

## Lifetime Profit Index (LPI) Formula - April 2014 -

$$\text{LPI} = \left( \begin{array}{l} \text{Production} \\ \text{Component} \\ \times \text{Emphasis} \\ \times \text{Factor} \end{array} + \begin{array}{l} \text{Durability} \\ \text{Component} \\ \times \text{Emphasis} \\ \times \text{Factor} \end{array} + \begin{array}{l} \text{Health \&} \\ \text{Fertility} \\ \text{Component} \\ \times \text{Emphasis} \\ \times \text{Factor} \end{array} \right) + \text{Constant}$$

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. As of April 2013, the multiplicative factors are reduced to produce an LPI scale with half the variation compared to previously.

Breed	LPI Constant	Production		Durability		Health & Fertility	
		Emphasis	Factor	Emphasis	Factor	Emphasis	Factor
Ayrshire	1783	54	.6095	31	.7679	15	.9918
Brown Swiss	828	54	.5600	31	.7022	15	1.0073
Canadienne	956	54	.6112	31	.7811	15	.8113
Guernsey	602	54	.5384	31	.7059	15	.7427
Holstein	1755	51	.6090	34	.7382	15	.7374
Jersey	941	57	.6789	33	.7120	10	1.0382
Milking Shorthorn	1039	54	.6208	31	.7892	15	1.1904

### Production Component (PROD):

$$\text{PROD} = [W_{PY} \times (PY - \text{Avg}_{PY}) / \text{SD}_{PY}] + [W_{PD} \times PD / \text{SD}_{PD}] + [W_{FY} \times (FY - \text{Avg}_{FY}) / \text{SD}_{FY}] + [W_{FD} \times FD / \text{SD}_{FD}]$$

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 <sup>1</sup>	Protein Yield	1	-2	-5	-2	8	6	-2
	Fat Yield	0	-1	-6	0	6	6	-1
EBV Standard Deviations	Protein Yield	21	17	7	15	21	25	11
	Protein Deviation	.11	.12	.13	.10	.12	.16	.09
	Fat Yield	25	20	11	23	28	34	19
Relative Weights Within the Production Component	Fat Deviation	.21	.20	.20	.27	.28	.38	.16
	Protein Yield	5.7	5.7	5.1	5.7	5.7	5.7	5.1
	Protein Deviation	0.3	0.3	0.9	0.3	0.3	1.0	0.9
	Fat Yield	3.8	3.8	3.4	3.8	3.8	2.8	3.4
	Fat Deviation	0.2	0.2	0.6	0.2	0.2	0.5	0.6

## Durability Component (DUR):

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

Where HL = Herd Life, MS = Mammary System, F&L = Feet and Legs, DS = Dairy Strength 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	2.0	3.6	3.6	3.6	2.0	2.0	3.2
	Mammary System	4.0	3.2	3.2	3.2	4.0	4.0	3.6
	Feet & Legs	3.0	2.4	2.4	2.4	3.0	3.0	2.4
	Dairy Strength	1.0	0.8	0.8	0.8	1.0	1.0	0.8

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

$$H\&F = [W_{SCS} \times -1 \times (SCS-3.00)/0.23] + [W_{UD} \times UD/5] + [W_{MSP} \times (MSP-100)/5] + [W_{DF} \times (DF-100)/5] + [W_{LP} \times (LP-100)/5]$$

Where SCS = Somatic Cell Score, UD = Udder Depth, MSP = Milking Speed, DF = Daughter Fertility and LP = Lactation Persistency. The relative weights for each trait (i.e.:  $W_{SCS}$ ,  $W_{UD}$ ,  $W_{MSP}$ ,  $W_{DF}$  and  $W_{LP}$  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	Somatic Cell Score	2.0	2.0	4.8	2.0	2.0	4.2	4.8
	Udder Depth	1.0	1.0	2.4	1.0	1.0	2.1	2.4
	Milking Speed	0.3	3.0	0.8	0.3	0.3	0.7	0.8
	Daughter Fertility	4.0	4.0	2.0	6.7	6.7	3.0	2.0
	Lactation Persistency	2.7	0.0	0.0	0.0	0.0	0.0	0.0

## Application

The Lifetime Profit Index formula for each breed is applied to all males and females in the CDN database. In terms of order of priority of genetic evaluations used for each trait, official domestic evaluations take precedence, followed by an Interbull MACE evaluation and finally, when no other evaluation is available, a Parent Average is used.

In the Holstein, Ayrshire, Jersey and Brown Swiss breeds, genomic evaluations take precedence, when available, over any traditional genetic evaluation.