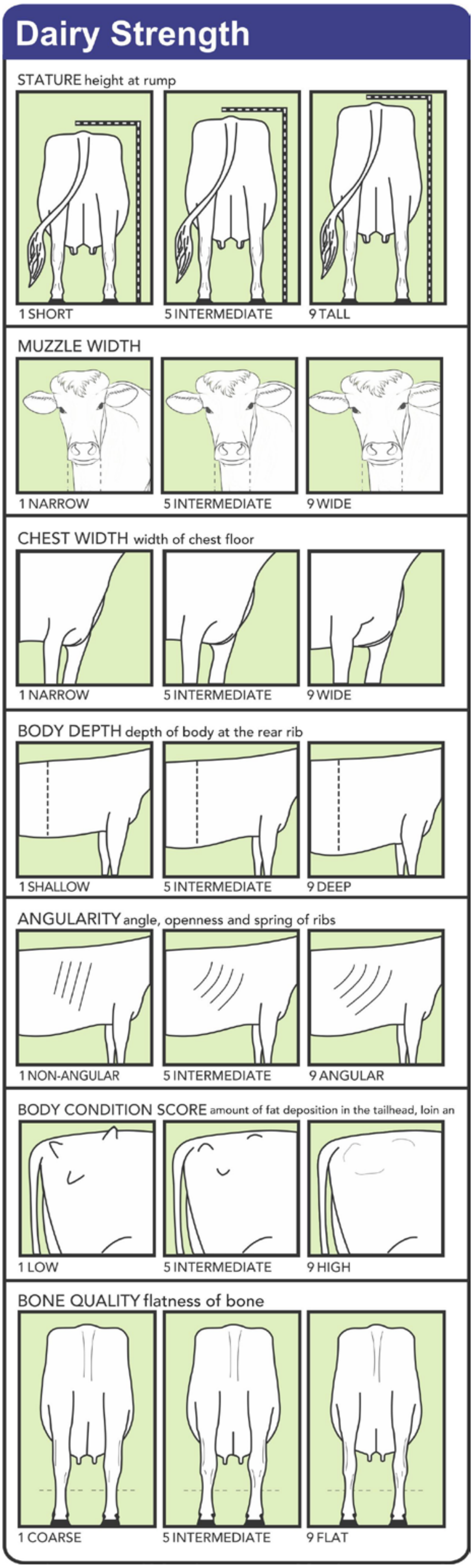
The following illustrations show the extremes and intermediate for type traits.







* For more information on foot angle and heel depth, refer to Appendix 6


Dairy Strength
STATURE height at rump
1 SHORT
5 INTERMEDIATE
9 TALL
MUZZLE WIDTH
1 NARROW
5 INTERMEDIATE
9 WIDE
CHEST WIDTH width of chest floor
1 NARROW
5 INTERMEDIATE
9 WIDE
BODY DEPTH depth of body at the rear rib
1 SHALLOW
5 INTERMEDIATE
9 DEEP
ANGULARITY angle, openness and spring of ribs
1 NON-ANGULAR
5 INTERMEDIATE
9 ANGULAR
BODY CONDITION SCORE amount of fat deposition in the tailhead, loin an
1 LOW
5 INTERMEDIATE
9 HIGH
BONE QUALITY flatness of bone
1 COARSE
5 INTERMEDIATE
9 FLAT

Appendix 3: Trait optimums and weightings in composites

Breed associations set trait optimums and their relative contribution to composite scores (weight). Classifiers use a sliding scale of 1 to 9 to measure each trait, with a score of 5 representing the intermediate position of the two biological extremes. Depending on the trait, the optimum could either be "9" so that the extreme is wanted, such as Pin Width, or an intermediate optimum, such as Teat Length with an optimum linear score at 5 as neither too short (1) nor too long teats (9) are desirable. Composite scores are calculated by comparing linear to the optimum linear for each trait.

Dairy Strength

Trait	Holsteins		Jersey
	Optimum	Weight	Optimum
Stature	6-8	5%	9
Muzzle Width	9	12%	9
Chest Width	7	22%	7
Body Depth	7	18%	7
Angularity (rib)	9	25%	9
Bone Quality	7	13%	7
Loin Strength	9	5%	Cow 6 Heifer 7
Body Length	n/a	n/a	9
Composite weighting in Overall Type		25%	n/a

Mammary System

Trait	Holstein		Jersey
	Optimum	Weight	Optimum
Udder Depth	5-6	13%	Heifer 4 Cow 3
Udder Texture	9	14%	9
Centre Ligament (median suspensory)	9	12%	9
Fore Attachment	9	16%	9
Front Teat Placement	6	8%	7
Rear Attach – Height	9	11%	9
Rear Attach – Width	9	11%	9
Rear Teat Placement	5	8%	5
Teat Length	5	7%	5
Composite weighting in Overall Type		40%	n/a

Feet & Legs

Trait	Holstein		Jersey
	Optimum	Weight	Optimum
Foot Angle	7	12%	5
Heel Depth	7-9	24%	6
Rear Set (Rear legs Side view)	5	22%	5
Rear Leg Rear View	9	30%	9
Thurl* placement	6	12%	n/a
Composite weighting in Overall Type		25%	

Rump

Trait	Holstein		Jersey
	Optimum	Weight	Optimum
Pin Set (rump angle)	5-6	24%	6
Pin Width	9	21%	9
Loin Strength	9	32%	Cow 6 Heifer 7
Rump Length	n/a	n/a	9
Thurl* placement	6	23%	n/a
Composite weighting in Overall Type		10%	n/a

* Thurl doesn't have an ABV. It contributes to Rump ABV via Rump classification score

Appendix 4: Holstein ABVs, average linear scores

Depending on your breeding goals, extremes are not always optimum for type traits, and therefore the highest ABVs are not always desirable. The table below shows the average linear scores for cows grouped by ABV for each trait. This helps to visualise the typical linear scores of animals with varying ABVs. To see what each score looks like, refer to Appendix 1 and 2.

Average linear (classification) score for Holstein animals with a given ABV for that trait and the optimum or ideal for that trait highlighted in blue.
i.e. the average linear score for animal with a breeding value of 100 for bone quality is 6.7

Linear Trait / ABV	90	95	Breed Average: 100	105	110	Extreme Optimum (>110)
Stature	4.6	5.5	6.3	7.1	8.0	
Angularity	4.3	5.0	5.6	6.2	6.8	✓
Muzzle Width	5.0	5.5	5.9	6.4	6.8	✓
Chest Width	3.9	4.6	5.3	6.1	6.8	✓
Body Depth	4.1	4.9	5.7	6.4	7.2	✓
Pin Set	2.6	3.3	4.0	4.7	5.4	
Pin Width	5.1	5.7	6.4	7.0	7.6	✓
Loin Strength	5.1	5.7	6.3	6.9	7.5	✓
Heel Depth	4.5	5.0	5.5	6.0	6.5	✓
Foot Angle	4.0	4.6	5.3	5.9	6.5	✓
Rear Set	4.1	4.9	5.6	6.4	7.2	
Rear Leg Rear View	4.1	4.9	5.7	6.5	7.3	✓
Bone Quality	5.8	6.3	6.7	7.2	7.7	
Udder Texture	4.2	4.9	5.6	6.3	7.0	✓
Udder Depth	3.3	4.2	5.1	6.0	6.9	
Fore Attach	4.1	4.8	5.6	6.3	7.1	✓
Rear Attach Height	4.8	5.6	6.3	7.1	7.8	✓
Rear Attach Width	3.0	4.3	5.5	6.7	8.0	✓
Centre Ligament	5.1	5.6	6.2	6.7	7.3	✓
Fore Teat Placement	3.6	4.2	4.9	5.5	6.1	
Rear Teat Placement	5.7	6.3	6.9	7.5	8.1	
Teat Length	3.0	3.7	4.4	5.1	5.8	

Appendix 5: Standardised ABVs

Comparing ABVs

Australian Breeding Values (ABVs) are a relative measure of an animal's genetic merit. They make more sense when compared to each other or to an average. The 'average', also known as the 'base' is a clearly defined group of animals to which all others are compared.

In Australia, average is all cows sired by AI (NASIS bulls) of the same breed that are born between 2009 and 2013.

Standard Deviations

A standard deviation is a statistical term that is describes how much spread there is in a set of numbers.

- The size of a standard deviation is small if there isn't much variation in the numbers.
- The size of a standard deviation is larger if there is greater difference in the spread of the information from best to worst.

In the case of animal performance, there are usually lots of animals that are about average and fewer animals that are extreme (either extremely bad or extremely good). This is a normal distribution pattern of data which is illustrated in Figure 1.

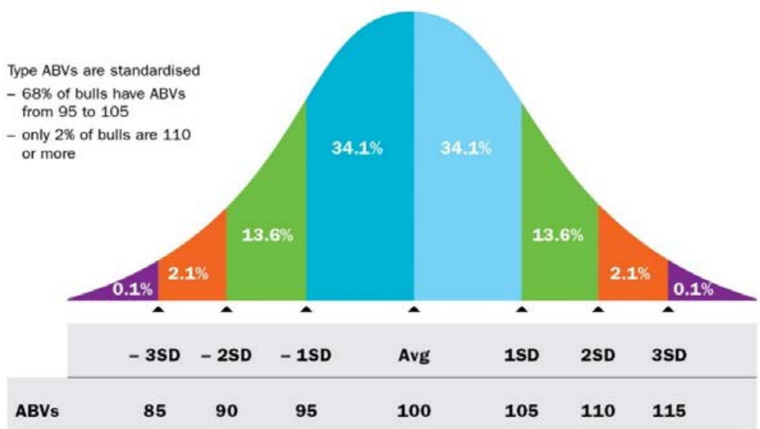
In a normal distribution:

- One third of animals will be within 1 standard deviation above average and another third below average.
- A smaller number (27%) will be between 1 and 2 standard deviations,
- A very small number (4%) will be between 2 and 3 standard deviations, and

The size of the standard deviation depends on how much difference exists between the best and worst groups of animals. To apply this to dairy cattle breeding, the trait of Rear Leg Set is a good example. There isn't much difference between best and worst. In fact, the standard deviation is about 5 whereas Stature has more than double the size of a standard deviation (11 for Holsteins).

If you know the size of the standard deviation, it's easy to figure out if an animal is average, a bit above average or extreme for a trait.

Figure 1: Normal distribution curve showing the proportion of a population expected in each standard deviation (SD).



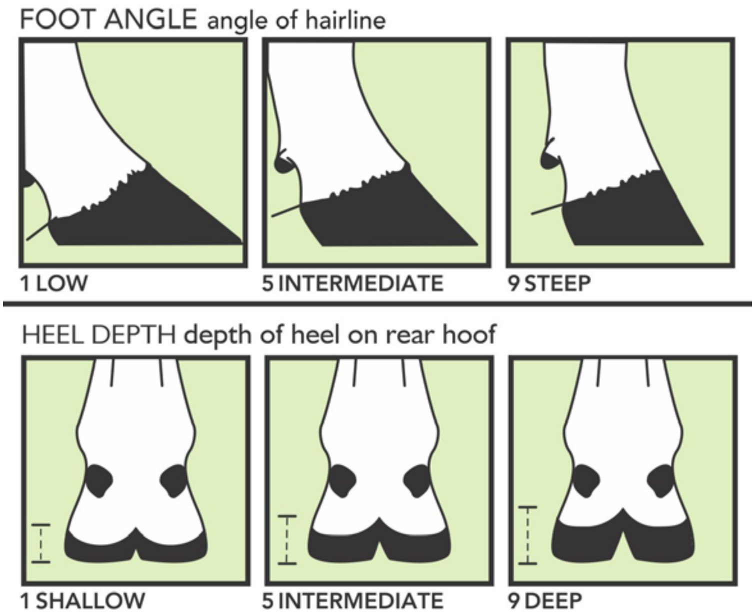
Appendix 6: Heel depth and foot angle

Australian dairy cows may have to walk long distances to and from the dairy. Good hoof health is important.

Heel depth and foot angle are two separate traits. While both relate to hoof conformation, they are measured differently, and some animals can have quite different ABVs for the two traits. An intermediate score is desirable for both traits.

Foot angle: describes the angle of the hairline on the hoof from low to steep. It is assessed from the side view of the animal. To increase foot angle, choose bulls with a Foot Angle ABV of greater than 100.

Heel depth: describes the depth of the heel on the outside claw. It relates to the groove (upside down V) that is taller or shorter in different animals. Heel depth is assessed from the rear view of the animal. To breed for deeper heel depth, select bulls with an ABV greater than 100.



Relationship with other traits

DairyBio researchers analysed the relationship between heel depth, foot angle and other traits such as feet and legs, health and survival traits (table).

Type
Both heel depth and foot angle are positively correlated (0.32), but the relationship is stronger between heel depth and overall feet and legs (0.62) compared to heel depth and foot angle (0.32).

Survival (longevity)
The relationship between heel depth and survival (0.55) is much stronger than the relationship between foot angle and survival (0.08).

Survival is also positively correlated with both feet & legs (0.44) and rump (0.41) composites.

It is worth noting that survival is to some degree influenced by Overall type and rump angle (both are used in the Survival ABV).

Correlation* between Heel Depth ABV and Survival ABV and other traits. Grey indicates the relationship between Heel depth, foot angle and longevity/survival.

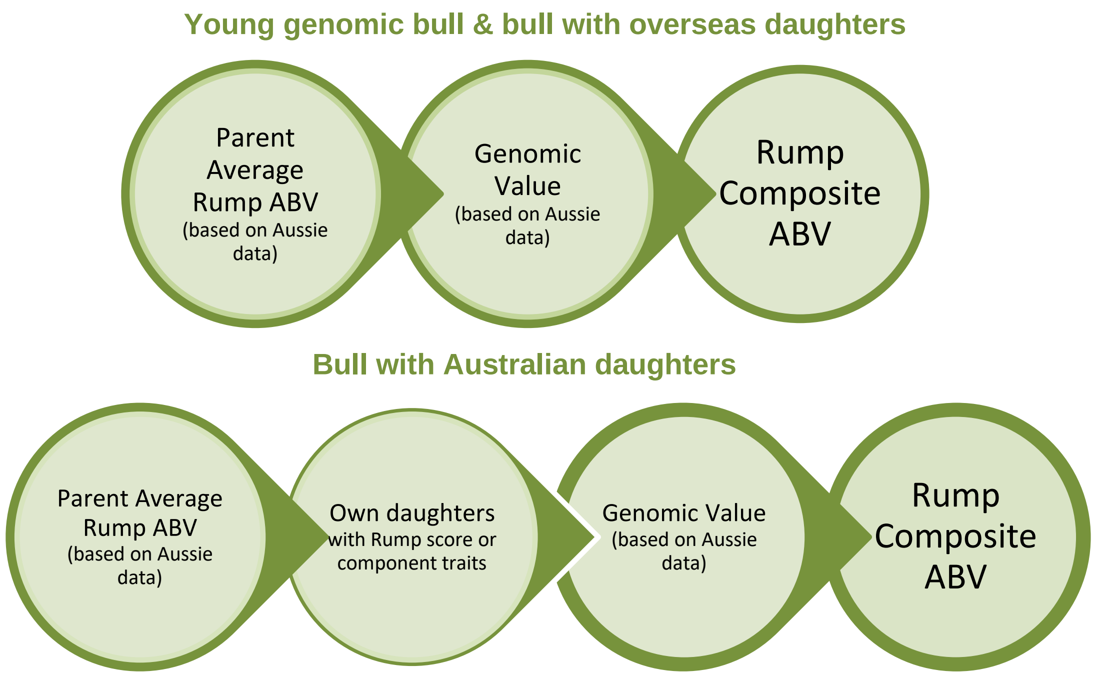
Trait	Heel depth	Survival (longevity)
Foot Angle	0.32	0.08
Heel Depth		0.55
Rear Leg, Rear View Leg	0.35	0.38
Overall Feet & Legs	0.65	0.44
Overall Type	0.59	0.64
Rump	0.29	0.41
Dairy Strength	0.15	-0.03
Mammary System	n/a	0.71
Mastitis	n/a	0.1
Somatic Cell Count (SCC)	0.41	0.7
Daughter Fertility	-0.12	0.26
Survival	0.55	

Correlation values indicate strength of relationship between traits. They range from +1 (strong positive relationship) to -1 (strong negative relationship).

Health
The results also show that mammary system and survival are strongly correlated (0.71). Heel depth is weakly, negatively related to daughter fertility, indicating that heavy selection pressure for heel depth could result in a slight reduction in daughter fertility.

Appendix 7: Interbull blending
(Rump and Dairy Strength Composites)

Rump Composite and Dairy Strength Composite are not routinely evaluated by Interbull. The information that influences these composite traits is based on Australian data, rather than information from other countries through Interbull. The following explains the evaluation of a non-Interbull trait, using Rump Composite as the example.



Steps in the genetic analysis

1. Calculate the Australian-only ABV

This includes data on Australian scored cows only.

The rump composite is calculated in a multi-trait analysis, so if it is not scored on a cow, but some other rump traits are, she will still get a Rump Composite ABV. This is mostly relevant to cows scored before 2007. The known relationships between these traits are used to fill in for the missing traits.

Bulls without Australian daughters (young genomic bulls and bulls with overseas daughters) will get a PARENT AVERAGE based on this analysis.

DataGene does not publish an ABV for thurl placement so this trait is only included for cows with a rump classification score.

2. Interbull blending

The Australian-only ABVs are augmented with MACE proofs on the animal or its relatives, for traits included in MACE analysis. This includes Overall Type, Mammary System and Feet and Legs, but not Rump and Dairy Strength composites (nor Heel Depth and Thurl Placement).

No attempt is made to re-estimate the rump composite based on MACE proofs for component traits, so after the Interbull blending step, for Rump the best estimate is still the Australian-only ABV.

Australian-only ABVs for Pin Width (Rump Width) and Pin Set (Rump Angle) are augmented with MACE proofs on the animal or its relatives. However, this does not flow through to Rump Composite for this component of the ABV.

3. Marker effect estimation

This uses deregressed proofs from the Australian-only ABV analysis. Only data from Australian scored cows is used. It uses information on component traits. In the case of Rump Composite, it uses pin set, pin width and loin strength.

4. Direct Genomic Value

Uses marker effects estimated above.

5. Genomic ABVs

Includes Direct Genomic Values and uhat, the latter estimated from the same deregressed proofs as used for the marker effects. For Rump the genomic therefore includes:

- The parent average or ABV for Rump based on observations on Australian cows for Rump or component traits
- The DGV is based on observations on Australian cows for Rump or component traits.

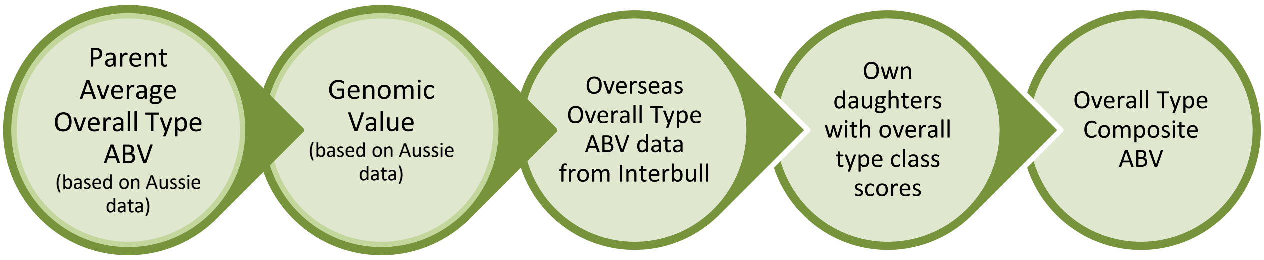
The relative weight of these components in the genomic ABV depends on their reliability. Traits with higher reliability have more weight.

The consequence of this calculation is that there may be overseas information going into components traits but not into the Rump composite.

Appendix 8: Interbull blending
(Overall Type, Mammary and Feet & Leg composites)

Overall Type, Mammary and Feet & Leg composites are routinely evaluated by Interbull. The information that influences these composite traits is a combination of Australian data (including genomics) and information from other countries through Interbull. The following example (Overall Type) explains the evaluation of a composite that includes Australian and overseas data.

Bull with Australian and overseas daughters



Data from different sources is added to a bull's breeding value when it becomes available. In the early period of a bull's career the breeding value is dominated by genomic data which includes Parent Average (pedigree). If the bull is from overseas, semen is usually distributed in their country of origin first. This means that the bulls first daughters to calve are in herds overseas and are subsequently picked up by Interbull. This data is then added to the genomic estimate and some proof movement occurs from time to time, especially if the Interbull data is somewhat different to the genomics. The breeding value reaches its most accurate phase with the addition of data from the bull's Australian daughters that are classified by the breed society classifiers. Local data is not added to the ABV until the bull meets the publishable threshold for type (which is daughters in 10 herds). If there is a difference in the performance of the Australian daughters and the Interbull estimate, their type ABVs and composites will change.

Composite trait definitions

Composite traits are defined differently around the world. At times this leads to variation when comparing Australian Breeding Values with those from other countries. This difference in trait definition can result in proof movement when the overseas data is added to the ABV via Interbull. As a rule, individual linear type traits measurements are a consistent around the world leading to higher correlations between linear traits than those that are achieved by the composite traits.

Within composite traits there are traits with varying weightings, ranges and heritability. This means that the composite trait does not have a simple relationship with its components and sometimes people struggle to understand how the value for the composite has been derived as it can't be explained by simple maths.