

## DESCRIPTION OF NATIONAL GENETIC EVALUATION SYSTEMS

<b>Country (or countries)</b>	Switzerland
<b>Main trait group<sup>1</sup></b> NOTE! Only one trait group per form!	Production
<b>Breed(s)</b>	Holstein (CHE)
<b>Trait definition(s) and unit(s) of measurement<sup>2</sup></b> Attach an appendix if needed	Milk, fat, and protein lactation yields (305-day) in kg
<b>Method of measuring and collecting data</b>	
<b>Time period for data inclusion</b>	Cows which first calved since January 1, 1994, Pedigree is traced back 3 generations from that date
<b>Age groups (e.g. parities) included</b>	All parities
<b>Other criteria (data edits) for inclusion of records</b>	Includes all test day records between 5 and 365 days in milk (DIM). test day records are expressed as 24-hour yields.
<b>Criteria for extension of records (if applicable)</b>	No extension of records is required
<b>Sire categories</b>	All bulls
<b>Environmental effects<sup>3</sup>, pre-adjustments</b>	Heterogeneous herd-test day variance adjustment, adjustment factors are estimated every run
<b>Method (model) of genetic evaluation<sup>3</sup></b>	MT (milk yield, fat yield, protein yield, somatic cell score) – ML (1, 2, 3+) - RR – TD -BLUP– AM. Later lactations (4 and up) are considered to be genetically the same as third lactation, permanent environmental effects in lactation 6 and later are assumed to be the same as 5 <sup>th</sup> lactation
<b>Environmental effects<sup>3</sup> in the genetic evaluation model</b>	Fixed: Herd-test day Regression on DIM within Parity - Age of calving - Region - Time Period - Season combination (6th order polynomials). Random: Animal lactation curve, lactation curve for permanent environment (4th order polynomials).
<b>Adjustment for heterogeneous variance in evaluation model</b>	Yes, see pre-adjustments
<b>Use of genetic groups and relationships</b>	Phantom parent groups are defined based on ancestry, birth year, breed and selection pathway
<b>Blending of foreign/Interbull information in evaluation</b>	Blending of Interbull proofs (previous evaluation) of foreign proven bulls.
<b>Genetic parameters in the evaluation</b>	See appendix PR
<b>System validation</b>	Method 3
<b>Expression of genetic evaluations</b> If standardised (e.g. RBV), give standardisation formula in the appendix	EBV in kgs (305- day yield) within each lactation then averaged across lactations.
<b>Definition of genetic reference base</b> <b>Next base change</b>	Rolling base yearly updated in April/May, defined by cows born 6 to 8 calendar years ago, that have test day records included in the genetic evaluation: e.g. April 2011: cows born 2003 to 2005

<b>Calculation of reliability</b>	Similar to the procedure used to calculate EDC's
<b>Criteria for official publication of evaluations</b>	sires in official domestic test program: 10 daughters in 10 herds, 3 TD all other sires: 30 daughters in 30 herds with 3 (5 for imported sires) test day yields of daughters
<b>Number of evaluations / publications per year</b>	3
<b>Use in total merit index<sup>4</sup></b>	IPQ (production index)= 17 % fat kg, 58 % protein kg, 8 % fat content, 17 % protein content ISEL (TMI)= 45 % IPQ, 8 % SCS, 10 % longevity, 2 % persistency of lactation, 15 % fertility, 20 % conformation
<b>Anticipated changes in the near future</b>	none
<b>Key reference on methodology applied</b>	Schaeffer, L. R., J. Jamrozik, G. J. Kistemaker, and B. J. Van Doormaal. 1999. Experience with a test day model. J. Dairy Sci. (Abstract & to be submitted for publication) Jamrozik, J., L. R. Schaeffer, and F. Grignola. 1998. Genetic parameters for production traits and somatic cell score of Canadian Holsteins with multiple trait random regression model 6WCGALP. 23:303-306. Jamrozik, J., L. R. Schaeffer, Z. Liu, and G. Jansen. 1997. Multiple trait random regression test day model for production traits. Interbull Bulletin No. 16:43.
<b>Key organisation: name, address, phone, fax, e-mail, web site</b>	Evaluation Center: Qualitas AG Chamerstrasse 56, CH-6300 Zug, Switzerland Phone: +41 (0)41 768 92 92 Fax: +41 (0)41 768 92 99 e-mail: zws@qualitasag.ch Internet: <a href="http://www.qualitasag.ch">http://www.qualitasag.ch</a>  EBV's published by herdbook organisation: Holstein Association of Switzerland Route de Grangeneuve 27, CH-1725 Posieux <a href="http://www.holstein.ch">http://www.holstein.ch</a>

1) Either: Production (e.g. milk, fat, protein), Conformation, Health (e.g. mastitis resistance, milk somatic cell, resistance to diseases other than mastitis), Longevity, Calving (e.g. stillbirth, calving ease), Female fertility (e.g. non-return rate, interval between reproductive events, number of AI's, heat strength), Workability (e.g. milking speed, temperament), Beef production, Efficiency (e.g. body weight, energy balance, body conditioning score), or Other traits.

2) Indicate frequencies per category if the trait is categorical and specify transformation of data if practiced.

3) Use abbreviations for most common effects (see document with list of abbreviations at [http://www-interbull.slu.se/service\\_documentation/General/list\\_of\\_abbreviations.rtf](http://www-interbull.slu.se/service_documentation/General/list_of_abbreviations.rtf)) and indicate random (R) or fixed (F).

4) Please give economic weights and indicate how they are expressed (preferably in genetic standard deviation units).

## Parameters for national genetic evaluations for production traits as provided to Interbull

<b>Country (or countries):</b>	Switzerland
<b>Main trait group:</b>	Production
<b>Breed(s):</b>	Holstein

Trait	$h^{2a}$	genetic variance <sup>a</sup>	official proof standardisation formula <sup>b</sup>
Milk yield:	.40	417816	$a = 0; c = 1; b = 1; d = 0$
Fat yield:	.36	728	$a = 0; c = 1; b = 1; d = 0$
Protein yield:	.36	306	$a = 0; c = 1; b = 1; d = 0$

<sup>a</sup> If lactations, or part of lactations, are treated as separate traits, provide heritability estimates and genetic variances separately for each lactation, as well as for all lactations pooled, i.e. for the trait submitted to Interbull.

<sup>b</sup> Expressed as follows:  $StandEval = ((eval - a) / b) * c + d$  where  $a$  = mean of the base adjustment,  $b$  = standard deviation of the base,  $c$  = standard deviation of expression (include sign if scale is reversed), and  $d$  = base of expression.

## Lactation heritabilities (diagonal), 305d PE correlations (above diagonal) and 305d genetic correlations (below diagonal) for Holstein breed.

	M1	F1	P1	SCS1	M2	F2	P2	SCS2	M3	F3	P3	SCS3
M1	<b>.38</b>	.88	.95	-.14	.52	.42	.52	.00	.46	.31	.43	.08
F1	.56	<b>.33</b>	.91	-.09	.39	.49	.46	.01	.34	.41	.40	.06
P1	.88	.66	<b>.33</b>	-.11	.51	.48	.57	-.01	.43	.36	.47	.05
SCS1	.16	.04	.14	<b>.23</b>	-.06	-.03	-.06	.35	-.04	-.01	-.02	.28
M2	<b>.74</b>	.39	.63	.03	<b>.42</b>	.87	.95	-.20	.49	.35	.47	-.02
F2	.35	.77	.42	-.05	.61	<b>.39</b>	.91	-.22	.37	.47	.44	-.06
P2	.61	.49	.71	.03	.88	.71	<b>.38</b>	-.18	.49	.44	.55	-.01
SCS2	.11	.02	.11	.54	-.04	-.07	-.02	<b>.25</b>	-.09	-.10	-.09	.54
M3	<b>.69</b>	.35	.59	.08	<b>.86</b>	.51	.76	.03	<b>.40</b>	.84	.95	-.15
F3	.30	.70	.38	.00	.47	.85	.58	-.03	.63	<b>.35</b>	.90	-.20
P3	.53	.44	.62	.07	.71	.60	.83	.03	.88	.75	<b>.36</b>	-.15
SCS3	.08	.00	.06	.51	-.08	-.10	-.10	.63	-.08	-.11	-.08	<b>.25</b>

Heritability, Genetic and permanent environmental variances  
(milk, fat, protein – 305d yield (kg<sup>2</sup>), SCS – average daily score).  
Combined values are submitted to Interbull

<b>Effect</b>	<b>Trait</b>	<b>Lactation</b>	<b>Variance</b>
<b>Genetic</b>	<b>Milk</b>	1	339,311
		2	511,162
		≥ 3	638,642
		Combine d	417,816
	<b>Fat</b>	1	476
		2	942
		≥ 3	1,215
		Combine d	728
	<b>Protein</b>	1	246
		2	395
		≥ 3	498
		Combine d	306
<b>SCS</b>	1	.377	
	2	.419	
	≥ 3	.566	
	Combine d	.319	
<b>Permanent Environment</b>	<b>Milk</b>	1	419,494
		2	598,481
		≥ 3	534,058
	<b>Fat</b>	1	590
		2	811
		≥ 3	793
	<b>Protein</b>	1	352
		2	493
		≥ 3	468
<b>SCS</b>	1	.808	
	2	.955	
	≥ 3	.743	
<b>Heritability</b>	<b>Milk</b>	Combine d	.40
	<b>Fat</b>	Combine d	.36
	<b>Protein</b>	Combine d	.36
	<b>SCS</b>	Combine d	.27

## DESCRIPTION OF NATIONAL GENETIC EVALUATION SYSTEMS

<b>Country (or countries)</b>	Switzerland
<b>Main trait group<sup>1</sup></b> NOTE! Only one trait group per form!	Type
<b>Breed(s)</b>	Holstein
<b>Trait definition(s) and unit(s) of measurement<sup>2</sup></b> Attach an appendix if needed	See Appendix
<b>Method of measuring and collecting data</b>	Linear scoring, on all 1 <sup>st</sup> lactation cows by classifiers
<b>Time period for data inclusion</b>	All data since 1992
<b>Age groups (e.g. parities) included</b>	First lactation cows
<b>Other criteria (data edits) for inclusion of records</b>	missing classifier calving out of range (17 to 44 months) week of lactation out of range (max. wk 105) records removed if classification result not present
<b>Criteria for extension of records (if applicable)</b>	
<b>Sire categories</b>	All AI sires
<b>Environmental effects<sup>3</sup>, pre-adjustments</b>	None
<b>Method (model) of genetic evaluation<sup>3</sup></b>	MT AM: within groups: format, rump, feet & legs, udder ST AM: final score, locomotion, BCS
<b>Environmental effects<sup>3</sup> in the genetic evaluation model</b>	F: age at calving, week of lactation, classifier x year, year x season of classification, R: herd (random effect, herd x year if > 14 animals, herd x 2 to 3 years to obtain 10 animals )
<b>Adjustment for heterogeneous variance in evaluation model</b>	None
<b>Use of genetic groups and relationships</b>	Genetic groups are assigned to unknown parents based on breed, sex, birth year and origin of the animal
<b>Blending of foreign/Interbull information in evaluation</b>	No
<b>Genetic parameters in the evaluation</b>	See Appendix
<b>System validation</b>	
<b>Expression of genetic evaluations</b> If standardised (e.g. RBV), give standardisation formula in the appendix	Standardized with mean=0 , sd=1 for linear traits, udder, F&L composite and locomotion, mean=100, sd=12 for final class and BCS
<b>Definition of genetic reference base</b> <b>Next base change</b>	cows born 6 to 8 years before present year base updated every April
<b>Calculation of reliability</b>	Reliabilities for final class and BCS are approximated assuming a ST-

	RP-AM
<b>Criteria for official publication of evaluations</b>	At least daughters in 30 herds; at least 10 daughters in 10 herds for bulls in domestic testing scheme.
<b>Number of evaluations / publications per year</b>	3 (following Interbull releases)
<b>Use in total merit index<sup>4</sup></b>	Yes, 20% final class; 5% F&L; 5% mammary system
<b>Anticipated changes in the near future</b>	none
<b>Key reference on methodology applied</b>	
<b>Key organisation: name, address, phone, fax, e-mail, web site</b>	<p>Evaluation Center:  Qualitas AG  Chamerstrasse 56, CH-6300 Zug, Switzerland  Phone: +41 (0)41 768 92 92  Fax: +41 (0)41 768 92 99  e-mail: zws@qualitasag.ch  Internet: <a href="http://www.qualitasag.ch">http://www.qualitasag.ch</a></p> <p>EBV's published by herdbook organisation:  Holstein Association of Switzerland  Rte de Grangeneuve 27  1725 Posieux / Switzerland  phone +41 26 305 5912  neuenschwander@holstein.ch, <a href="http://www.holstein.ch">www.holstein.ch</a></p>

1) Either: Production (e.g. milk, fat, protein), Conformation, Health (e.g. mastitis resistance, milk somatic cell, resistance to diseases other than mastitis), Longevity, Calving (e.g. stillbirth, calving ease), Female fertility (e.g. non-return rate, interval between reproductive events, number of AI's, heat strength), Workability (e.g. milking speed, temperament), Beef production, Efficiency (e.g. body weight, energy balance, body conditioning score), or Other traits.

2) Indicate frequencies per category if the trait is categorical and specify transformation of data if practiced.

3) Use abbreviations for most common effects (see document with list of abbreviations at [http://www-interbull.slu.se/service\\_documentation/General/list\\_of\\_abbreviations.rtf](http://www-interbull.slu.se/service_documentation/General/list_of_abbreviations.rtf)) and indicate random (R) or fixed (F).

4) Please give economic weights and indicate how they are expressed (preferably in genetic standard deviation units).

**Parameters for national genetic evaluations for conformation traits as provided to Interbull  
(all breeds except Brown Swiss)**

<b>Country (or countries):</b>	Switzerland
<b>Main trait group:</b>	Conformation
<b>Breed(s):</b>	Holstein

Trait	Definition	$h^{2a}$	genetic variance <sup>a</sup>	official proof standardisation formula <sup>b</sup>
Stature	Height at withers	0.48	6.65	ebv/ $\sigma$
Chest Width	Distance between fore legs	0.20	26.16	ebv/ $\sigma$
Body Depth	Depth at rear ribs	0.30	21.75	ebv/ $\sigma$
Angularity	Distance, flatness and openness of ribs	0.22	12.02	ebv/ $\sigma$
Rump Angle	Angle of rump between hips and pins	0.39	35.89	ebv/ $\sigma$
Rump Width	Distance between pins	0.42	51.11	ebv/ $\sigma$
Rear Leg Set	Angle of hock, side view	0.11	5.54	ebv/ $\sigma$
Rear Leg Rear View	Angle of rear feet	0.10	10.42	ebv/ $\sigma$
Foot Angle	Angle of foot	0.08	6.26	ebv/ $\sigma$
Fore Udder	Strength and quality of attachment	0.22	24.77	ebv/ $\sigma$
Rear Udder Height	Distance between vulva and milk secreting tissue	0.24	35.30	ebv/ $\sigma$
Udder Support	Udder cleft, emphasis on udder floor	0.19	16.27	ebv/ $\sigma$
Udder Depth	Distance between hock and udder floor	0.25	34.21	ebv/ $\sigma$
Front Teat Placement	Placement of front teats	0.37	36.91	ebv/ $\sigma$
Teat Length	Length of front teats	0.40	31.10	ebv/ $\sigma$
Rear Teat Placement	Placement of front teats	0.38	27.31	ebv/ $\sigma$
Overall Conformation Score	Final score, computed from composites	0.27	1.33	(ebv/ $\sigma$ )*12+100
Overall Udder Score	Computed from linear traits	0.21	1.19	ebv/ $\sigma$
Overall Feet & Leg Score	Computed from linear traits	0.16	0.88	ebv/ $\sigma$
Locomotion	Computed from linear traits	0.06	5.66	ebv/ $\sigma$
Body Condition Score	Linear score for BCS (Edmondson)	0.17	1.84	(ebv/ $\sigma$ )*12+100

- <sup>a</sup> If repeated records are treated as separate traits, provide heritability estimates and genetic variances separately for each trait, as well as for all traits pooled, i.e. for the trait submitted to Interbull.
- <sup>b</sup> Expressed as follows:  $\text{StandEval} = ((\text{eval} - a) / b) * c + d$  where  $a$  = mean of the base adjustment,  $b$  = standard deviation of the base,  $c$  = standard deviation of expression (include sign if scale is reversed), and  $d$  = base of expression.



## DESCRIPTION OF NATIONAL GENETIC EVALUATION SYSTEMS

<b>Country (or countries)</b>	Switzerland
<b>Main trait group<sup>1</sup></b> NOTE! Only one trait group per form!	Udder Health
<b>Breed(s)</b>	Holstein (CHE)
<b>Trait definition(s) and unit(s) of measurement<sup>2</sup></b> Attach an appendix if needed	Somatic cell score: expressed as average daily score
<b>Method of measuring and collecting data</b>	
<b>Time period for data inclusion</b>	Cows which first calved since January 1, 1994, Pedigree is traced back 3 generations from that date
<b>Age groups (e.g. parities) included</b>	All parities
<b>Other criteria (data edits) for inclusion of records</b>	Includes all test day records between 5 and 365 days in milk (DIM).
<b>Criteria for extension of records (if applicable)</b>	No extension of records is required
<b>Sire categories</b>	All bulls
<b>Environmental effects<sup>3</sup>, pre-adjustments</b>	Heterogeneous herd-test day variance adjustment, adjustment factors are estimated every run
<b>Method (model) of genetic evaluation<sup>3</sup></b>	MT (milk yield, fat yield, protein yield, somatic cell score) – ML (1, 2, 3+) - RR – TD -BLUP– AM. Later lactations (4 and up) are considered to be genetically the same as third lactation, permanent environmental effects in lactation 6 and later are assumed to be the same as 5th lactation.
<b>Environmental effects<sup>3</sup> in the genetic evaluation model</b>	Fixed: Herd-test day Regression on DIM within Parity - Age of calving - Region - Time Period - Season combination (6th order polynomials). Random: Animal lactation curve, lactation curve for permanent environment (4th order polynomials).
<b>Adjustment for heterogeneous variance in evaluation model</b>	Yes, see pre-adjustments
<b>Use of genetic groups and relationships</b>	Phantom parent groups are defined based on ancestry, birth year, breed and selection pathway
<b>Blending of foreign/Interbull information in evaluation</b>	No
<b>Genetic parameters in the evaluation</b>	See appendix PR
<b>System validation</b>	Method 3
<b>Expression of genetic evaluations</b> If standardised (e.g. RBV), give standardisation formula in the appendix	RBV: EBVs for average score within each lactation are averaged across lactations and then standardized to a mean of 100 and a genetic standard deviation of 12. Sign is changed such that high RBVs are desirable: $RBV = 100 + (-12) * ((EBV - \text{mean EBV of base animals}) / \text{genetic standard deviation})$
<b>Definition of genetic reference base</b>	Rolling base yearly updated in May, defined by cows born 6 to 8 calendar years ago, that have test day records included in the genetic

<b>Next base change</b>	evaluation: e.g. April 2011: cows born 2003 to 2005
<b>Calculation of reliability</b>	Similar to the procedure used to calculate EDC's
<b>Criteria for official publication of evaluations</b>	All bulls: 65 % reliability of EBV for SCS and published proof for production traits.
<b>Number of evaluations / publications per year</b>	3
<b>Use in total merit index<sup>4</sup></b>	8%
<b>Anticipated changes in the near future</b>	none
<b>Key reference on methodology applied</b>	Schaeffer, L. R., J. Jamrozik, G. J. Kistemaker, and B. J. Van Doormaal. 1999. Experience with a test day model. J. Dairy Sci. (Abstract & to be submitted for publication) Jamrozik, J., L. R. Schaeffer, and F. Grignola. 1998. Genetic parameters for production traits and somatic cell score of Canadian Holsteins with multiple trait random regression model. 6WCGALP. 23:303-306. Jamrozik, J., L. R. Schaeffer, Z. Liu, and G. Jansen. 1997. Multiple trait random regression test day model for production traits. Interbull Bulletin No. 16:43.
<b>Key organisation: name, address, phone, fax, e-mail, web site</b>	Evaluation Center: Qualitas AG Chamerstrasse 56, CH-6300 Zug, Switzerland Phone: +41 (0)41 768 92 92 Fax: +41 (0)41 768 92 99 e-mail: zws@qualitasag.ch Internet: <a href="http://www.qualitasag.ch">http://www.qualitasag.ch</a>  EBV's published by herdbook organisation: Holstein Association of Switzerland Route de Grangeneuve 27, CH-1725 Posieux <a href="http://www.holstein.ch">http://www.holstein.ch</a>

1) Either: Production (e.g. milk, fat, protein), Conformation, Health (e.g. mastitis resistance, milk somatic cell, resistance to diseases other than mastitis), Longevity, Calving (e.g. stillbirth, calving ease), Female fertility (e.g. non-return rate, interval between reproductive events, number of AI's, heat strength), Workability (e.g. milking speed, temperament), Beef production, Efficiency (e.g. body weight, energy balance, body conditioning score), or Other traits.

2) Indicate frequencies per category if the trait is categorical and specify transformation of data if practiced.

3) Use abbreviations for most common effects (see document with list of abbreviations at [http://www-interbull.slu.se/service\\_documentation/General/list\\_of\\_abbreviations.rtf](http://www-interbull.slu.se/service_documentation/General/list_of_abbreviations.rtf)) and indicate random (R) or fixed (F).

4) Please give economic weights and indicate how they are expressed (preferably in genetic standard deviation units).

## Parameters for national genetic evaluations for udder health traits as provided to Interbull

<b>Country (or countries):</b>	
<b>Main trait group:</b>	Health
<b>Breed(s):</b>	

Trait	$h^{2a}$	genetic variance <sup>a</sup>	official proof standardisation formula <sup>b</sup>
Milk Somatic Cell:	0.24	0.319	$a = 0; c = -12; b = 0.5857; d = 100$
Clinical Mastitis:			

<sup>a</sup> If repeated records are treated as separate traits, provide heritability estimates and genetic variances separately for each trait, as well as for all traits pooled, i.e. for the trait submitted to Interbull.

<sup>b</sup> Expressed as follows:  $StandEval = ((eval - a) / b) * c + d$  where  $a$  = mean of the base adjustment,  $b$  = standard deviation of the base,  $c$  = standard deviation of expression (include sign if scale is reversed), and  $d$  = base of expression.

## Lactation heritabilities (diagonal), 305d PE correlations (above diagonal) and 305d genetic correlations (below diagonal) for Holstein breed.

	M1	F1	P1	SCS1	M2	F2	P2	SCS2	M3	F3	P3	SCS3
M1	<b>.38</b>	.88	.95	-.14	.52	.42	.52	.00	.46	.31	.43	.08
F1	.56	<b>.33</b>	.91	-.09	.39	.49	.46	.01	.34	.41	.40	.06
P1	.88	.66	<b>.33</b>	-.11	.51	.48	.57	-.01	.43	.36	.47	.05
SCS1	.16	.04	.14	<b>.23</b>	-.06	-.03	-.06	.35	-.04	-.01	-.02	.28
M2	<b>.74</b>	.39	.63	.03	<b>.42</b>	.87	.95	-.20	.49	.35	.47	-.02
F2	.35	.77	.42	-.05	.61	<b>.39</b>	.91	-.22	.37	.47	.44	-.06
P2	.61	.49	.71	.03	.88	.71	<b>.38</b>	-.18	.49	.44	.55	-.01
SCS2	.11	.02	.11	.54	-.04	-.07	-.02	<b>.25</b>	-.09	-.10	-.09	.54
M3	<b>.69</b>	.35	.59	.08	<b>.86</b>	.51	.76	.03	<b>.40</b>	.84	.95	-.15
F3	.30	.70	.38	.00	.47	.85	.58	-.03	.63	<b>.35</b>	.90	-.20
P3	.53	.44	.62	.07	.71	.60	.83	.03	.88	.75	<b>.36</b>	-.15
SCS3	.08	.00	.06	.51	-.08	-.10	-.10	.63	-.08	-.11	-.08	<b>.25</b>

Heritability, Genetic and permanent environmental variances  
(milk, fat, protein – 305d yield (kg<sup>2</sup>), SCS – average daily score).  
Combined values are submitted to Interbull

<b>Effect</b>	<b>Trait</b>	<b>Lactation</b>	<b>Variance</b>
<b>Genetic</b>	<b>Milk</b>	1	339,311
		2	511,162
		≥ 3	638,642
		Combine d	417,816
	<b>Fat</b>	1	476
		2	942
		≥ 3	1,215
		Combine d	728
	<b>Protein</b>	1	246
		2	395
		≥ 3	498
		Combine d	306
<b>SCS</b>	1	.377	
	2	.419	
	≥ 3	.566	
	Combine d	.319	
<b>Permanent Environment</b>	<b>Milk</b>	1	419,494
		2	598,481
		≥ 3	534,058
	<b>Fat</b>	1	590
		2	811
		≥ 3	793
	<b>Protein</b>	1	352
		2	493
		≥ 3	468
<b>SCS</b>	1	.808	
	2	.955	
	≥ 3	.743	
<b>Heritability</b>	<b>Milk</b>	Combine d	.40
	<b>Fat</b>	Combine d	.36
	<b>Protein</b>	Combine d	.36
	<b>SCS</b>	Combine d	.24

## DESCRIPTION OF NATIONAL GENETIC EVALUATION SYSTEMS

<b>Country (or countries)</b>	Switzerland (CHE)
<b>Main trait group<sup>1</sup></b> NOTE! Only one trait group per form!	Longevity
<b>Breed(s)</b>	Holstein
<b>Trait definition(s) and unit(s) of measurement<sup>2</sup></b> Attach an appendix if needed	Productive life span of cow, days
<b>Method of measuring and collecting data</b>	The productive life span is calculated using data from the milk recording system: number of days between the first calving and the last test date. Information from the national animal tracing database is used to determine whether the cow was culled or sold to a non-herd book farm after the last recorded test date. In the latter case, the record of the cow is treated as right censored.
<b>Time period for data inclusion</b>	Lactations starting 1st of January 1990
<b>Age groups (e.g. parities) included</b>	Parities 1 to 6. Records of cows with more than 6 lactations are treated as right censored at the end of lactation 6.
<b>Other criteria (data edits) for inclusion of records</b>	Minimum number of daughters per sire : 6 Minimum number of (lactation) records per herd and year: 4 Cows that change herds (within herd book / milk recording scheme) are left truncated, i.e. only lactation records pertaining to the last herd of each cow are used to define environmental effects. If herd size changes by >50 % compared to the previous year, lactation records associated with the respective calving year are discarded. Consequently, records of productive life are treated as either right censored or left truncated.
<b>Criteria for extension of records (if applicable)</b>	
<b>Sire categories</b>	all.
<b>Environmental effects<sup>3</sup>, pre-adjustments</b>	none
<b>Method (model) of genetic evaluation<sup>3</sup></b>	Direct longevity: ST S-MGS survival analysis model, applying a proportional hazards model with a piecewise Weibull baseline hazard distribution, stratified according to lactation stage (4 stages: 0-50, 51-240, 201-400 and >400 days after calving) within lactation number (1 to 6).  Combined longevity: direct proofs are combined with 4 indicator traits (SCS, udder depth, overall feet & legs, days to first service) using selection index theory.
<b>Environmental effects<sup>3</sup> in the genetic evaluation model</b>	<i>HYS</i> : 2 seasons are distinguished per year. This random class effect is time-dependent and changes when a cow is transferred, and on April 1 and October 1 of each year. It is assumed that the dispersion follows the loggamma distribution; <i>Age</i> : At first calving. At first calving, expressed in days. This fixed effect is categorised in 7 levels from <26 to > 37 months, with steps of 2 months... <i>Within Herd*year*parity-deviation for milk yield and combined fat &amp;protein content</i> time-dependent effects of within-herd deviations for milk yield (5

	<p>classes: &lt; 80%, 80 - 94%, 95 - 104%, 105 - 120%, and &gt; 120% of the herd average) and sum of fat and protein content (5 classes: &lt; 94%, 94 - 97%, 98 - 101%, 102 - 106%, and &gt; 106% of the herd average) based on the age-adjusted 305d lactation records, with changes at each new calving. Cows without standard lactation records in the current lactation are assigned to the same production class as in the previous lactation</p> <p><i>Herd size change</i>: fixed time-dependent effect of herd size change relative to the previous herd*year: 6 possible classes: -50 to -20 %, -20 to -10 %, -10 to 0 %, 0 to +10 %, +10 to +20 %, +20 to +50 % (first two currently not used)</p>
<b>Adjustment for heterogeneous variance in evaluation model</b>	no
<b>Use of genetic groups and relationships</b>	Unknown parents in the sire pedigrees are grouped together according to country and year of birth.
<b>Blending of foreign/Interbull information in evaluation</b>	no
<b>Genetic parameters in the evaluation</b>	<p>Use Appendix GE for heritability/genetic variance estimates; for multiple-trait genetic evaluations, provide genetic correlation estimates between traits separately.</p> <p>Use <b>also</b> appendices PR, CO, BCO, SM, LO, CA, as applicable, if you participate in the international genetic evaluations of Interbull</p>
<b>System validation</b>	check of input/output data, comparison with former evaluations
<b>Expression of genetic evaluations</b> If standardised (e.g. RBV), give standardisation formula in the appendix	RBV: sire solutions are standardized to a base mean of 100 and a genetic (sire) standard deviation of 12, the scale is inverted such that a high risk of culling results in a low RBV.
<b>Definition of genetic reference base</b> <b>Next base change</b>	Male rolling base, defined by bulls born 8 to 12 calendar years ago with a minimum reliability of 50 %, yearly updated with the spring-evaluation, e.g. 2011: bulls born 1999 to 2003
<b>Calculation of reliability</b>	<p>Direct longevity see Yazdi et al., 2002, JDS 85:1563-1577</p> <p>Combined longevity based on selection index theory</p>
<b>Criteria for official publication of evaluations</b>	Reliability of 50% (combined longevity)
<b>Number of evaluations / publications per year</b>	3
<b>Use in total merit index<sup>4</sup></b>	weight of 10% in total merit index
<b>Anticipated changes in the near future</b>	none
<b>Key reference on methodology applied</b>	<b>Stricker, C., Sharifi, R., Schnyder, U. and Ducrocq, V.,</b> An improved model for the genetic evaluation for length productive life, Session 39, 58 <sup>th</sup> EAAP-Meeting, Dublin 2007
<b>Key organisation: name, address, phone, fax, e-mail, web site</b>	<p>Evaluation Center:  Qualitas AG  Chamerstrasse 56, CH-6300 Zug, Switzerland  Phone: +41 (0)41 768 92 92  Fax: +41 (0)41 768 92 99  e-mail: zws@qualitasag.ch  Internet: <a href="http://www.qualitasag.ch">http://www.qualitasag.ch</a></p>

	<p>EBV's published by herdbook organisation: Holstein Association of Switzerland Route de Grangeneuve 27, CH-1725 Posieux <a href="http://www.holstein.ch">http://www.holstein.ch</a></p>
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- 1) Either: Production (e.g. milk, fat, protein), Conformation, Health (e.g. mastitis resistance, milk somatic cell, resistance to diseases other than mastitis), Longevity, Calving (e.g. stillbirth, calving ease), Female fertility (e.g. non-return rate, interval between reproductive events, number of AI's, heat strength), Workability (e.g. milking speed, temperament), Beef production, Efficiency (e.g. body weight, energy balance, body conditioning score), or Other traits.
- 2) Indicate frequencies per category if the trait is categorical and specify transformation of data if practiced.
- 3) Use abbreviations for most common effects (see document with list of abbreviations at [http://www-interbull.slu.se/service\\_documentation/General/list\\_of\\_abbreviations.rtf](http://www-interbull.slu.se/service_documentation/General/list_of_abbreviations.rtf)) and indicate random (R) or fixed (F).
- 4) Please give economic weights and indicate how they are expressed (preferably in genetic standard deviation units).

## Parameters for national genetic evaluations for longevity traits as provided to Interbull

<b>Country (or countries):</b>	Switzerland
<b>Main trait group:</b>	Longevity
<b>Breed(s):</b>	Switzerland

Trait	$h^2$	genetic variance	official proof standardisation formula <sup>a</sup>
Direct longevity:	0.077	0.02356 (sire variance)	$a = 0.012392; c = -12; b = 0.15349; d = 100$
Combined longevity:	Proofs calculated with selection index		scale with average=100, sd=12

<sup>a</sup> Expressed as follows:  $StandEval = ((eval - a) / b) * c + d$  where  $a$ =mean of the base adjustment,  $b$ =standard deviation of the base,  $c$ =standard deviation of expression (include sign if scale is reversed), and  $d$ =base of expression.



## DESCRIPTION OF NATIONAL GENETIC EVALUATION SYSTEMS

<b>Country (or countries)</b>	Switzerland
<b>Main trait group<sup>1</sup></b> NOTE! Only one trait group per form!	Calving traits
<b>Breed(s)</b>	Holstein
<b>Trait definition(s) and unit(s) of measurement<sup>2</sup></b> Attach an appendix if needed	All traits have direct and maternal component 1. calving ease (1=easy, 2=average, 3=heavy pull, caesarean) 2. Stillbirth (1= alive, 2 = dead at or within 24 h after birth) 3. weight at birth (estimated or weighed by breeder) for bv-evaluations, scores for calving ease and stillbirth are multiplied by 10 to get similar scale and deviations as birth weight
<b>Method of measuring and collecting data</b>	1. calving ease, weight: information from breeder is transmitted to national animal database and from there to herd book database 2. stillbirth: breeders announce stillborn calves to herd book
<b>Time period for data inclusion</b>	starting at 1997
<b>Age groups (e.g. parities) included</b>	All parities
<b>Other criteria (data edits) for inclusion of records</b>	Records are excluded if: multiple births, gestation length < 255 or > 310 days, weight < 15 or > 90, age at first calving < 17 or > 44 months
<b>Criteria for extension of records (if applicable)</b>	No extension of records
<b>Sire categories</b>	All sires
<b>Environmental effects<sup>3</sup>, pre-adjustments</b>	none
<b>Method (model) of genetic evaluation<sup>3</sup></b>	MT-RP-BLUP-SM, correlated direct and maternal genetic effects (Sire-MGS) AM MT linear model with direct and maternal effects
<b>Environmental effects<sup>3</sup> in the genetic evaluation model</b>	1. HY (R) 2. permanent environment effect of dam ® 3. lactation number x age at calving (F) 4. season x region (F) 5. sex of calf (F)
<b>Adjustment for heterogeneous variance in evaluation model</b>	no
<b>Use of genetic groups and relationships</b>	genetic groups are assigned to unknown parents according to birth year, sex and origin of the animal
<b>Blending of foreign/Interbull information in evaluation</b>	No
<b>Genetic parameters in the evaluation</b>	Use Appendix GE for heritability/genetic variance estimates; for multiple-trait genetic evaluations, provide genetic correlation estimates between traits separately. Use <b>also</b> appendices PR, CO, BCO, SM, LO, CA, as applicable, if you participate in the international genetic evaluations of Interbull
<b>System validation</b>	
<b>Expression of genetic evaluations</b> If standardised (e.g. RBV), give standardisation formula in the appendix	RBV
<b>Definition of genetic reference</b>	Rolling base, yearly updated with spring evaluation, defined by bulls

<b>base</b> <b>Next base change</b>	born 8 to 10 calendar years ago, e.g. April 2013: bulls born 2001 to 2003 April 2014
<b>Calculation of reliability</b>	Reliabilities are approximated using the approach of Strabel et al. 2001, J.Anim. Sci. 79:833-839, implemented in program accf90 by I. Mistzal
<b>Criteria for official publication of evaluations</b>	direct traits: bulls with 80 calvings registred maternal traits: bulls with 65% reliability, daughters in 30 herds
<b>Number of evaluations / publications per year</b>	3
<b>Use in total merit index<sup>4</sup></b>	No
<b>Anticipated changes in the near future</b>	None
<b>Key reference on methodology applied</b>	
<b>Key organisation: name, address, phone, fax, e-mail, web site</b>	Evaluation Center: Qualitas AG Chamerstrasse 56, CH-6300 Zug, Switzerland Phone: +41 (0)41 768 92 92 Fax: +41 (0)41 768 92 99 e-mail: zws@qualitasag.ch Internet: <a href="http://www.qualitasag.ch">http://www.qualitasag.ch</a>  EBV's published by herdbook organisation: Holstein Association of Switzerland Route de Grangeneuve 27, CH-1725 Posieux <a href="http://www.holstein.ch">http://www.holstein.ch</a>

1) Either: Production (e.g. milk, fat, protein), Conformation, Health (e.g. mastitis resistance, milk somatic cell, resistance to diseases other than mastitis), Longevity, Calving (e.g. stillbirth, calving ease), Female fertility (e.g. non-return rate, interval between reproductive events, number of AI's, heat strength), Workability (e.g. milking speed, temperament), Beef production, Efficiency (e.g. body weight, energy balance, body conditioning score), or Other traits.

2) Indicate frequencies per category if the trait is categorical and specify transformation of data if practiced.

3) Use abbreviations for most common effects (see document with list of abbreviations at [http://www-interbull.slu.se/service\\_documentation/General/list\\_of\\_abbreviations.rtf](http://www-interbull.slu.se/service_documentation/General/list_of_abbreviations.rtf)) and indicate random (R) or fixed (F).

4) Please give economic weights and indicate how they are expressed (preferably in genetic standard deviation units).



## Parameters for national genetic evaluations for calving traits as provided to Interbull

<b>Country (or countries):</b>	Switzerland
<b>Main trait group:</b>	Calving Traits
<b>Breed(s):</b>	Holstein

Trait	$h^2$	genetic variance	official proof standardisation formula <sup>a</sup>
Direct calving ease:	.1012	2.906	b= 1.705, c = - 12, d=100
Maternal calving ease:	.0105	.3004	b= 0.548, c = - 10, d=100
Direct stillbirth:	.0302	.06696	b= 0.259, c = - 12, d=100
Maternal stillbirth:	.0284	.06307	b= 0.251, c = - 10, d=100

<sup>a</sup> Expressed as follows:  $StandEval = ((eval - a) / b) * c + d$  where a=mean of the base adjustment, b=standard deviation of the base, c=standard deviation of expression (include sign if scale is reversed), and d=base of expression.

## DESCRIPTION OF NATIONAL GENETIC EVALUATION SYSTEMS

<b>Country (or countries)</b>	Switzerland
<b>Main trait group<sup>1</sup></b> NOTE! Only one trait group per form!	Female fertility
<b>Breed(s)</b>	Holstein
<b>Trait definition(s) and unit(s) of measurement<sup>2</sup></b> Attach an appendix if needed	Non Return Rate after 56 Days (NRR), % (Trait 4) Interval from Calving to First Service (ICF), days (Trait 2)
<b>Method of measuring and collecting data</b>	Inseminations reported by AI-technicians via AI-companies (~95%) or directly by breeders (~5%), natural services reported by bull owners.
<b>Time period for data inclusion</b>	All AI and NS records since 1994
<b>Age groups (e.g. parities) included</b>	Records of cows from all lactations (no virgin heifers)
<b>Other criteria (data edits) for inclusion of records</b>	First service within lactation used if: 30 days ICF 200 days; Occurrence of a second service within 12 to 56 days after first service invokes a return event (Non Return Event = 0 or false)
<b>Criteria for extension of records (if applicable)</b>	
<b>Sire categories</b>	all sires
<b>Environmental effects<sup>3</sup>, pre-adjustments</b>	none
<b>Method (model) of genetic evaluation<sup>3</sup></b>	MT – BLUP – AM
<b>Environmental effects<sup>3</sup> in the genetic evaluation model</b>	Age*parity (both, F); sampling code (NRR, F); year*month of calving (ICF, F); year*month of service (NRR, F); herd*year (both, R); technician (NRR, R); service bull*batch of sperm collection (NRR, R); PE (both, R)
<b>Adjustment for heterogeneous variance in evaluation model</b>	none
<b>Use of genetic groups and relationships</b>	genetic groups are assigned to unknown parents according to birth year, sex and origin of the animal
<b>Blending of foreign/Interbull information in evaluation</b>	none
<b>Genetic parameters in the evaluation</b>	Use Appendix GE for heritability/genetic variance estimates; for multiple-trait genetic evaluations, provide genetic correlation estimates between traits separately. Use <b>also</b> appendices PR, CO, BCO, SM, LO, CA, as applicable, if you participate in the international genetic evaluations of Interbull
<b>System validation</b>	
<b>Expression of genetic evaluations</b> If standardised (e.g. RBV), give standardisation formula in the appendix	Standardized: days from calving- first inseminations Percentage of daughters not inseminated within 56 days after first insemination
<b>Definition of genetic reference base</b>	rolling base, cows born 2005-2007
<b>Next base change</b>	April 2014

<b>Calculation of reliability</b>	Reliabilities are approximated using the approach of Strabel et al. 2001, J.Anim. Sci. 79:833-839, implemented in program accf90 by I. Mistzal
<b>Criteria for official publication of evaluations</b>	For both traits (NRR and ICF): Reliability(ICF) 65 % EBVs' are published for bulls only
<b>Number of evaluations / publications per year</b>	4
<b>Use in total merit index<sup>4</sup></b>	no
<b>Anticipated changes in the near future</b>	none
<b>Key reference on methodology applied</b>	Schnyder U. & Stricker C., 2002, Interbull Bulletin No. 29, 138-141
<b>Key organisation: name, address, phone, fax, e-mail, web site</b>	<p>Evaluation Center:  Qualitas AG  Chamerstrasse 56, CH-6300 Zug, Switzerland  Phone: +41 (0)41 768 92 92  Fax: +41 (0)41 768 92 99  e-mail: zws@qualitasag.ch  Internet: <a href="http://www.qualitasag.ch">http://www.qualitasag.ch</a></p> <p>EBV's published by herdbook organisation:  Holstein Association of Switzerland  Route de Grangeneuve 27, CH-1725 Posieux  <a href="http://www.holstein.ch">http://www.holstein.ch</a></p>

1) Either: Production (e.g. milk, fat, protein), Conformation, Health (e.g. mastitis resistance, milk somatic cell, resistance to diseases other than mastitis), Longevity, Calving (e.g. stillbirth, calving ease), Female fertility (e.g. non-return rate, interval between reproductive events, number of AI's, heat strength), Workability (e.g. milking speed, temperament), Beef production, Efficiency (e.g. body weight, energy balance, body conditioning score), or Other traits.

2) Indicate frequencies per category if the trait is categorical and specify transformation of data if practiced.

3) Use abbreviations for most common effects (see document with list of abbreviations at [http://www-interbull.slu.se/service\\_documentation/General/list\\_of\\_abbreviations.rtf](http://www-interbull.slu.se/service_documentation/General/list_of_abbreviations.rtf)) and indicate random (R) or fixed (F).

4) Please give economic weights and indicate how they are expressed (preferably in genetic standard deviation units).

## Parameters used in genetic evaluation

<b>Country (or countries):</b>	Switzerland
<b>Main trait group:</b>	Female fertility
<b>Breed (repeat as necessary):</b>	Holstein

Trait	Definition	ITB <sup>a</sup>	h <sup>2b</sup>	genetic variance <sup>b</sup>	official proof standardisation formula <sup>c</sup>
Trait 1: Maiden heifer's ability to conceive					
Trait 2: Lactating cow's ability to start cycling	Number of days between calving and first service	x	0.059	54.2	b= 7.36, c = 12 d=100
Trait 3: Lactating cow's ability to conceive 1					
Trait 4: Lactating cow's ability to conceive 2	Proportion of non return events within 56 days after first service (%)	x	0.01	0.0024	b= 0.049, c = - 12, d=100
Trait 5: : Lactating cow's interval calving-conception					

<sup>a</sup> Indicate, with X, traits that are submitted to Interbull for international genetic evaluations.

<sup>b</sup> If repeated records are treated as separate traits, provide heritability estimates and genetic variances separately for each trait, as well as for all traits pooled, i.e. for the trait submitted to Interbull.

<sup>c</sup> Expressed as follows:  $StandEval = ((eval - a) / b) * c + d$  where a=mean of the base adjustment, b=standard deviation of the base, c=standard deviation of expression (include sign if scale is reversed), and d=base of expression.

Genetic and residual covariances for countries with national multiple trait evaluations.

Genetic covariances on upper diagonals, residual covariances on lower diagonals.

Trait name	Trait 1:	Trait 2:	Trait 3:	Trait 4:	Trait 5:
Trait 1: Maiden heifer's ability to conceive					
Trait 2: Lactating cow's ability to start cycling				0.0206	
Trait 3: Lactating cow's ability to conceive 1					
Trait 4: Lactating cow's ability to conceive 2		0.1377			
Trait 5: : Lactating cow's interval calving-conception					

## DESCRIPTION OF NATIONAL GENETIC EVALUATION SYSTEMS

<b>Country (or countries)</b>	Switzerland
<b>Main trait group<sup>1</sup></b>	Milkability
<b>NOTE!</b> Only one trait group per form!	
<b>Breed(s)</b>	Holstein
<b>Trait definition(s) and unit(s) of measurement<sup>2</sup></b>	Milking speed: very slow to very fast Temperament: nervous, normal, quiet
Attach an appendix if needed	
<b>Method of measuring and collecting data</b>	survey by classifier, scale of 1 to 5 for milking speed, 1 to 3 for temperament
<b>Time period for data inclusion</b>	alle data since 1992
<b>Age groups (e.g. parities) included</b>	first lactation
<b>Other criteria (data edits) for inclusion of records</b>	
<b>Criteria for extension of records (if applicable)</b>	missing classifier number, calving age out of range
<b>Sire categories</b>	all AI sires
<b>Environmental effects<sup>3</sup>, pre-adjustments</b>	none
<b>Method (model) of genetic evaluation<sup>3</sup></b>	MT within groups: format&capacity, rump, feet&legs, udder: ST: final score
<b>Environmental effects<sup>3</sup> in the genetic evaluation model</b>	F: age at calving, week of lactation, classifier x year, year x season of classification, R: herd (random effect, herd x year if > 14 animals, herd x 2 to 3 years to obtain 10 animals )
<b>Adjustment for heterogeneous variance in evaluation model</b>	none
<b>Use of genetic groups and relationships</b>	Genetic groups are assigned to unknown parents based on breed, sex, birth year and origin of the animal
<b>Blending of foreign/Interbull information in evaluation</b>	none
<b>Genetic parameters in the evaluation</b>	Use Appendix GE for heritability/genetic variance estimates; for multiple-trait genetic evaluations, provide genetic correlation estimates between traits separately. Use <b>also</b> appendices PR, CO, BCO, SM, as applicable, if you participate in the international genetic evaluations of Interbull
<b>System validation</b>	
<b>Expression of genetic evaluations</b>	Standardized with mean=0 , sd=1 for linear traits and udder, F&L composite, mean=100, sd=10 for final class
If standardised (e.g. RBV), give standardisation formula in the appendix	
<b>Definition of genetic reference base</b>	rolling base, cows born 2005-2007
<b>Next base change</b>	April 2014
<b>Calculation of reliability</b>	Reliabilities are approximated assuming a ST-RP-AM
<b>Criteria for official publication of evaluations</b>	At least daughters in 30 herds
<b>Number of evaluations / publications per year</b>	3



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<b>Use in total merit index<sup>4</sup></b>	No
<b>Anticipated changes in the near future</b>	None

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**Key reference on methodology applied**


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**Key organization: name, address, phone, fax, e-mail, web site**      Evaluation Center:  
 Qualitas AG  
 Chamerstrasse 56, CH-6300 Zug, Switzerland  
 Phone: +41 (0)41 768 92 92  
 Fax: +41 (0)41 768 92 99  
 e-mail: zws@qualitasag.ch  
 Internet: <http://www.qualitasag.ch>

EBV's published by herdbook organisation:  
 Holstein Association of Switzerland  
 Route de Grangeneuve 27, CH-1725 Posieux  
<http://www.holstein.ch>

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1) Either: Production (e.g. milk, fat, protein), Conformation, Health (e.g. mastitis resistance, milk somatic cell, resistance to diseases other than mastitis), Longevity (e.g. direct longevity, combined longevity), Calving (e.g. stillbirth, calving ease), Female fertility (e.g. non-return rate, interval between reproductive events, number of AI's, heat strength), Workability (e.g. milking speed, temperament), Beef production, Efficiency (e.g. body weight, energy balance, body conditioning score), or Other traits.

2) Indicate frequencies per category if the trait is categorical and specify transformation of data if practiced.

3) Use abbreviations for most common effects (see document with list of abbreviations at [http://www-interbull.slu.se/service\\_documentation/General/list\\_of\\_abbreviations.rtf](http://www-interbull.slu.se/service_documentation/General/list_of_abbreviations.rtf)) and indicate random (R) or fixed (F).

4) Please give economic weights and indicate how they are expressed (preferably in genetic standard deviation units).

## Parameters for national genetic evaluations for workability traits as provided to Interbull

Country (or countries): Switzerland

Main trait group: Workability

Breed(s): Holstein

Trait	$h^2$	genetic variance	official proof standardisation formula <sup>a</sup>
Milkability:	0.1837	0.07189	$(ebv/\sigma_g)*12+100$
Temperament	0.1393	0.0477	$(ebv/\sigma_g)*12+100$

<sup>a</sup> Expressed as follows:StandEval= $((eval-a)/b)*c+d$  where a=mean of the base adjustment, b=standard deviation of the base, c=standard deviation of expression (include sign if scale is reversed), and d=base of expression.