

## INTERBULL breeding values calculated April 2019

This newsletter is primarily written for VikingGenetics staff and breeding advisors in Denmark, Sweden and Finland, but can also be of interest for dairy farmers.

### Table of content

International breeding values for the traits and breeds shown in table 1 have been published 02.04.2019.

Current evaluation	
<b>Daughter proven bulls:</b>	<b>Young genomic tested bulls:</b>
<b>Yield</b>	<b>Yield</b>
Conformation	Conformation
Somatic cell count and udder health	Somatic cell count and udder health
Longevity	Longevity
Calving – maternal and direct	Calving – maternal and direct
Female fertility	Female fertility
Milking speed and temperament	Milking speed and temperament
NTM for Nordic and foreign bulls	Changes since last routine run
Changes since last routine run	

Table 1. Traits and breeds for which international breeding values are published.

Trait:	International breeding values for the breeds:
Yield	Red breeds, Holstein and Jersey
Conformation	Red breeds, Holstein and Jersey
Udder health	Red breeds, Holstein and Jersey
Longevity	Red breeds, Holstein and Jersey
Calving – maternal and direct	Red breeds and Holstein
Female fertility	Red breeds, Holstein and Jersey
Milking speed	Red breeds, Holstein and Jersey
Temperament	Red breeds and Holstein

You can find Interbull breeding values for all bulls with international breeding values on [www.nordicebv.info](http://www.nordicebv.info)

On the page you can search within breed or country. You can also search with the herdbook number or the name of the bull. Click on the herdbook number of the bull and view a graphical representation of the bulls breeding values.

You can sort the bulls by different breeding values by clicking on the top line of the table.

Bulls from Denmark, Finland and Sweden are in the following grouped under DNK/FIN/SWE

## Daughter proven bulls

In the tables below, only sires that have breeding values based on daughter information is shown

### Yield

In tables 2-4 is a comparison of the genetic level of yield for bulls from different countries. The analysis includes bulls born in 2012 or later, that have more than 60 daughters in the genetic evaluation.

Table 2. Genetic level for yield traits, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Milkindex	Fatindex	Proteinindex	Y-index	Y-index STD
Australia	10	94,6	94,2	91,1	91,9	13,8
Canada	23	89,0	90,3	86,4	87,9	8,8
Germany	7	98,9	102,7	98,3	100,7	9,4
DNK/FIN/SWE	282	101,2	102,8	103,3	103,6	7,8
Estonia	13	97,5	99,0	97,1	98,1	10,1
Norway	262	94,9	94,7	95,7	95,3	9,3
New Zealand	21	85,4	90,1	84,7	87,6	9,2
USA	6	68,8	70,2	63,2	65,7	10,7

Table 3. Genetic level for yield traits, Holstein. Bulls born in 2012 or later.

Country	No. of bulls	Milkindex	Fatindex	Proteinindex	Y-index	Y-index STD
Australia	67	95,9	100,5	96,0	98,6	5,9
Austria	5	104,0	101,6	97,4	98,0	7,3
Belgium	29	102,6	103,4	100,9	101,9	8,5
Canada	575	107,8	108,3	105,3	106,3	8,5
Switzerland	91	91,0	97,9	91,1	94,9	9,5
Czech Republic	30	103,9	105,9	100,4	102,6	6,4
Germany	772	108,1	106,0	105,2	104,9	9,1
DNK/FIN/SWE	462	102,9	103,9	104,8	104,9	8,7
Spain	72	108,2	104,9	101,9	102,0	7,5
Estonia	39	100,9	97,7	94,5	94,7	6,5
France	388	104,6	102,0	103,2	102,2	7,6
UK	138	101,7	104,1	98,6	100,8	12,1
Hungary	6	105,8	104,2	102,8	102,8	7,9
Ireland	95	78,6	94,5	86,0	92,6	8,8
Israel	93	98,8	106,7	98,1	102,7	7,5
Italy	351	104,0	104,7	102,1	103,1	8,6
Japan	44	107,2	105,1	102,8	103,0	9,5
Luxembourg	7	110,4	111,4	106,3	108,0	10,5
Netherlands	860	103,2	104,5	103,0	103,8	9,8
New Zealand	663	79,3	94,8	88,7	94,5	6,9
Poland	207	99,5	99,9	96,2	97,4	8,4
Slovenia	30	94,3	88,8	88,4	87,1	8,5
USA	2711	108,5	109,1	105,2	106,5	9,0

Table 4. Genetic level for yield traits, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Milkindex	Fatindex	Proteinindex	Y-index	Y-index STD
Australia	16	105,9	90,3	104,9	95,2	6,3
Canada	7	106,9	98,6	102,6	98,6	15,5
DNK/FIN/SWE	96	100,9	104,4	103,2	104,7	7,9
UK	5	103,6	92,0	99,6	93,6	8,5
New Zealand	375	97,2	89,3	96,7	91,8	7,4
USA	446	117,5	102,0	111,9	103,8	9,8

International comparison for yield among most important populations shows that:

- Red breeds: DNK/FIN/SWE have higher genetic level than Norway and Canada
- Holstein: DNK/FIN/SWE, Canada, France, Germany, USA, and Netherlands have similar genetic level
- Jersey: Denmark has same genetic level than USA, but higher genetic level than New Zealand

## Conformation

The international genetic evaluation is done for 16 linear traits for Holstein, Red breeds and Jersey. In addition, frame condition score and locomotion is included in this trait group.

### Breeding values for frame

EBV for frame is calculated from the 6 linear traits that are part of the international genetic evaluation. The composite NAV breeding value for frame also includes topline. There is no international genetic evaluation of topline.

We calculate international breeding value for frame based on a regression of NAV breeding values for the 6 linear international traits on NAV EBV for frame for Danish, Swedish and Finnish bulls born in 2004-05. The estimated regression coefficients are used to calculate international breeding value for frame for foreign bulls. This method is used to ensure the same relative weight between traits in NAV and international composite traits.

### Breeding values for feet and legs

EBV for feet and legs is calculated from the 3 linear traits that are part of the international genetic evaluation. The composite NAV breeding values for feet and legs also include hock quality and bone quality. There is no international genetic evaluation for these two traits.

We calculate international breeding value for feet and legs based on a regression of NAV breeding values for the 3 linear international traits on NAV EBV for feet and legs for Danish, Swedish and Finnish bulls born in 2004-05. The estimated regression coefficients are used to calculate international breeding value for feet and legs for foreign bulls.

### Breeding values for udder

The international genetic evaluation for udder includes 7 traits. The Nordic genetic evaluation for udder also includes teat thickness and udder balance. There is no international evaluation for these two traits.

We calculate international breeding value for udder based on a regression of NAV breeding values for the 7 linear international traits on NAV EBV for udder for Danish, Swedish and Finnish

bulls born in 2004-05. The estimated regression coefficients are used to calculate international breeding value for udder for foreign bulls.

### Genetic level of composite conformation traits

In tables 5-7 is a comparison of genetic level of composite conformation traits for bulls from different countries. The calculation includes bulls that have at least 25 daughters in genetic evaluation.

Table 5. Genetic level for conformation traits, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Frame		Feet&legs		Udder	
		Average	STD	Average	STD	Average	STD
Canada	39	100,5	5,4	102,2	4,5	108,6	9,2
Germany	18	106,6	9,6	106,7	3,7	100,8	8,4
DNK/FIN/SWE	310	98,1	10,4	100,4	5,2	101,6	8,2
UK	6	99,3	2,7			108,0	9,9
Norway	147	104,0	6,7	98,7	4,6	88,2	8,0
USA	5	103,6	9,1	104,6	3,2	109,6	8,1

Table 6. Genetic level of conformation traits, Holstein. Bulls born in 2012 or later.

Country	No	Frame		Feet&legs		Udder	
		Average	STD	Average	STD	Average	STD
Australia	32	115,9	8,9	98,9	4,6	99,9	13,3
Belgium	30	111,5	12,4	103,9	6,5	106,3	10,9
Canada	509	115,9	9,7	101,2	5,6	111,4	9,4
Switzerland	110	115,4	9,2	99,9	5,5	108,8	8,2
Czech Republic	40	113,4	7,7	102,0	4,9	100,7	11,2
Germany	766	111,5	9,6	102,2	6,0	106,8	9,0
DNK/FIN/SWE	452	101,5	10,9	101,2	6,2	103,8	8,4
Spain	88	116,6	9,1	101,3	5,7	108,8	8,2
Estonia	38	105,7	5,8	99,9	5,0	94,4	10,7
France	351	114,3	10,3	100,7	5,5	108,6	8,8
UK	101	113,0	12,2	100,3	4,9	107,3	12,1
Hungary	6	112,3	8,3	100,8	7,3	102,7	7,6
Ireland	37	92,1	12,8	96,7	6,2	81,0	14,8
Italy	330	114,7	10,1	100,7	4,5	108,7	9,6
Japan	345	114,7	9,0	100,7	4,3	105,2	9,2
Korea	8	109,8	5,3	98,4	3,1	104,1	5,5
Luxembourg	7	109,7	6,7	101,0	2,1	103,3	5,7
Netherlands	791	111,1	10,3	103,0	6,2	105,9	9,6
New Zealand	628	85,7	10,1	105,0		93,0	
Poland	270	109,0	9,9	99,9	4,4	96,8	8,6
Slovenia	25	103,6	11,4	98,0	6,5	95,3	8,9
USA	1388	113,6	9,9	101,2	5,2	111,2	8,6

Table 7. Genetic level of conformation traits, Jersey. Bulls born in 2012 or later.

Country	No	Frame		Feet&legs		Udder	
		Average	STD	Average	STD	Average	STD
Canada	16	116,0	6,3	103,9	5,6	100,3	7,9
DNK/FIN/SWE	113	100,8	9,6	100,4	6,7	100,6	9,2
UK	7	103,9	5,1			99,6	7,1
USA	486	114,0	8,6	102,8	6,4	100,1	7,9

International comparison for conformation traits among most important populations show that:

- Red breeds: Canada have generally higher genetic level for frame, feet&legs and udder than DNK/FIN/SWE. Compared to Norway, DNK/FIN/SWE have similar genetic level for feet&legs and higher level for udder
- Holstein: DNK/FIN/SWE has lower genetic level for frame than most other populations. North America, Spain, France, Germany, UK, Netherlands and Italy have the highest genetic level for frame. Populations with grass based dairy farming like Ireland and New Zealand has lower genetic level for frame. For feet&legs there are only small differences between populations. DNK/FIN/SWE has a below average genetic level for udder. North America has the highest genetic level for udder.
- Jersey: Denmark has lower genetic level for frame than USA, but same level for udders

### Somatic cell count and udder health

Interbull does two international genetic evaluations – one for somatic cell count and one for udder health. In the first one only somatic cell count is included for all countries. NAV sends breeding values for somatic cell count to Interbull, so Nordic bulls get official breeding values for somatic cell count in countries where this trait is official. In the second evaluation breeding values based on mastitis diagnoses are included. NAV's official breeding value for udder health is used. For countries that do not record mastitis diagnoses, somatic cell count is included in this evaluation.

Index for udder health is published in the Nordic countries, when reliability is 40% or higher. In tables 8-10 is a comparison of genetic level of udder health for bulls from different countries.

Table 8. Genetic level for udder health, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	9	94,6	10,1
Germany	8	97,2	9,7
DNK/FIN/SWE	346	100,7	8,7
Estonia	12	92,1	11,5
Norway	262	95,4	10,5
New Zealand	32	90,7	10,2
USA	9	92,7	12,0

Table 9. Genetic level for udder health, Holstein. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	103	94,8	8,1
Austria	5	103,1	6,7
Belgium	33	97,5	8,5
Canada	225	96,4	8,2
Switzerland	10	94,7	6,5
Czech Republic	37	97,4	7,3
Germany	791	97,0	8,7
DNK/FIN/SWE	456	102,4	7,9
Spain	106	93,2	8,0
Estonia	35	93,9	8,1
France	350	97,7	6,9
UK	76	95,3	8,3
Hungary	6	101,5	6,8
Ireland	134	94,9	10,2
Israel	96	99,5	9,5
Italy	319	97,4	8,2
Japan	298	92,8	8,1
Korea	23	91,1	5,4
Luxembourg	7	96,1	8,5
Netherlands	852	98,4	7,4
New Zealand	727	91,0	8,8
Poland	285	94,6	8,6
Slovenia	31	94,3	9,5
USA	729	98,8	8,2

Table 10. Genetic level for udder health, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	13	89,8	7,3
Canada	8	87,8	9,8
DNK/FIN/SWE	109	101,8	7,1
UK	6	88,0	9,2
New Zealand	375	95,0	8,1
USA	541	91,3	8,2

International comparison for udder health among most important populations show that:

- Red breeds: DNK/FIN/SWE has higher genetic level than Norway
- Holstein: DNK/FIN/SWE have higher genetic level than other major European populations, USA and Canada
- Jersey: Denmark is substantially better than USA

## Longevity

In tables 11-13 is a comparison of genetic level of longevity for bulls from different countries. Bulls are included if they have at least 40 daughters in the genetic evaluation.

Table 11. Genetic level for longevity, Red breeds. Bulls born in 2011 or later.

Country	No. of bulls	Average	STD
Australia	9	91,0	6,0
Canada	49	90,8	8,1
Germany	24	92,5	7,7
DNK/FIN/SWE	219	102,6	7,9
UK	8	80,7	6,5
Norge	292	91,6	7,8
New Zealand	50	85,8	6,2
USA	9	83,1	5,3

Table 12. Genetic level for longevity, Holstein. Bulls born in 2011 or later.

Country	No. of bulls	Average	STD
Australia	67	90,0	5,4
Austria	6	95,1	0,6
Belgium	50	101,4	9,4
Canada	716	99,2	8,8
Switzerland	146	90,2	7,4
Czech Republic	7	100,6	8,9
Germany	1058	100,5	8,8
DNK/FIN/SWE	466	102,7	8,2
Spain	139	97,4	6,0
France	543	94,2	7,3
UK	171	98,1	8,2
Hungary	9	96,8	5,7
Ireland	186	92,6	6,5
Israel	131	93,5	5,6
Italy	470	97,8	6,6
Luxembourg	11	99,2	10,2
Netherlands	1108	99,6	8,1
New Zealand	920	90,5	6,3
Poland	479	93,2	7,6
Slovenia	44	90,9	8,2
USA	3079	104,7	9,0

Table 13. Genetic level for longevity, Jersey. Bulls born in 2011 or later.

Country	No. of bulls	Average	STD
Australia	20	88,4	6,3
Canada	18	91,1	7,3
DNK/FIN/SWE	76	100,8	6,7
UK	5	84,8	3,1
New Zealand	539	91,2	6,1
USA	508	94,3	7,6

International comparison for longevity among most important populations shows that:

- Red breeds: DNK/FIN/SWE has higher level than the other populations
- Holstein: Canada and France have the lowest level, while USA and DNK/FIN/SWE have the highest level
- Jersey: Denmark has higher genetic level than other populations

## Calving – maternal and direct

For Red breeds Canada, Denmark, Finland, Norway, Sweden and the United States send data to this evaluation. It has not been possible to obtain sufficient high correlations between countries for still birth so the international evaluation only includes calving ease (maternal and direct) for Red breeds.

In the Holstein group there are international breeding values for both still birth (maternal and direct) and calving ease (maternal and direct), but only for first lactation. In the Nordic countries also information from later lactations and from birth weight is included in calving, maternal and calving, direct.

We have calculated international indices for calving, maternal and calving, direct by performing a regression between NAV breeding values for still birth and calving ease and NAV breeding value for calving for Nordic bulls born in 2001-2006. The calculated regression coefficients are used to calculate a calving index for foreign bulls - same method is used for calving, maternal and calving, direct.

In Tables 14 and 15 the average genetic level for Red breed and Holstein bulls is shown for different countries. Only bulls born in 2011 or later are included. Bulls need to have breeding values for yield to be included.

Table 14. Genetic level for calving, maternal and calving, direct, Red breeds. Bulls born in 2012 or later.

Country	Calving, direct			Calving, maternal		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Canada	39	95,7	6,5	13	98,5	5,1
DNK/FIN/SWE	291	100,7	7,7	272	102,0	6,7
Norway	262	99,2	8,3	262	89,6	6,8



Table 15. Genetic level for calving, maternal and calving, direct, Holstein. Bulls born in 2012 or later.

Country	Calving, direct			Calving, maternal		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Australia	47	95,2	6,5	4	96,5	9,2
Austria	8	94,4	8,4	6	98,2	5,0
Belgium	32	96,7	5,8	29	99,0	6,4
Canada	627	98,0	6,7	559	100,1	8,8
Switzerland	127	93,9	6,6	83	93,2	9,7
Germany	824	98,0	7,1	699	99,0	9,4
DNK/FIN/SWE	462	101,8	7,2	453	102,8	7,2
Spain	64	95,6	5,0	9	96,9	6,2
France	411	98,3	7,2	360	101,0	9,6
UK	129	99,3	5,8	49	98,9	7,8
Ireland	136	101,1	5,0	1	121,0	
Israel	35	97,9	5,7	98	96,8	5,8
Italy	362	95,7	6,8	131	96,7	8,4
Luxembourg	7	91,4	6,4	7	98,6	6,9
Netherlands	869	98,0	6,5	728	98,1	8,4
New Zealand	725	100,3	5,3	1	99,0	
USA	2948	98,8	5,9	2382	105,5	6,8

International comparison for calving traits among most important populations shows that:

- Red breeds: DNK/FIN/SWE and Norway have similar genetic level for calving, direct. For calving, maternal DNK/FIN/SWE has a higher level than Norway
- Holstein: DNK/FIN/SWE are among the best populations for both calving, direct and calving, maternal.

## Female fertility

NAV calculates breeding values for female fertility based on linear regression between NAV breeding values for female fertility and NAV breeding values for the sub-indices in female fertility. Basis for the regressions are Nordic bulls born in 2001-2005 – see more information below. The estimated regression coefficients are used to calculate international breeding value for female fertility for foreign bulls.

In practice 3 regressions are calculated with different explaining variables (Jersey only 2 and 3):

- 1: Female fertility = Ability to conceive ( $R^2$ , HOL = 0,05) ( $R^2$ , Red breeds = 0,35)
- 2: Female fertility = Days open ( $R^2$ , HOL = 0,87) ( $R^2$ , Red breeds = 0,85) ( $R^2$ , Jer = 0,87)
- 3: Female fertility = Ability to return to recycle after calving + ability to conceive + Days open ( $R^2$ , HOL = 0,96) ( $R^2$ , Red breeds = 0,94), ( $R^2$ , Jer = 0,94).

$R^2$  (degree of explanation) indicates the proportion of the variance of the index for female fertility, that the traits in the regression can explain. Since the regression is used on foreign bulls, and the genetic correlations between international and NAV traits are not 1, the observed degree of explanation will be lower.

For each foreign bull we use the regression with the greatest explanatory power given the international sub-indices that are available. The degree of explanation therefore depends largely of the traits being available from the different countries.

Table 16. Genetic level for female fertility, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	9	99,6	11,9
Canada	22	95,9	8,8
Germany	7	88,6	8,2
DNK/FIN/SWE	249	100,5	8,3
Norway	205	115,1	9,3
New Zealand	21	100,2	5,3
USA	6	97,0	9,4

Table 17. Genetic level for female fertility, Holstein. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	57	88,3	8,0
Austria	5	94,0	14,4
Belgium	24	98,0	8,0
Canada	562	94,8	10,1
Switzerland	89	94,0	3,2
Czech Republic	25	95,6	2,4
Germany	666	94,3	8,8
DNK/FIN/SWE	452	102,3	10,6
Spain	9	92,4	7,1
France	301	94,1	8,5
UK	132	97,7	8,2
Ireland	95	107,9	3,6
Israel	82	98,0	2,5
Italy	304	92,9	8,0
Japan	44	86,7	8,0
Luxembourg	7	90,9	7,8
Netherlands	788	95,6	8,5
New Zealand	662	100,6	4,9
Poland	173	91,2	7,1
USA	2576	99,0	9,2

Table 18. Genetic level for female fertility, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	15	90,9	7,3
Canada	6	87,0	9,0
DNK/FIN/SWE	97	100,2	10,5
UK	5	90,8	10,8
New Zealand	375	98,1	6,7
USA	428	86,9	10,4

International comparison for female fertility among most important populations shows that:

- Red breeds: DNK/FIN/SWE has a lower level than Norway
- Holstein: DNK/FIN/SWE and USA are the populations with the highest genetic level. However Ireland and New Zealand have the highest genetic levels
- Jersey: Genetic level is higher in Denmark than the other major countries

## Milking speed and temperament

In Tables 19-21, the genetic level for bulls from different countries, born in 2012 or later are shown for Holstein, Red breeds and Jersey.

Table 19. Genetic level for milking speed and temperament, Red breeds. Bulls born in 2012 or later.

Country	Milking speed			Temperament		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Australia	5	96,9	4,2	5	104,8	3,5
Canada	39	92,8	7,8	39	91,8	6,1
Germany	18	102,5	6,2	18	101,8	4,3
DNK/FIN/SWE	307	101,5	7,7	266	100,6	9,4
Norway	158	97,1	2,1	167	98,7	2,7
New Zealand	22	101,0	6,1	22	99,8	5,0

Table 20. Genetic level for milking speed and temperament, Holstein. Bulls born in 2012 or later.

Country	Milking speed			Temperament		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Australia	69	102,2	6,6	69	102,4	6,1
Austria	8	93,2	7,6			
Belgium	17	95,6	8,7	14	100,0	8,7
Canada	422	99,3	8,5	413	104,2	7,8
Switzerland	114	93,5	7,1	114	98,6	6,9
Germany	638	98,1	9,1	443	103,1	10,8
DNK/FIN/SWE	451	98,9	8,5	283	102,5	13,9
France	297	97,3	8,7	291	103,7	8,9
UK	121	100,7	14,5	108	102,9	10,1
Italy	295	98,3	7,7	114	102,3	6,7
Luxembourg	7	101,0	7,4			
Netherlands	702	96,7	9,7	616	102,8	8,8
New Zealand	666	103,8	4,8	666	99,6	2,6
Slovenia	32	96,6	6,2			
USA	522	99,6	11,1	490	106,4	10,2

Table 21. Genetic level for milking speed, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australien	14	101,1	7,2
Canada	13	92,6	9,6
DNK/FIN/SWE	102	100,4	9,1
New Zealand	351	99,4	7,3
USA	39	97,6	7,7

International comparison for milking speed and temperament among most important countries show that:

- Red breeds: DNK/FIN/SWE has a higher genetic level for milking speed than Norway. For temperament the levels are similar
- Holstein: DNK/FIN/SWE has similar level as other populations for milking speed and temperament.
- Jersey: Denmark has similar genetic level as New Zealand and USA

## NTM for Nordic and foreign bulls

NTM index is calculated for all bulls (Nordic and others) that have official breeding values (NAV breeding values or international EBVs) for yield, udder health and conformation.

Interbull NTM is calculated by weighing the Interbull / NAV breeding values for yield, female fertility, calving (maternal and direct), udder health, longevity, feet&legs, udder, milking speed and temperament. The same economic weight factors are used as for NAV breeding values.

Rules for calculation of NTM based partly or entirely on international breeding values are stated below in order of priority.

### 1. Bull has NAV breeding value for a trait

If the bull has NAV breeding value for a specific trait, this is used in the calculation of NTM - no matter if the bull also has international breeding value for that trait.

### 2. Bull has no NAV breeding value, but has an international breeding value for a trait

If the bull does not have NAV breeding value for the trait, the international breeding value is used, provided that Interbull calculates international breeding values for that trait and the bull comes from a country which provides data for that trait.

### 3. Bull has no NAV or no international breeding value for a trait

For traits where no Interbull EBV is available or the bull has no Interbull EBV, and at the same time it is not tested in the Nordic countries, a pedigree index is used. Pedigree index is calculated as  $\frac{1}{2} (EBV_{\text{sire}} - 100) + \frac{1}{4} (EBV_{\text{maternal grand sire}} - 100) + 100$ . The contributions from the sire and maternal grand sire can be based on either NAV breeding values or international breeding values. If  $EBV_{\text{sire}}$  or  $EBV_{\text{maternal grand sire}}$  are unofficial the pedigree index is set to 100.

## Publication rules for NTM

All foreign and Nordic bulls that have Interbull breeding values for yield, udder health and udder get a public Interbull NTM. This NTM is calculated with a lower reliability than an NTM for Nordic proven bulls, where information for all traits is always available.

## Genetic level for Interbull NTM

In tables 22-24 genetic level for Interbull NTM for Jersey, Red breeds and Holstein are shown. Bulls included are born in 2011 or later.

Table 22. Genetic level for NTM, Red breeds. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Canada	10	-11,9	12,9
Germany	7	-2,6	9,3
DNK/FIN/SWE	282	6,2	8,6
Norway	147	-6,1	10,1

Table 23. Genetic level for NTM, Holstein. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Australia	20	-8,1	9,9
Belgium	29	0,7	8,5
Canada	248	2,1	8,8
Switzerland	13	-8,4	10,3
Czech Republic	30	0,1	6,2
Germany	739	2,1	9,4
DNK/FIN/SWE	455	8,6	8,2
Spain	72	-2,6	8,0
Estonia	35	-10,9	7,0
France	322	-0,5	8,1
UK	105	1,1	8,6
Hungary	6	-1,5	8,5
Ireland	42	-7,9	7,4
Italy	316	-1,0	9,5
Japan	44	-4,4	8,8
Luxembourg	7	2,0	7,6
Netherlands	797	2,0	9,0
Poland	205	-9,5	8,5
Slovenia	29	-17,5	7,2
USA	732	8,7	8,9

Table 24. Genetic level for NTM, Jersey. Bulls born in 2012 or later.

Country	No. of bulls	Average	STD
Canada	5	-9,6	12,3
DNK/FIN/SWE	95	5,5	7,9
USA	379	-4,5	8,9

International comparison of NTM among most important populations shows that:

- Red breeds: DNK/FIN/SWE is better than Canada and Norway
- Holstein: DNK/FIN/SWE and USA have the highest level
- Jersey: Denmark's average NTM is 8 index points better than USA

## **Changes since last routine run**

In the routine evaluation in April 2019 the following changes are done compared to December 2018 routine evaluation:

### Yield

- Following countries and breeds have made base changes:
  - Holstein from Italy
  - All breeds from France
  - All breeds from Canada
- All breeds from Germany have reduced heritability, causing reduction in reliability
- All breeds from Holland have made minor change in editing, causing a minor decrease in number of herds and daughters for some bulls
- RDC from Norway has made change in editing, causing some old bulls will loose few daughters. Rolling definition of hys is causing that some bulls occasionally may loose EDC although the number of daughters stay the same
- All breeds from New Zealand has continuous DNA parentage testing so daughters, herds, EDC will always change, causing small change in reliability

### Fertility

- Following countries and breeds have made base changes:
  - Holstein from Italy
  - All breeds from France
  - All breeds from Canada
- All breeds from Holland has changed such that conception rate is based on all insemination and IFL is corrected for effect of sexed semen
- RDC from Norway has introduced new traits and new data cutoff
- All breeds from New Zealand has continuous DNA parentage testing so daughters, herds, EDC will always change, causing small change in reliability

### Calving

- Following countries and breeds have made base changes:
  - Holstein and RDC from Germany
  - Holstein from Italy
  - All breeds from Canada
- Holstein and RDC from Germany has made data and pedigree correction causing some decrease in information for some bulls
- Holstein from Holland has made changes in type of proofs
- All breeds from Canada has corrected error, causing drop in herds, daughters and EDCs for many of the bulls
- RDC from Norway has made change in editing, causing some old bulls will loose few daughters. Rolling definition of hys is causing that some bulls occasionally may loose EDC although the number of daughters stay the same

### Conformation

- Following countries and breeds have made base changes:
  - Holstein from Italy
  - All breeds from France
  - All breeds from Canada
- All breeds from New Zealand has continuous DNA parentage testing so daughters, herds, EDC will always change, causing small change in reliability
- RDC from Norway has changed weighting in composite traits, trait definition and calculation of reliability for some traits

### Udder health

- Following countries and breeds have made base changes:
  - Holstein from Italy

- All breeds from France
- All breeds from Canada
- All breeds from DFS has decrease in information for Swedish bulls
- Holstein from USA participate for the first time with mastitis data
- All breeds from New Zealand has continuous DNA parentage testing so daughters, herds, EDC will always change, causing small change in reliability

### Longevity

- Following countries and breeds have made base changes:
  - Holstein from Italy
  - All breeds from Canada
- All breeds from Holland include Flemish data
- RDC from Norway has changed criteria to enter analysis. It is more stringent as records in progress are not entered. This cause loss of daughters compared to earlier. Rolling definition of hys is causing that some bulls occasionally may loose EDC although the number of daughters stay the same
- All breeds from New Zealand has continuous DNA parentage testing so daughters, herds, EDC will always change, causing small change in reliability

### Milking speed and temperament

- Following countries and breeds have made base changes:
  - All breeds in France
  - All breeds from Canada
- All breeds in Holland has minor change in the calculation of the reliability, causing a drop in reliability of about 2% for a small group of bulls
- RDC from Norway has made change in editing, causing some old bulls will loose few daughters. Rolling definition of hys is causing that some bulls occasionally may loose EDC although the number of daughters stay the same
- All breeds from New Zealand has continuous DNA parentage testing so daughters, herds, EDC will always change, causing small change in reliability

## **Genomic tested young Holstein bulls**

In the tables below, only Holstein sires that have breeding values based on genomic information and no daughters is shown

Averages are only shown for countries with more than 20 bulls.

### **Yield**

In tables 25 is a comparison of the genetic level of yield for bulls from different countries.

Table 25. Genetic level for yield traits, Holstein. Bulls born in 2016 or later.

Country	No. of bulls	Milkindex	Fatindex	Proteinindex	Y-index	Y-index STD
Belgium	100	107,2	107,7	105,8	106,3	6,9
Brasil	5	109,8	119,6	109,8	113,6	8,1
Canada	453	118,0	120,1	118,5	119,2	6,6
Switzerland	16	105,6	107,0	104,6	105,4	7,5
Germany	421	116,6	115,9	117,5	117,0	6,8
DNK/FIN/SWE	149	109,1	114,8	114,3	115,5	6,6
Spain	54	114,6	109,2	110,6	109,3	8,3
France	300	111,5	112,9	113,7	113,8	6,7
UK	35	107,9	115,9	110,4	113,1	15,0
Hungary	10	117,1	115,6	114,1	114,2	6,3
Italy	128	115,1	116,8	116,7	117,1	6,0
Luxembourg	10	120,9	121,1	118,4	119,0	4,9
Netherlands	240	111,4	116,0	115,1	116,2	7,5
Poland	85	112,7	111,5	112,3	111,9	6,7
USA	940	116,2	121,9	117,2	119,3	6,8

International comparison for yield shows that DNK/FIN/SWE, has nearly similar level as other major countries

## Conformation

The international genetic evaluation is done for 16 linear traits for Holstein. In addition, frame condition score and locomotion is included in this trait group.

Calculation of frame, feet&legs and udder follows same principles as for daughter proven bulls.

In tables 26 is a comparison of genetic level of composite conformation traits for bulls from different countries.

Table 26. Genetic level of conformation traits, Holstein. Bulls born in 2016 or later.

Country	No	Frame		Feet&legs		Udder	
		Average	STD	Average	STD	Average	STD
Belgium	100	114,2	6,7	102,7	3,4	111,5	5,7
Brasil	5	111,4	6,8	102,0	3,6	106,4	7,9
Canada	453	115,0	8,3	101,3	3,8	116,5	7,4
Switzerland	16	118,3	8,6	101,8	3,2	119,1	7,5
Germany	421	114,1	8,6	105,1	4,5	116,3	6,8
DNK/FIN/SWE	149	106,5	9,4	103,5	4,3	113,9	6,6
Spain	54	119,1	10,6	105,0	5,5	117,6	7,9
France	300	119,3	9,3	104,5	4,4	119,3	7,6
UK	34	106,0	9,2	101,2	3,7	109,8	9,4
Hungary	10	116,7	6,3	100,2	2,8	113,1	5,8
Italy	128	116,8	8,6	103,1	4,5	115,1	7,1
Luxembourg	10	115,9	7,7	101,7	4,1	114,5	7,1
Netherlands	240	110,5	8,9	106,1	5,1	112,1	7,6
Poland	85	114,8	8,9	102,4	4,4	109,2	7,2
USA	940	112,0	8,7	101,8	3,9	113,7	7,8



International comparison for conformation traits among most important populations shows that DNK/FIN/SWE has lower genetic level for frame than most other populations. For feet&legs and udder there are only small differences between populations.

## Somatic cell count and udder health

In tables 27 is a comparison of genetic level of udder health for bulls from different countries.

Table 27. Genetic level for udder health, Holstein. Bulls born in 2016 or later.

Country	No. of bulls	Average	STD
Belgium	100	99,4	5,9
Brasil	5	100,2	4,7
Canada	453	100,2	5,9
Switzerland	16	96,9	6,1
Germany	421	102,3	6,8
DNK/FIN/SWE	149	106,6	6,3
Spain	54	103,3	7,8
France	300	107,2	6,7
UK	34	103,1	6,1
Hungary	10	92,9	9,4
Italy	128	102,0	7,5
Luxembourg	10	100,0	7,7
Netherlands	240	104,0	6,5
Poland	85	101,5	6,3
USA	936	99,6	5,7

International comparison for udder health among most important populations show that DNK/FIN/SWE, Netherlands and France have higher genetic level than other major European and North American populations

## Longevity

In tables 28 is a comparison of genetic level of longevity for bulls from different countries.

Table 28. Genetic level for longevity, Holstein. Bulls born in 2016 or later.

Country	No. of bulls	Average	STD
Belgium	14	108,8	7,4
Brasil	5	107,1	6,0
Canada	453	109,1	4,6
Switzerland	16	103,6	6,0
Germany	420	112,2	6,4
DNK/FIN/SWE	148	115,2	5,8
Spain	54	107,0	8,2
France	297	109,7	5,9
UK	35	110,4	6,2
Hungary	10	104,8	5,8
Italy	128	107,3	5,4
Luxembourg	10	111,2	4,1
Netherlands	240	111,3	6,6
Poland	36	105,8	6,4
USA	940	109,4	5,2

International comparison for longevity among most important populations shows that DNK/FIN/SWE has the highest level closely followed by Germany and Netherlands

## Calving – maternal and direct

In Tables 29 the average genetic level for bulls is shown for different countries.

Table 29. Genetic level for calving, maternal and calving, direct, Holstein. Bulls born in 2016 or later.

Country	Calving, direct			Calving, maternal		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Belgium	100	98,8	3,4	100	103,8	3,4
Brasil	5	100,8	6,1	5	107,8	5,8
Canada	453	101,2	4,2	453	109,7	5,0
Switzerland	16	97,9	5,4	16	101,7	5,7
Germany	414	101,4	5,0	414	106,1	5,5
DNK/FIN/SWE	148	103,8	4,9	148	108,0	5,5
Spain	49	99,4	4,2	49	103,8	5,6
France	292	99,7	5,0	292	106,7	6,3
UK	34	101,3	3,6	34	108,6	5,4
Hungary	10	99,2	4,6	10	106,8	3,0
Italy	128	100,1	4,9	128	106,2	5,0
Luxembourg	10	100,6	5,8	10	108,0	4,1
Netherlands	238	102,5	5,0	239	105,6	5,7
Poland	35	100,1	3,4	35	104,2	7,3
USA	929	102,7	4,5	940	110,6	5,0

International comparison for calving traits shows that DNK/FIN/SWE is the best population for calving and have a similar level as most other countries for calving, maternal.

## Female fertility

In Tables 30 the average genetic level for bulls is shown for different countries.

Table 30. Genetic level for female fertility, Holstein. Bulls born in 2016 or later.

Country	No. of bulls	Average	STD
Belgium	100	96,8	4,2
Brasil	5	96,8	6,7
Canada	453	104,1	7,5
Switzerland	16	99,1	7,8
Germany	421	100,5	7,1
DNK/FIN/SWE	149	106,4	6,6
Spain	54	96,5	7,7
France	293	99,8	6,8
UK	32	106,5	7,9
Hungary	5	105,0	4,6
Italy	128	100,0	7,0
Luxembourg	10	98,0	5,9
Netherlands	240	101,4	7,3
Poland	85	96,7	7,5
USA	940	103,1	6,3

International comparison for female fertility among most important populations shows that DNK/FIN/SWE is in the top.

## Milking speed and temperament

In Tables 31, the genetic level for bulls from different countries.

Table 31. Genetic level for milking speed and temperament, Holstein. Bulls born in 2016 or later.

Country	Milking speed			Temperament		
	No. of bulls	Average	STD	No. of bulls	Average	STD
Belgium	12	99,4	5,3	11	108,3	4,8
Brasil	5	92,6	3,1	5	104,8	1,1
Canada	453	100,7	2,6	436	108,0	4,1
Switzerland	16	100,9	3,9			
Germany	404	100,0	4,5	402	106,0	7,5
DNK/FIN/SWE	147	102,2	2,5	146	105,1	5,5
Spain	50	96,5	1,9	49	107,5	1,5
France	292	98,8	2,6	285	106,7	4,8
UK	31	101,3	4,6	30	108,1	1,2
Hungary	5	100,5	1,9			
Italy	128	99,7	3,8	125	106,8	5,3
Luxembourg	10	99,7	2,5	10	104,9	1,2
Netherlands	240	98,7	4,8	236	106,1	10,5
Poland	36	96,6	2,2	31	104,8	2,4
USA	921	102,0	3,0	902	107,6	4,4

For temperament and milking speed there are only small differences between populations.

## Changes since last routine run

In the routine evaluation in April 2019 the following changes are done compared to December 2018 routine evaluation:

### Yield

- Holstein from Canada, France and Italy have made base change
- Holstein from Germany has introduced a mixed genomic reference population

### Fertility

- Holstein from Canada, France and Italy have made base change
- Holstein from Germany has introduced a mixed genomic reference population

### Calving

- Holstein from Canada, France and Italy have made base change
- Holstein from Germany has introduced a mixed genomic reference population

### Conformation

- Holstein from Canada, France and Italy have made base change
- Holstein from Germany has introduced a mixed genomic reference population

### Udder health

- Holstein from Canada, France and Italy have made base change
- Holstein from Germany has introduced a mixed genomic reference population

### Longevity

- Holstein from Canada, France and Italy have made base change
- Holstein from Germany has introduced a mixed genomic reference population

### Milking speed and temperament

- Holstein from Canada, France and Italy have made base change
- Holstein from Germany has introduced a mixed genomic reference population

## Dates of publication of Interbull breeding values in 2019:

Table 32. Dates of publication in 2019

Month	Date
April	2
August	13
December	3

The indices can be found at the national databases in Denmark, Sweden and Finland 2-3 days after they have been published by Interbull.

Regards

Ulrik Sander Nielsen, Anders Fogh, Emma Carlén, Terhi Vahlsten and Martha Bo Almskou