Country: Denmark

<table>
<thead>
<tr>
<th>Trait category</th>
<th>Individual trait(s):</th>
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<tr>
<td>Reproduction-calving</td>
<td>Calving ease (direct, maternal)</td>
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<td>Non-return rate 56 (female)</td>
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<td>Other</td>
</tr>
</tbody>
</table>

National Committee on Danish Cattle Husbandry
Udkaersvej 15
DK-8200 Aarhus N, Denmark
Telephone +45 86 10 90 88
Facsimile +45 86 10 97 00
| Reproduction calving traits | Calving ease (direct, maternal)  
Vitality of calf (direct, maternal)  
Size of calf (direct, maternal) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed(s)</td>
<td>Danish Black and White, Danish Red, Danish Red and White, Danish Jersey</td>
</tr>
</tbody>
</table>
| 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):  
$$ \text{Calving index} = 1830 \times \text{vitality}_{1st \text{ calving}} + 165 \times \text{calving ease}_{1st \text{ calving}} + 12.25 \times \text{size}_{1st \text{ calving}} + 1225 \times \text{vitality}_{\text{later calvings}} + 135 \times \text{calving ease}_{\text{later calvings}} + 10 \times \text{size}_{\text{later calvings}} / 17 + 100 $$  
Danish Black & White, Danish Red, Danish Red & White:  
|
### Reproduction calving traits

- Calving ease (direct, maternal)
- Vitality of calf (direct, maternal)
- Size of calf (direct, maternal)

### Expression of proof

- **Danish Jersey:**
  
  \[
  [850 \times \text{vitality}_{1\text{-calving}} + 135 \times \text{calving ease}_{1\text{-calving}} + 12.50 \times \\
  \text{size}_{1\text{-calving}} + 1000 \times \text{vitality}_{\text{later calvings}} + 250 \times \text{calving ease}_{\text{later calvings}} + 15 \times \text{size}_{\text{later calvings}}] / 5 + 100
  \]

- **Birth index (maternal):**

  \[
  \text{Danish Black & White, Danish Red, Danish Red & White:} \\
  [850 \times \text{vitality}_{1\text{-calving}} + 165 \times \text{calving ease}_{1\text{-calving}}] / 15 + 100
  \]

- **Danish Jersey:**

  \[
  [500 \times \text{vitality}_{1\text{-calving}} + 500 \times \text{vitality}_{\text{later calvings}}] / 5 + 100
  \]

### Genetic (reference) base

- Al-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:**

    \[
    100 + [0.75 \times \text{Y-index} + 0.23 \times \text{I-index} + 0.25 \times \text{female} \\
    \text{fertility} + 0.18 \times \text{calving performance} + 0.42 \times \text{mastitis} \\
    \text{resistance} + 0.21 \times \text{body} + 0.36 \times \text{feet & legs} + 0.35 \times \\
    \text{mammary} + 0.14 \times \text{milking speed} + 0.04 \times \text{temperament}]
    \]

  - **Danish Red:**

    \[
    100 + [0.70 \times \text{Y-index} + 0.30 \times \text{I-index} + 0.24 \times \text{female} \\
    \text{fertility} + 0.17 \times \text{calving performance} + 0.22 \times \text{mastitis} \\
    \text{resistance} + 0.14 \times \text{feet & legs} + 0.41 \times \text{mammary} + 0.21 \times \\
    \text{milking speed} + 0.06 \times \text{temperament}]
    \]

  - **Danish Red & White:**

    \[
    100 + [0.55 \times \text{Y-index} + 0.35 \times \text{I-index} + 0.21 \times \text{female} \\
    \text{fertility} + 0.15 \times \text{calving performance} + 0.20 \times \text{mastitis} \\
    \text{resistance} + 0.19 \times \text{body} + 0.34 \times \text{feet & legs} + 0.51 \times \\
    \text{mammary} + 0.15 \times \text{milking speed} + 0.03 \times \text{temperament}]
    \]

  - **Danish Jersey:**

    \[
    100 + [0.80 \times \text{Y-index} + 0.09 \times \text{I-index} + 0.14 \times \text{female} \\
    \text{fertility} + 0.05 \times \text{calving performance} + 0.24 \times \text{mastitis} \\
    \text{resistance} + 0.10 \times \text{feet & legs} + 0.36 \times \text{mammary} + 0.24 \times \\
    \text{milking speed} + 0.08 \times \text{temperament}]
    \]

  - **NB:** I-index is the beef & growth index

  - **Y-index is the production index**

### Key reference on methodology applied

| **DENMARK** |
| 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 $\times$ year, age at calving (age at first insemination in heifers), calving season $\times$ 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:  
$[0.61 \times \text{non-return rate 56 (heifer)} - 5.30 \times \text{interval first to last insemination (heifer)} + 1.32 \times \text{non-return rate 56 (cow)} - 13.50 \times \text{interval first to last insemination (cow)} - 13.50 \times \text{interval calving to first insemination}] / 24 + 100$ |
<table>
<thead>
<tr>
<th>Reproduction fertility traits continued</th>
<th>Non-return rate 56 (female)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interval first to last insemination (female)</td>
</tr>
<tr>
<td></td>
<td>Interval calving to first insemination (female)</td>
</tr>
</tbody>
</table>

**Expression of proof continued**

Danish Jersey:

\[0.61 \times \text{non-return rate 56 (heifer)} - 4.75 \times \text{interval first to last insemination (heifer)} + 1.65 \times \text{non-return rate 56 (cow)} - 7.10 \times \text{interval first to last insemination (cow)} - 7.10 \times \text{interval calving to first insemination} / 13 + 100\]

**Genetic (reference) base**

All 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**

### Denmark

| 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 diagnosis (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 | $h^2_{\text{mastitis}} = 0.04$  
|                  | $h^2_{\text{somatic cell count}} = 0.11$  
|                  | $r_{\text{g(mastitis, somatic cell count)}} = 0.61$  

| 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

<table>
<thead>
<tr>
<th>Breed(s)</th>
<th>Milking speed</th>
<th>Temperament</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danish Black and White, Danish Red, Danish Red and White, Danish Jersey</td>
<td>Milking speed is scored from slow (1) to fast (9)</td>
<td>General temperament is scored from difficult (1) to easy (9) to handle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trait definition and unit(s) of measuring</th>
<th>Method of measuring and collecting data</th>
<th>Time period for data inclusion</th>
<th>Age groups</th>
<th>Genetic parameters</th>
<th>Sire categories</th>
<th>Environmental effects pre-adjustment evaluation model</th>
<th>Base for age adjustment</th>
<th>Use of genetic groups and/or relationships</th>
<th>Method (model) of genetic evaluation</th>
<th>System validation</th>
<th>Expression of proof</th>
<th>Genetic (reference) base</th>
<th>Criteria for official publication of sire proofs</th>
<th>Number of evaluations/publications per year</th>
<th>Use in total merit index</th>
<th>Key reference on methodology applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milking speed is scored from slow (1) to fast (9)</td>
<td>Scored by farmer collected by classifier when cows are scored for conformation traits</td>
<td>Since 1989</td>
<td>1st lactation</td>
<td>Different heritabilities for different breeds</td>
<td>All AI bulls with classified daughters</td>
<td>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</td>
<td>Effects of age included in the model</td>
<td>Relationships included</td>
<td>ST BLUP AM</td>
<td>-</td>
<td>Standardized EBV with M = 0 and SD = 1</td>
<td>AI bulls born 6-7 years before actual year</td>
<td>≥ 15 effective classified daughters</td>
<td>Eight; February, March, May, June, August, September, November, December</td>
<td>Included, see page 35</td>
<td>-</td>
</tr>
</tbody>
</table>
**DENMARK**

<table>
<thead>
<tr>
<th>Conformation traits</th>
<th>Udder:</th>
<th>fore udder attachment, rear udder width, udder support, udder depth, teat length, teat thickness, front teat placement-rear view, mammary overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rear udder width, udder support, udder depth, teat length, teat thickness, feet &amp; legs overall</td>
<td></td>
</tr>
<tr>
<td>Locomotion</td>
<td>Rear legs-side view, rear legs-rear view, hock quality, bone quality, foot angle, feet &amp; legs overall</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>stature, body depth, chest width, dairy form, top line, rump width, rump angle, body overall</td>
<td></td>
</tr>
</tbody>
</table>

**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

\[ h^2_{\text{udder traits}} = 0.17 \text{ to } 0.43 \]

\[ h^2_{\text{locomotion traits}} = 0.09 \text{ to } 0.30 \]

\[ h^2_{\text{other traits}} = 0.16 \text{ to } 0.63 \]

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