# Lifetime Performance Index (LPI) Formula
## - April 2022 -

$$LPI = \left[ \begin{array}{c} \text{Production} \\ \text{Component} \\ \text{x Emphasis} \\ \text{x Factor} \end{array} + \begin{array}{c} \text{Durability} \\ \text{Component x} \\ \text{Emphasis} \\ \text{x Factor} \end{array} + \begin{array}{c} \text{Health \&} \\ \text{Fertility} \\ \text{Component} \\ \text{x Emphasis} \\ \text{x Factor} \end{array} \right] + \text{Constant}$$

Where the relative emphasis placed on each of the three main components in each breed is presented in the following table along with the multiplicative factors for each component.

| Breed | LPI Constant | Production | | Durability | | Health & Fertility | |
|---|---|---|---|---|---|---|---|
| | | Emphasis | Factor | Emphasis | Factor | Emphasis | Factor |
| Ayrshire | 2004 | 46 | .5685 | 32 | .7215 | 22 | .9561 |
| Brown Swiss | 959 | 55 | .5440 | 27 | .6786 | 18 | .8349 |
| Canadienne | 932 | 55 | .4565 | 30 | .6653 | 15 | .8759 |
| Guernsey | 644 | 50 | .5540 | 35 | .7523 | 15 | .6923 |
| Holstein | 2200 | 40 | .5408 | 40 | .8243 | 20 | .6967 |
| Jersey | 1087 | 50 | .5970 | 30 | .6387 | 20 | .7483 |
| Milking Shorthorn | 1065 | 56 | .5389 | 30 | .7992 | 14 | 1.0363 |

## Production Component (PROD):

$$PROD = [W_{PY}x(PY\text{-}Avg_{PY})/SD_{PY}] + [W_{PD}xPD/SD_{PD}] + [W_{FY}x(FY\text{-}Avg_{FY})/SD_{FY}] + [W_{FD}xFD/SD_{FD}]$$

Where PY = Protein Yield, PD = Protein Deviation, FY = Fat Yield and FD = Fat Deviation, which are standardized using the appropriate averages (Avg) and standard deviations (SD) and then multiplied by their respective relative weight (W), all of which are breed specific as outlined in the following table.

| Parameter | Trait | Ayrshire | Brown Swiss | Canadienne | Guernsey | Holstein | Jersey | Milking Shorthorn |
|---|---|---|---|---|---|---|---|---|
| EBV Averages | Milk Yield | -372 | -221 | -256 | -179 | -328 | -146 | -195 |
| | Fat Yield | -18 | -7 | -5 | -8 | -22 | -13 | -13 |
| | Protein Yield | -14 | -8 | -4 | -7 | -15 | -8 | -6 |
| EBV Standard Deviations | Milk Yield | 620 | 500 | 450 | 550 | 740 | 760 | 450 |
| | Fat Yield | 25 | 20 | 11 | 23 | 28 | 34 | 19 |
| | Fat Deviation | .21 | .20 | .20 | .27 | .28 | .38 | .16 |
| | Protein Yield | 21 | 17 | 7 | 15 | 21 | 25 | 11 |
| | Protein Deviation | .11 | .12 | .13 | .10 | .12 | .16 | .09 |
| Relative Weights Within the Production Component | Fat Yield | 5.0 | 4.5 | 4.5 | 4.5 | 6.0 | 4.5 | 4.5 |
| | Fat Deviation | | 0.5 | 0.5 | 0.5 | | 0.5 | 0.5 |
| | Protein Yield | 5.0 | 4.5 | 4.5 | 4.5 | 4.0 | 4.5 | 4.5 |
| | Protein Deviation | | 0.5 | 0.5 | 0.5 | | 0.5 | 0.5 |

**Durability Component (DUR):**

$$\text{DUR} = [W_{HL} \times (HL - 100)/5] + [W_{MS} \times MS/5] + [W_{F\&L} \times F\&L/5] + [W_{HH} \times (HH - 100)/5] +$$

$$[W_{DS} \times DS/5] + [W_{RP} \times RP/5]$$

Where HL = Herd Life, MS = Mammary System, F&L = Feet and Legs, HH = Hoof Health, DS = Dairy Strength and RP = Rump, and each trait is standardized using the appropriate averages and standard deviations and then multiplied by their respective relative weight (W) that is breed specific as outlined in the following table.

| Parameter | Trait | Ayrshire | Brown Swiss | Canadienne | Guernsey | Holstein | Jersey | Milking Shorthorn |
|---|---|---|---|---|---|---|---|---|
| Relative Weights Within the Durability Component | Herd Life | 4.0 | 4.0 | 2.0 | 3.4 | 2.0 | 2.0 | 2.6 |
| | Mammary System | 3.8 | 3.2 | 5.5 | 3.2 | 3.7 | 4.0 | 4.0 |
| | Feet & Legs | 2.2 | 1.6 | 2.5 | 2.4 | 2.1 | 4.0 | 2.6 |
| | Hoof Health | | | | | 0.7 | | |
| | Dairy Strength | | | | 1.0 | 1.0 | | 0.8 |
| | Rump | | 1.2 | | | 0.5 | | |

**Health & Fertility Component (H&F):**

$$\text{H\&F} = [W_{DF} \times (DF-100)/5] + [W_{MR} \times (MR-100)/5] + [W_{SCS} \times (SCS-100)/5] +$$

$$[W_{UD} \times UD/5] + [W_{MSP} \times (MSP-100)/5] + [W_{MT} \times (MT-100)/5]$$

Where DF = Daughter Fertility, MR = Mastitis Resistance, SCS = Somatic Cell Score, UD = Udder Depth, MSP = Milking Speed and MT = Milking Temperament. The relative weights for each trait (i.e.: $W_{DF}$, $W_{MR}$, $W_{SCS}$, $W_{UD}$, $W_{MSP}$ and $W_{MT}$, respectively), which are specific to each breed, are provided in the following table.

| Parameter | Trait | Ayrshire | Brown Swiss | Canadienne | Guernsey | Holstein | Jersey | Milking Shorthorn |
|---|---|---|---|---|---|---|---|---|
| Relative Weights Within the Health & Fertility Component | Daughter Fertility | 4.0 | 4.0 | 4.0 | 6.7 | 6.7 | 5.0 | 2.0 |
| | Mastitis Resistance | 1.0 | | | | 3.3 | 5.0 | |
| | Somatic Cell Score | | 3.0 | 3.0 | 2.0 | | | 4.8 |
| | Udder Depth | | 1.0 | 2.0 | 1.0 | | | 2.4 |
| | Milking Speed | 3.0 | 2.0 | 1.0 | 0.3 | | | 0.8 |
| | Milking Temperament | 2.0 | | | | | | |