Country	Denmark

Trait category:	*Individual trait(s):*
Reproduction-calving	**Calving ease (direct, maternal)**
	Vitality of calf (direct, maternal)
	Size of calf (direct, maternal)
Reproduction-fertility	**Non-return rate 56 (female)**
	Interval first to last insemination (female)
	Interval calving to first insemination (female)
Health	**Mastitis resistance**
	Somatic cell count
Workability	**Milking speed**
	Temperament
Conformation	**Udder**
	Locomotion
	Other

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Reproduction calving traits	**Calving ease (direct, maternal)** **Vitality of calf (direct, maternal)** **Size of calf (direct, maternal)**
Breed(s)	Danish Black and White, Danish Red, Danish Red and White, Danish Jersey
Trait definition and unit(s) of measuring	Calving ease is scored in 4 categories; difficult with vet assistance (1), difficult without vet assistance (2), easy assistance (3), easy (4) Vitality of calf is scored in 2 categories; stillborn (0), liveborn (1) Size of calf is scored in 4 categories; small (1), little below average (2), little above average (3), large (4)
Method of measuring and collecting data	Data from milk recording system and farmers score
Time period for data inclusion	Since 1985
Age groups	All
Genetic parameters	Different heritabilities and correlations for different breeds, for first and later calvings, and for direct and maternal traits. In total 24 h^2 and 132 r_g $h^2_{vitality}$ = 0.01 to 0.06 $h^2_{calving\ ease}$ = 0.01 to 0.10 h^2_{size} = 0.06 to 0.18 $r_{g(vitality,\ calving\ ease)}$ = 0.08 to 0.50 $r_{g(vitality,\ size)}$ = -0.40 to 0.30 $r_{g(calving\ ease,\ size)}$ = -0.70 to -0.25 $r_{g(1st\ calving,\ later\ calving)}$ = -0.49 to 0.80 $r_{g(direct\ traits,\ maternal\ traits)}$ = 0
Sire categories	All bull categories with progeny
Environmental effects pre-adjustment evaluation model	Heterosis effects in cow, heterosis effects in calf Herd x year, season x year, age of calf x region, sex of calf x region
Base for age adjustment	Effect of age included in the model
Use of genetic groups and/or relationships	Relationships between bulls are included
Method (model) of genetic evaluation	MT BLUP SM; all traits evaluated simultaneously; first and later calvings treated as different (correlated) traits
System validation	-
Expression of proof	The traits are summarized in two combined indices: calving index (direct) and birth index (maternal) expressed in RBV with M = 100 and SD = 5, higher values are more desirable Calving index (direct): Danish Black & White, Danish Red, Danish Red & White: $[850 \times vitality_{1st\ calving} + 165 \times calving\ ease_{1st\ calvings} + 12.25 \times size_{1st\ calving} + 1225 \times vitality_{later\ calvings} + 135 \times calving\ ease_{later\ calvings} + 10 \times size_{later\ calvings}] / 17 + 100$

Reproduction calving traits *continued*	**Calving ease (direct, maternal)** **Vitality of calf (direct, maternal)** **Size of calf (direct, maternal)**
Expression of proof *continued*	Danish Jersey: [850 x $vitality_{1st\ calving}$ + 135 x $calving\ ease_{1st\ calving}$ + 12.50 x $size_{1st\ calving}$ + 1000 x $vitality_{later\ calvings}$ + 250 x $calving\ ease_{later\ calvings}$ + 15 x $size_{later\ calvings}$] / 5 + 100 Birth index (maternal): Danish Black & White, Danish Red, Danish Red & White: [850 x $vitality_{1st\ calving}$ + 165 x $calving\ ease_{1st\ calving}$] / 15 +100 Danish Jersey: [500 x $vitality_{1st\ calving}$ + 500 x $vitality_{later\ calving}$] / 5 + 100
Genetic (reference) base	AI-bulls born 6-7 years before actual year
Criteria for official publication of sire proofs	Birth index: REL > 50% Calving index: REL > 35% (for Danish Black & White, Danish Red, Danish Red & White) REL > 25% (for Danish Jersey)
Number of evaluations/ publications per year	Four; March, June, September, December
Use in total merit index	Calving index is included in total merit index (S-index): Danish Black & White: 100 + [0.75 x Y-index + 0.23 x I-index + 0.25 x female fertility + 0.18 x calving performance + 0.42 x mastitis resistance + 0.21 x body + 0.36 x feet & legs + 0.35 x mammary + 0.14 x milking speed + 0.04 x temperament] Danish Red: 100 + [0.70 x Y-index + 0.30 x I-index + 0.24 x female fertility + 0.17 x calving performance + 0.22 x mastitis resistance + 0.14 x feet & legs + 0.41 x mammary + 0.21 x milking speed + 0.06 x temperament] Danish Red & White: 100 + [0.55 x Y-index + 0.35 x I-index + 0.21 x female fertility + 0.15 x calving performance + 0.20 x mastitis resistance + 0.19 x body + 0.34 x feet & legs + 0.51 x mammary + 0.15 x milking speed + 0.03 x temperament] Danish Jersey: 100 + [0.80 x Y-index + 0.09 x I-index + 0.14 x female fertility + 0.05 x calving performance + 0.24 x mastitis resistance + 0.10 x feet & legs + 0.36 x mammary + 0.24 x milking speed + 0.08 x temperament] **NB**: I-index is the beef & growth index Y-index is the production index
Key reference on methodology applied	Pedersen, J., J. Jensen & P. Madsen, 1995. Evaluation of Calving Performance in Danish Dairy Sires. Proceedings of the open session of Interbull meeting in Prague, Czech Republic. Bulletin no. 11.

Reproduction fertility traits	Non-return rate 56 (female) Interval first to last insemination (female) Interval calving to first insemination (female)
Breed(s)	Danish Black and White, Danish Red, Danish Red and White, Danish Jersey
Trait definition and unit(s) of measuring	Non-return rate 56 is scored as re-inseminated (0) or not re-inseminated (1) within 56 days after first insemination Interval first to last insemination is the period from first to last insemination (in days) Interval calving to first insemination is the period from calving to first insemination (in days)
Method of measuring and collecting data	Insemination information from AI service system Calving information from milk recording system
Time period for data inclusion	Since 1985
Age groups	All
Genetic parameters	$h^2_{\text{non-return rate 56 (heifer)}} = 0.008$ $h^2_{\text{Interval first to last insemination (heifer)}} = 0.016$ $h^2_{\text{non-return rate 56 (cow)}} = 0.01$ $h^2_{\text{interval first to last insemination (cow)}} = 0.02$ $h^2_{\text{interval calving to first insemination (cow)}} = 0.07$ $r_{g(\text{non-return rate 56, Interval first to last insemination (heifer)})} = -0.85$ $r_{g(\text{non-return rate 56 (female), interval first to last insemination (cow)})} = -0.70$ $r_{g(\text{non-return rate 56 (female), interval calving to first insemination (cow)})} = 0.15$ $r_{g(\text{interval first to last insemination, interval calving to first insemination (cow)})} = 0.29$
Sire categories	All bull categories with progeny
Environmental effects **pre-adjustment** **evaluation model**	None Heterosis, herd x year, age at calving (age at first insemination in heifers), calving season x year
Base for age adjustment	Effects of age included in the model
Use of genetic groups and/or relationships	Relationships among bulls are included
Method (model) of genetic evaluation	MT BLUP SM, heifers and cows evaluated separately
System validation	-
Expression of proof	Combined index (fertility index) expressed as RBV with M = 100 and SD = 5. Higher values are more desirable Danish Black & White, Danish Red, Danish Red & White: [0.61 x non-return rate 56 (heifer) - 5.30 x interval first to last insemination (heifer) + 1.32 x non-return rate 56 (cow) - 13.50 x interval first to last insemination (cow) - 13.50 x interval calving to first insemination] / 24 + 100

Reproduction fertility traits *continued*	**Non-return rate 56 (female)** **Interval first to last insemination (female)** **Interval calving to first insemination (female)**
Expression of proof *continued*	Danish Jersey: [0.61 x non-return rate 56 (heifer) - 4.75 x interval first to last insemination (heifer) + 1.65 x non-return rate 56 (cow) - 7.10 x interval first to last insemination (cow) - 7.10 x interval calving to first insemination] / 13 + 100
Genetic (reference) base	AI bulls born 6-7 years before actual year
Criteria for official publication of sire proofs	REL > 35%
Number of evaluations/ publications per year	Four; March, June, September, December
Use in total merit index	Included, see page 35
Key reference on methodology applied	Pedersen, J. & J. Jensen, 1996. Evaluation of female fertility of Danish dairy sires. Proceedings of the international workshop on genetic improvement of functional traits in cattle. Gembloux, Belgium. Bulletin No. 12

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Health traits	Mastitis resistance Somatic cell count
Breed(s)	Danish Black and White, Danish Red, Danish Red and White, Danish Jersey
Trait definition and unit(s) of measuring	Mastitis resistance is scored between 10 days before calving and 180 days after calving in 2 categories; no mastitis diagnose (0), ≥ 1 mastitis diagnosis (1) Somatic cell count is the geometric mean of log transformed test-day somatic cell count in the period from 10 to 180 days after calving
Method of measuring and collecting data	Mastitis information is collected by milk recording system or by special equipment used by veterinarians Somatic cell count is recorded by milk recording system
Time period for data inclusion	Since 1990
Age groups	1st lactation
Genetic parameters	$h^2_{mastitis} = 0.04$ $h^2_{somatic\ cell\ count} = 0.11$ $r_{g(mastitis,\ somatic\ cell\ count)} = 0.61$
Sire categories	All bull categories with progeny
Environmental effects **pre-adjustment** **evaluation model**	 None Herd x year, region x season x year, age at calving
Base for age adjustment	Effects of age included in the model
Use of genetic groups and/or relationships	Relationships between bulls are included
Method (model) of genetic evaluation	MT BLUP SM, mastitis and somatic cell count evaluated together
System validation	-
Expression of proof	RBV with M = 100 and SD = 5, higher values are more desirable. Somatic cell count is only used as an indicator trait
Genetic (reference) base	AI bulls born 6-7 years before actual year
Criteria for official publication of sire proofs	REL > 40% EBV for SCC is not published
Number of evaluations/ publications per year	Four; March, June, September, December
Use in total merit index	Included, see page 35
Key reference on methodology applied	-

Workability traits	Milking speed Temperament
Breed(s)	Danish Black and White, Danish Red, Danish Red and White, Danish Jersey
Trait definition and unit(s) of measuring	Milking speed is scored from slow (1) to fast (9) General temperament is scored from difficult (1) to easy (9) to handle
Method of measuring and collecting data	Scored by farmer collected by classifier when cows are scored for conformation traits
Time period for data inclusion	Since 1989
Age groups	1st lactation
Genetic parameters	Different heritabilities for different breeds $h^2_{\text{milking speed}}$ = 0.19 to 0.32 $h^2_{\text{temperament}}$ = 0.05 to 0.20
Sire categories	All AI bulls with classified daughters
Environmental effects pre-adjustment evaluation model	Standardization of scores within classifier x season Region x year, herd (random), aged at calving, month of calving, month from calving, year x season x classifier
Base for age adjustment	Effects of age included in the model
Use of genetic groups and/or relationships	Relationships included
Method (model) of genetic evaluation	ST BLUP AM
System validation	-
Expression of proof	Standardized EBV with M = 0 and SD = 1
Genetic (reference) base	AI bulls born 6-7 years before actual year
Criteria for official publication of sire proofs	≥ 15 effective classified daughters
Number of evaluations/ publications per year	Eight; February, March, May, June, August, September, November, December
Use in total merit index	Included, see page 35
Key reference on methodology applied	-

Conformation traits	**Udder:**	**fore udder attachment, rear udder width, udder support, udder depth, teat length, teat thickness, front teat placement-rear view, mammary overall**
	Locomotion:	**rear legs-side view, rear legs-rear view, hock quality, bone quality, foot angle, feet & legs overall**
	Other:	**stature, body depth, chest width, dairy form, top line, rump width, rump angle, body overall**

Breed(s)	Danish Black and White, Danish Red, Danish Red and White, Danish Jersey
Trait definition and unit(s) of measuring	Individual traits are scored on a linear scale 1-9 point scale, following recommendation of the European and World-wide group for harmonization of linear type classification Overall traits are not scored individually, but are combinations of the individual traits
Method of measuring and collecting data	Scored by classifiers who are appointed by the National Committee on Danish Cattle husbandry. Randomly selected daughters are classified in the period from 1 to 8 months after calving. All AI-bulls have classified daughters
Time period for data inclusion	Since 1989
Age groups	1st lactation
Genetic parameters	Different heritabilities for different breeds $h^2_{\text{udder traits}}$ = 0.17 to 0.43 $h^2_{\text{locomotion traits}}$ = 0.09 to 0.30 $h^2_{\text{other traits}}$ = 0.16 to 0.63
Sire categories	All AI bulls with classified daughters
Environmental effects pre-adjustment evaluation model	Standardization of scores within classifier x season Region x year, herd (random), aged at calving, month of calving, month from calving, year x season x classifier
Base for age adjustment	Effects of age included in the model
Use of genetic groups and/or relationships	Relationships included
Method (model) of genetic evaluation	ST BLUP AM
System validation	-
Expression of proof	Individual traits are expressed in a standardized EBV with M = 0 and SD = 1 Overall traits are expressed in RBV with M = 100 and SD = 5
Genetic (reference) base	AI bulls born 6-7 years before actual year

Conformation traits *continued*	Udder Locomotion Other
Criteria for official publication of sire proofs	≥ 15 effective classified daughters
Number of evaluations/ publications per year	Eight; February, March, May, June, August, September, November, December
Use in total merit index	Included, see page 35
Key reference on methodology applied	-