Country United States of America

Trait category:	*Individual trait(s):*
Reproduction-calving	**Dystocia (direct)**
Health	**Somatic cell score**
Conformation	**Udder**
	Locomotion
	Other
Longevity	**Productive life**

Calving performance:
National Association of Animal Breeders
P.O. Box 1033
Columbia, Missouri 65205-1033 U.S.A.
Telephone +1 573 445 4406
Facsimile +1 573 446 2279
E-mail "s=naab.css/o=naab/"@sprint.com

Conformation traits of Holstein:
Holstein Association
1 Holstein Place
Brattleboro, Vermont 05301 U.S.A.
Telephone +1 802 254 4551
Facsimile +1 802 254 8251
E-mail lawlor@holstein.com

Conformation traits (breeds other than Holsteins), somatic cell count and productive life:
Animal Improvement Programs Laboratory
Building 263, BARC-East
10300 Baltimore Avenue
Beltsville, Maryland 20705-2350 U.S.A.
Telephone +1 301 504 8334
Facsimile +1 301 504 8092
E-mail rlaipl@ggpl.arsusda.gov

Reproduction calving traits	Dystocia (direct)
Breed(s)	Holstein, Red & White
Trait definition and unit(s) of measuring	Scored in 5 categories; no problem (1), slight problem (2), needed assistance (3), considerable force (4), extreme difficulty (5)
Method of measuring and collecting data	Scored by dairyman and collected by milk recording programs or AI-organizations
Time period for data inclusion	Since 1985
Age groups	All
Genetic parameters	$h^2_{\text{calving performance (on underlying scale)}} = 0.147$
Sire categories	AI-bulls
Environmental effects **pre-adjustment** **evaluation model**	None Herd x year x season, sex of calf, parity
Base for age adjustment	None
Use of genetic groups and/or relationships	Bulls are grouped by birth year of bull. Relationships considered are sire and MGS of bulls with progeny
Method (model) of genetic evaluation	ST Threshold model SM
System validation	Genetic trend calculated at each run
Expression of proof	PTA as percentage of difficult births for heifer calving in winter; difficult birth is defined as score 4 (considerable force) or 5 (extreme difficulty), M = 9.05% and SD = 5.42%
Genetic (reference) base	Fixed base of bulls born prior to 1977
Criteria for official publication of sire proofs	≥ 20 calvings
Number of evaluations/ publications per year	Two; January, July
Use in total merit index	No
Key reference on methodology applied	Berger, P.J., 1994. Genetic prediction for calving ease in the United States: Data, models and uses by the dairy industry. J. Dairy Sci. 77: 1146 Clutter, A.C., P.J. Berger & J.M. Mattison, 1989. Threshold model analysis of dystocia in dairy cattle when progeny information is limited. J. Dairy Sci. 72: 3264 Djemali, M., P.J. Berger & A.E. Freeman, 1987. Ordered categorical sire evaluation for dystocia in Holsteins. J. Dairy Sci. 70: 2374

Health traits	Somatic cell score
Breed(s)	Holstein, Red & White, Ayrshire, Brown Swiss, Guernsey, Jersey, Milking Shorthorn
Trait definition and unit(s) of measuring	Somatic cell score is lactation mean of log 2 somatic cell counts
Method of measuring and collecting data	Collected by milk recording program
Time period for data inclusion	Since 1987
Age groups	1st to 5th lactation
Genetic parameters	$h^2_{\text{somatic cell score}} = 0.10$, t = 0.35
Sire categories	All bulls
Environmental effects pre-adjustment evaluation model	Days in milk, calving age, calving month Management group (as for yield)
Base for age adjustment	Average age of 46 months for Holstein, Red & White, Ayrshire, Brown Swiss and Milking Shorthorn Average age of 49 for Jersey and Guernsey
Use of genetic groups and/or relationships	All relationships used. Unknown parents grouped by sex and year
Method (model) of genetic evaluation	ST BLUP AM
System validation	Separate regional analyses were compared pre-implementation
Expression of proof	PTA, adjusted so cows establishing genetic bases have the following means: Holstein 3.20, Red & White 3.20, Ayrshire 3.15, Brown Swiss 3.22, Guernsey 3.35, Jersey 3.31, Milking Shorthorn 2.87. Higher values indicate a higher somatic cell score
Genetic (reference) base	5-year stepwise, cows born in 1990
Criteria for official publication of sire proofs	Published if yield evaluation published
Number of evaluations/ publications per year	Two; January, July
Use in total merit index	USDA: net merit $: 0.70 x milk-fat-protein $ + 11.30 x productive life - 28.22 x (somatic cell score - breed average) Relative emphasis = 10: 4 : -1
Key reference on methodology applied	Schutz, M.M., 1994. Genetic evaluation of somatic cell scores for United States dairy cattle. J. Dairy Sc. 77: 2113

Conformation traits	**Udder:**	**fore udder attachment, rear udder height, rear udder width, udder cleft, udder depth, front teat placement, teat length (only for Holstein, Guernsey and Jersey)**
	Locomotion:	**foot angle, rear legs (side view)**
	Other:	**Stature, strength, body depth (only for Holstein, Guernsey and Jersey), dairy form, rump angle, thurl width (only for Holstein, Guernsey and Jersey), final score**

Breed(s)	[H]	Holstein
	[O]	Other breeds: Ayrshire, Brown Swiss, Guernsey, Jersey, Milking Shorthorn, Red & White
Trait definition and unit(s) of measuring	[H,O]	Ayrshires are scored on 1-9 point scale, other breeds scored on a 1-50 point scale
Method of measuring and collecting data	[H,O]	Scored visually by breed association classifiers/appraisers
Time period for data inclusion	[H]	Final score since 1955, other traits since 1982
	[O]	Final score since 1976, other traits since 1980
Age groups	[H,O]	All
Genetic parameters	[H]	$h^2_{\text{udder traits}}$ = 0.23 to 0.29, t = 0.37 to 0.46 $h^2_{\text{locomotion traits}}$ = 0.15 to 0.21, t = 0.25 to 0.32 $h^2_{\text{other traits}}$ = 0.26 to 0.42, t = 0.30 to 0.60 $r_{g(\text{between linear traits})}$ = -0.34 to 0.92
	[O]	$h^2_{\text{udder traits}}$ = 0.16 to 0.27, t = 0.40 to 0.652 $h^2_{\text{locomotion traits}}$ = 0.12 to, t = 0.288 $h^2_{\text{other traits}}$ = 0.16 to 0.40, t = .40 to 0.65
Sire categories	[H,O]	All bulls
Environmental effects		
pre-adjustment	[H]	None
	[O]	Age at calving, stage of lactation
evaluation model	[H]	Herd x classification date, animal, permanent environment, herd x sire-interaction, age at calving, stage of lactation
	[O]	Herd x classification date x parity, genetic groups, herd x sire-interaction
Base for age adjustment	[H]	5 year old cow, born in 1990 and milking in her 5th month of her 3rd lactation
	[O]	Set so actual and age adjusted scores are equal for breed-trait
Use of genetic groups and/or relationships	[H]	All relationships and unknown parent groups
	[O]	Grouping on pedigree index for final score
Method (model) of genetic evaluation	[H]	MT BLUP AM, different traits evaluated simultaneously
	[O]	ST BLUP SM

Conformation traits *continued*	**Udder** **Locomotion** **Other**	
System validation	[H]	Validation of genetic trend, monitoring of changes in genetic predictions
	[O]	Examination resulted in addition of parity to model
Expression of proof	[H]	Most traits have a PTA with M = 0 and SD = 1 Final score is expressed in PTA
	[O]	PTA with M = 0
Genetic (reference) base	[H,O]	5-year stepwise, cows born in 1990
Criteria for official publication of sire proofs	[H]	≥ 10 daughters (and for Guernsey)
	[O]	Published if yield evaluation published and if ≥ 5 daughters and REL ≥ 20%
Number of evaluations/ publications per year	[H,O]	Two; January, July
Use in total merit index	[H]	*Holstein:* Type-Production Index (TPI): [3 x protein (lb.) / 19.0 + fat (lb) / 22.5 + final score / 0.7 + UDC / 0.8] x 50 + 576 UDC = [udder composite = 0.30 x udder depth + 0.16 x fore udder + 0.16 x teat placement + 0.16 x rear udder height + 0.12 x rear udder width + 0.10 x udder cleft]
	[O]	*Other breeds:* Production-type index (PTI): *Ayrshire:* [4 x protein (kg) + 2 x fat (kg) + 1 x final score] (100 / 7) *Brown Swiss:* [5 x protein (kg) + 1 x fat (kg) + 1 x final score] (100 / 7) *Guernsey*: [5 x protein (kg) + 1 x fat (kg) + 1 x functional herdlife] (100 / 7) *Jersey:* [8 x protein (kg) + 2 x fat (kg) + 2 x functional trait index + 2 x productive life (mo) - 1 x SCS] (100 / 13) Functional trait index = 0.15 x stature + 0.11 x strength + 0.40 x dairy form - 0.20 x rear legs + 0.30 x foot angle + 0.49 x fore udder attachment + 0.63 x rear udder height + 0.42 x rear udder width + 0.22 x udder cleft + 0.55 x teat placement + 1.00 udder depth *Milking Shorthorn:* [4 x protein (kg) + 2 x fat (kg) + 1 x final score] (100 / 7) **NB**: All variables are in units of SD (divided by SD)
Key reference on methodology applied	[H]	Misztal, I., T.J. Lawlor & T.H. Short, 1993. Implementation of single and multiple trait animal models for genetic evaluations of Holstein type traits. J. Dairy Sci. 76: 1421
	[O]	Norman, H.D., B.G. Cassell, G.J. King, R.L. Powell & E.E. Wright, 1979. Sire evaluation for conformation of Jersey cows. J. Dairy Sci. 62:1914

Longevity traits	Productive life
Breed(s)	Holstein, Red & White, Ayrshire, Brown Swiss, Guernsey, Jersey, Milking Shorthorn
Trait definition and unit(s) of measuring	Total months of milk production, limited to 10 mo/lactation and 7 year of age
Method of measuring and collecting data	Calculated from predicted and realized data of milk recording program, augmented by conformation data for Holsteins
Time period for data inclusion	Since 1960
Age groups	≥ 3 years
Genetic parameters	$h^2_{\text{productive life}} = 0.085$
Sire categories	All bulls
Environmental effects **pre-adjustment** **evaluation model**	 Incomplete records are extended Birth year x season
Base for age adjustment	None
Use of genetic groups and/or relationships	All relationships used. Unknown parents grouped by sex and year
Method (model) of genetic evaluation	ST BLUP AM
System validation	-
Expression of proof	PTA in months, with SD = 1.9 months, higher values are more desirable
Genetic (reference) base	5-year stepwise, cows born in 1990
Criteria for official publication of sire proofs	Published if yield evaluation published
Number of evaluations/ publications per year	Two; January, July
Use in total merit index	Included, see pages 155 (USDA) and 157 (PTI)
Key reference on methodology applied	VanRaden, P.M. & G.R. Wiggans, 1995. Productive life evaluations: calculation, accuracy and economic value. J. Dairy Sci. 78: 631