

Key index figures
E-33
Lifetime Production Index (LP Index)

▪ **Introduction**

A cow's lifetime production is determined by her milk production and by the number of days she is in milk production. When the genetic capacity for lifetime production must be improved, the selection of the right bull is important. To determine a bull's genetic potential for lifetime production, knowledge about the potential for production and longevity are important as well. Breeding values are already available for both components. However, if you wish to determine lifetime production in more detail, the rate of maturity, persistency and calving interval play a role as well. Breeding values are available for the first two factors as well.

A lifetime production index for bulls can be derived from existing breeding values and information.

The aim of the lifetime production index for bulls is to express the genetic potential for lifetime production, which in essence is calculated from the breeding values for production and longevity.

▪ **Background of the calculation**

When the breeding value for lifetime production is derived from existing breeding values, production breeding values, rate of maturity, longevity and calving interval qualify as key index figures.

The breeding value longevity of a bull indicates the average number of production days that his daughters spend more or less on a farm from the first calving compared to the population. Thus, the breeding value longevity indicates the differences between daughter groups with regard to the number of days that the daughters are actually in lactation. Of course, half of the breeding value is passed on to the daughters. So half the difference in breeding value that is shown in bulls can be found in the performance of the daughter groups.

The breeding value longevity is used to determine the difference in the percentage of survival per day of life of a bull's daughter group compared to the population. Each bull has his own survival curve. If the longevity breeding value of a bull is high, then the probability of survival per day of a daughter of this bull is increased. Cows are followed for 11 lactations in this manner.

For the genetic potential for production, the 305-day production breeding values for milk, fat and protein are available. To take into account the difference in genetic potential, for the first three lactations, the genetic lactation curves for milk, fat and protein yield from the test day model are used. Breeding values are available from day 5 through 335. Lactation curves for later lactations are based on the shape of the curve in lactation 3, using a lactation correction factor. With this lactation correction factor the effect of age on production can be taken into account.

Using the genetic curves, differences in persistency and rate of maturity can be taken into account. The rate of maturity in the lifetime production breeding value is determined by using the individual breeding values for lactations 1, 2 and 3. When a bull's daughters show a higher rate of maturity than average, then this is clear from the three individual breeding values. Currently, in the test day model (milk production breeding value estimation), the breeding value rate of maturity is also determined from the difference in production realised in lactation 3 compared to the production in

lactation 1. The production in lactation 3 is used to estimate the production in lactation 4 and higher, using the general age factors to get from lactation 3 to lactation 4 or higher. It is assumed that daughters do not show any further production development after lactation 3 compared to the whole population. So the rate of maturity shown by a daughter group is based on the rate of maturity from lactation 1 to lactation 3 as already shown.

For lactations longer than 305 days, the genetic potential for the days from day 305 can be predicted using the 305-day curves by fitting a function to the breeding values of the daily productions.

The average length of lactation of a daughter group is determined by the calving interval. The average calving interval in the population is currently 418 days. With an average dry period of 60 days, this results in an average length of lactation in the population of 358 days. For each bull, the average length of lactation of the daughter group can be determined based on his breeding value for calving interval.

Based on a bull's survival curve and lactation curves, the quantity of milk produced per day during the whole lifetime of a daughtergroup is determined.

The length of lactation is bull-dependent, but the dry period is constant for every bull.

The result of the addition of all daily productions is a breeding value for lifetime production for milk, fat and protein production.

For bulls without any known genetic lactation curves, because they have no daughters in milk production in the Netherlands and Flanders, the population lactation curve is used. Based on this population-lactation curve and the breeding value for production, the genetic potential per day is determined. This situation applies to both bulls tested abroad and genomic bulls.

The lifetime production index that is published for bulls is based on the lifetime production values for lactose, fat and protein, with weighting given to the current INET factors. The lifetime production index indicates a cow's lifetime yield in terms of milk production minus feed costs, all expressed in euros. It is *the* combination of longevity and milk production, providing insight into the extent to which the production of milk depends on longevity, when the cow's whole lifetime is taken into account. The lifetime lactose yield is computed from the lifetime milk yield and the breeding value for lactose percentage.

The correlations between lifetime production and the traits are shown in Table 1. The correlations are based on breeding values of a group of bulls.

Table 1 Correlation between breeding values for black-and-white bulls born in 2004 for the traits used in the lifetime production index. Lt stands for the lifetime production of the trait.

	NVI	Ci	long	milk	fat	prot	lt milk	lt fat	lt prot	lt lnet
NVI		0.45	0.77	0.41	0.60	0.55	0.80	0.84	0.82	0.83
ci	0.45		0.36	-0.19	-0.04	-0.12	0.29	0.33	0.31	0.32
long	0.77	0.36		0.31	0.36	0.41	0.94	0.95	0.96	0.97
milk	0.41	-0.19	0.31		0.45	0.82	0.59	0.39	0.49	0.44
fat	0.60	-0.04	0.36	0.45		0.65	0.44	0.60	0.48	0.54
prot	0.55	-0.12	0.41	0.82	0.65		0.61	0.54	0.63	0.60
lt milk	0.80	0.29	0.94	0.59	0.44	0.61		0.94	0.98	0.96
lt fat	0.84	0.33	0.95	0.39	0.60	0.54	0.94		0.97	0.99
lt prot	0.82	0.31	0.96	0.49	0.48	0.63	0.98	0.97		0.99
lt lnet	0.83	0.32	0.97	0.44	0.54	0.60	0.96	0.99	0.99	

▪ Base and base differences

Breeding values for longevity traits are published based on the 2015-base. Bulls born in 2006 or 2007 determine the base of 2015. The average breeding value of the base animals is zero. There are three different bases: Milk goal Black, Milk goal Red and Dual purpose. The definitions of these bases are as follows:

Milk goal Black (Z)

AI-bulls born in 2006 or 2007 with at least 87.5% HF-blood and up to 12.5% FH-blood and hair colour black pied, with at least one observation in the genetic evaluation.

Milk goal Red (R)

AI-bulls born in 2006 or 2007 with at least 87.5% HF-blood and up to 12.5% MRY-blood and hair colour red pied, with at least one observation in the genetic evaluation.

Dual purpose (D)

AI-bulls born in 2006 or 2007 with at least 87.5% MRIJ-blood and 12.5% or less HF blood, with at least one observation in the genetic evaluation.

The standard deviation of the lifetime production index is 1550 euros.

The standard deviation of the underlying breeding values for lifetime production of milk is 6600 kg, for lifetime production of fat is 290 kg and for lifetime production of protein is 225 kg.

Every five years, in a year dividable by 5, the reference year for the base is moved 5 years. The base differences are shown in Table 2.

Table 2 Base differences for the lifetime production index and for the four underlying lifetime production traits of milk, fat, protein and lactose.

	B->R	B->D	R->D
Lifetime production index	816	2616	1800
Lifetime production milk	4357	11194	5569
Lifetime production fat	122	442	320
Lifetime production protein	122	371	249
Lifetime production lactose	199	556	357

▪ Publication requirements

The lifetime production index for a bull is published if the bull has a breeding value for longevity and a breeding value for the milk production traits.