DHI info sheet
Western Canadian Dairy Herd Improvement Services

Breed Class Average

DHI Breed Class Average (BCA) is a milk, fat and protein index used by all milk recording programs across Canada. The BCA index allows fair evaluation and comparison of cows of different breeds, ages and months of calving. When the BCA concept was developed in 1952, BCA indexes of 100 were set at the average 305-day production levels determined from official records. In comparison, many of today's cows have BCAs well above 200, which is twice the average production of 40 years ago.

BCA 100 standards

BCA standards have been established for Ayrshire, Brown Swiss, Canadienne, Guernsey, Holstein, Jersey, Red Poll and Shorthorn dairy breeds. As shown in Table 1, the standards are different for each breed. For example, a Holstein cow calving in January at 38 months of age must produce 4667 kilograms (kg) of milk in a 305-day lactation to earn a BCA MILK of 100. A Jersey cow calving at the same age and in the same month is required to produce only 3102 kg in 305 days to earn the same BCA MILK.

	BCA 100 STANDARDS		
BREED	MILK	FAT	PROTEIN
Ayrshire	3492	144	115
Brown Swiss	3909	156	137
Guernsey	3394	170	121
Holstein	4667	172	149
Jersey	3102	168	118
Shorthorn	2776	112	90

Table 1 : BCA 100 standards by breed for cows calving in January at 38 months of age.

BCA standards increase with the age of the cow until she reaches maturity. Depending upon the breed, maturity is reached when a cow reaches 78 to 90 months or approximately 7 years of age. After a cow reaches her mature age, the BCA standard gradually declines. Table 2 demonstrates the effect of age at calving on BCA standards.

AGE AT	BCA 100 STANDARDS		
CALVING	MILK	FAT	PROTEIN
25	4039	149	128
38	4667	172	149
51	5103	188	160
64	5350	197	166
77	5445	200	168
90	5470	200	169
103	5423	198	167

Table 2 : BCA 100 standards by age at calving (months) for Holsteins calving in January.

The month of the year in which a cow calves also affects her production and, therefore, the BCA standard to which her production is compared. Cows calving in the fall and winter normally produce more milk than cows calving during spring and summer. The effect of month of calving on BCA standards is shown in table 3 on page 2.

How are BCA indexes calculated?

BCA indexes are calculated by comparing the cow's actual or projected 305 day production to the BCA standard for a cow of the same breed, age at calving and month of calving.

For example, a Holstein cow that calved in July at 38 months of age produced 8875 kg of milk, 320 kg of fat and 282 kg of protein over a 305 day lactation. The BCA 100 standards for this cow are given in table 3 and her BCA indexes are calculated as follows :

CALVING MONTH	BCA 100 STANDARDS MILK	FAT	PROTEIN
January	4667	172	149
April	4536	167	145
July	4385	164	143
October	4680	176	150

Table 3 : BCA 100 standards by calving month for Holsteins calving at 38 months of age.

$$\text{BCA} = \frac{\text{PRODUCTION KG}}{\text{BCA 100 STANDARD}} \times 100$$

$$\text{BCA MILK} = \frac{8875}{4385} \times 100 = 202$$

$$\text{BCA FAT} = \frac{320}{164} \times 100 = 195$$

$$\text{BCA PROTEIN} = \frac{282}{143} \times 100 = 197$$

Calculation of actual production

Actual milk production between consecutive tests is calculated by multiplying the average production between tests by the number of days between tests. For example, if MILK KG was 24 kg at test 1 and 32 kg at test 2, with 30 days between the two tests, the total production between tests is calculated as follows :

$$\text{MILK KG BETWEEN TESTS} = \text{AVE MILK/DAY KG BETWEEN TESTS} \times \text{DAYS BETWEEN TESTS}$$

$$= \frac{(24 + 32)}{2} \times 30 = 840 \text{ KG}$$

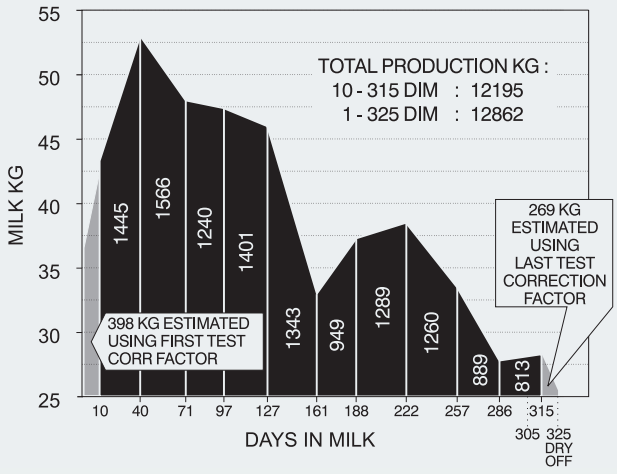

Figure 1 : Production under the lactation curve.

Fat and protein production between consecutive tests is calculated by replacing AVERAGE MILK/DAY KG with average daily component yields in the formula above. Component yields at each test are simply calculated by multiplying FAT % or PROTEIN % by MILK KG.

Production between first and last tests (10 - 315 DIM in figure 1 example) is the sum of the yields calculated between consecutive tests. Since there will be no test weight on day 1 after calving nor will there likely be a test on the day before dry off, production between calving and first test and between last test and dry off must be estimated.

PRODUCTION TO FIRST TEST

Milk production between calving and first test is estimated using the correction factors shown in table 4. The 5 year old cow whose lactation curve is shown in figure 1 produced 43.3 kg on her first test, at 10 DIM. Total production for her first 10 days in milk is calculated as follows :

DIM AT FIRST TEST	AGE OF COW IN YEARS 2	3	4+
10	0.892	0.914	0.919
20	0.912	0.934	0.933
30	0.933	0.956	0.951
40	0.955	0.979	0.970
50	0.978	1.004	0.992
60	1.002	1.032	1.016

Table 4 : First test correction factors (examples).

TOTAL PRODUCTION TO FIRST TEST
= FIRST TEST MILK KG x DIM x FACTOR
= 43.3 x 10 x 0.919 = 398 KG

Fat and protein production from calving to first test are calculated by multiplying component production at first test by DIM. Component production at first test is the product of FAT % or PROTEIN % and MILK KG.

PRODUCTION TO DAY 305

When a cow has a test day after 305 DIM, her production between day 305 and her immediately previous test must be estimated. Average daily milk, fat and protein production between the tests immediately previous to and immediately after day 305 are multiplied by the number of days between day 305 and the previous test.

For the example shown in figure 1, milk production was 27.8 kg at 286 DIM and 28.3 kg at 315 DIM. Average milk production between tests was 28.1 kg with 19 days between day 305 and the previous test (286 DIM). Production between day 305 and the immediately previous test was (28.1 x 19 =) 533 kg.

PRODUCTION FROM LAST TEST TO TERMINATION

For lactations that terminate before 305 DIM, lactation production and BCA indexes are calculated for cows dried off after 119 DIM and for those that died or were sold after 239 DIM. When a lactation terminates between tests, milk production from last test to termination is calculated using last test correction factors, examples of which are shown in table 5. The method, which is similar to that used for calculating production to first test, is also used in calculating total lactation production for lactations terminating after 305 DIM.

DAYS FROM LAST TEST TO TERMINATION	AGE OF COW IN YEARS 2	3	4+
10	0.966	0.960	0.952
20	0.939	0.912	0.899
30	0.921	0.876	0.863
40	0.912	0.853	0.844

Table 5 : Last test correction factors (examples).

For example, the lactation shown in figure 1 was terminated with dry off at 325 DIM. Milk production at the last test (315 DIM) was 28.4 kg. Production after last test is calculated as follows :

$$\text{TOTAL PRODUCTION AFTER LAST TEST} = \text{LAST TEST MILK KG} \times \text{DAYS FROM LAST TEST TO TERMINATION} \times \text{FACTOR}$$

$$= 28.3 \times (325 - 315) \times 0.952 = 269 \text{ KG}$$

Fat and protein production from last test to termination are calculated by multiplying the component production at last test (the product of FAT % or PROTEIN % and MILK KG) by the number of days from last test to termination.

Calculation of projected 305 day production

For cows that are still lactating but less than 305 days in milk (DIM) , 305 day production is projected from partial lactation production data, with the following exceptions :

- less than 45 DIM with only one valid test;
- first test was after 75 DIM;
- greater than 75 days between tests;
- record is uncertifiable;
- breed is unknown;
- no calving date recorded;
- no birth date recorded.

Projected 305 day records are calculated using two sets of correction factors derived from the DHI database of official records. Tables 6 and 7 give examples of bias correction (BC) factors and multiplicative last test day (MLL) factors, respectively. The formula used in calculating projections is as follows:

$$\text{PROJECTED PRODUCTION} = \text{LACTATION YIELD TO DATE} + \left[\text{BC} \times \text{MLL} \times \text{LAST TEST DAY YIELD} \right]$$

BREED	BIAS CORRECTION FACTORS MILK	FAT	PROTEIN
Ayrshire	0.926	0.899	0.895
Brown Swiss	0.980	0.980	0.980
Guernsey	0.980	0.980	0.980
Holstein	0.928	0.907	0.892
Jersey	0.920	0.896	0.878
Shorthorn	0.980	0.980	0.980

Table 6 : Bias correction factors used in the calculation of projected 305 day records.

For example, at 222 DIM of the lactation shown in figure 1, milk yield to date was 9630 kg, fat yield was 277.5 kg and protein yield was 271.5 kg. This cow calved in April at 62 months of age. Projected 305 day production is calculated as follows :

PROJECTED 305 DAY MILK KG
= 9630 + [0.928 x 73.63 x 38.5] = 12260

PROJECTED 305 DAY FAT KG
= 277.5 + [0.907 x 80.49 x 1.17] = 362.9

PROJECTED 305 DAY PROTEIN KG
= 271.5 + [0.892 x 80.49 x 1.18] = 356.2

DIM	-- MAR/APR/MAY -- MILK	FAT	PROT	-- JUN/JUL/AUG -- MILK	FAT	PROT	-- SEP/OCT/NOV -- MILK	FAT	PROT	-- DEC/JAN/FEB -- MILK	FAT	PRO
	AGE AT CALVING LESS THAN 36 MONTHS											
75	184.17	204.78	204.78	200.43	223.73	223.73	201.11	215.99	215.99	189.36	203.32	203.32
150	136.32	153.05	153.05	143.63	157.05	157.05	141.25	151.48	151.48	133.62	146.52	146.52
222	79.38	87.58	87.58	79.86	87.48	87.48	78.47	84.91	84.91	76.26	86.28	86.28
300	6.30	7.18	7.18	5.94	6.80	6.80	6.16	6.94	6.94	6.15	7.15	7.15
	AGE AT CALVING GREATER THAN 35 MONTHS											
75	162.00	174.84	174.84	172.82	187.80	187.80	178.54	187.30	187.30	171.30	180.57	180.57
150	119.74	131.43	131.43	129.62	138.49	138.49	130.59	137.32	137.32	122.37	131.74	131.74
222	73.63	80.49	80.49	75.44	81.19	81.19	74.35	79.51	79.51	70.79	77.92	77.92
300	7.14	8.33	8.33	6.57	7.47	7.47	6.54	7.48	7.48	6.93	7.97	7.97

Table 7 : Multiplicative last test day (MLL) factors used in calculating projected 305 day records.