2020 Jersey Performance Index™ (JPI)

Updates to Jersey Performance Index™ authorized by the AJCA Board of Directors were implemented with the April 2020 official CDCB-AJCA genetic evaluations. JPI_{2020} predicts the efficiency of production by expressing lifetime production of fat and protein per unit of feed consumed. New traits included in JPI_{2020} are the six Jersey Health Traits (https://www.uscdcb.com/wp-content/uploads/2020/01/CDCB-Jersey-Health-Traits.pdf) and two linear type traits—Rear Teat Placement Side View and Rear Teat Placement Rear View (https://www.usjersey.com/Portals/0/AJCA/2_Docs/Appraisal/19-Appraisal-Standards.pdf).

As with JPI_{2017}, JPI_{2020} applies the key principles of Jersey sustainability identified by researchers Jude Capper and Roger Cady (J. L. Capper & R. M. Cady (2012). J. Dairy Sci. 95: 165-176).

The three primary drivers of U.S. dairy cow sustainability are production, milk nutrient density, and body size. Specifically, Jerseys need to increase milk yield, maintain—or better improve—component levels, and maintain an optimum body size. The focus on Jersey sustainability was retained for JPI_{2020}.

Traits and their percentage of JPI_{2020} are 27% PTA protein; 19% PTA fat; 3% Milk Density; 19.4% Functional Trait Index (subsets are Jersey Udder Index™, Feet and Legs and Body); 14.5% Fertility (includes 9% Daughter Pregnancy Rate, 3.5% Cow Conception Rate and 2% Heifer Conception Rate); 8% Survival (includes 5% Productive Life and 3% Livability); 4.5% Somatic Cell Score; and six new Jersey Health Traits at 4.6% (Milk Fever 1.0%; Displaced Abomasum 1.0%; Ketosis 0.4%; Mastitis 1.9%; Metritis 0.2% and Retained Placenta 0.1.%). (Fig. 1)

Milk Density is calculated by subtracting the sum of PTA Protein and PTA Fat divided by .09 from PTA Milk.

Calculation of the Jersey Performance Index™

Beginning with April 2020 genetic evaluations, JPI™ is calculated as follows:

JPI_{2020} = (27 x PTA protein / SD) + (19 x PTA fat / SD) + (-3 x Milk Density / SD PTA milk)
+ (5 x PTA Productive Life / SD) + (3 x PTA Livability / SD)
+ [-4.5 x (PTA Somatic Cell Score -3.0) / SD)]
+ (9 x PTA Daughter Pregnancy Rate / SD) + (3.5 x PTA Cow Conception Rate / SD)
+ (2 x PTA Heifer Conception Rate / SD) + Functional Trait $Index_{2020}$ + Health Trait $Index_{2020}$

where Milk Density = PTA Milk - ((PTA Fat + PTA Protein) / .09), Functional Trait Index equals the PTAs of linear type traits weighted by their relative economic contribution to JPI_{2020} and Health Trait Index (see Table 2).

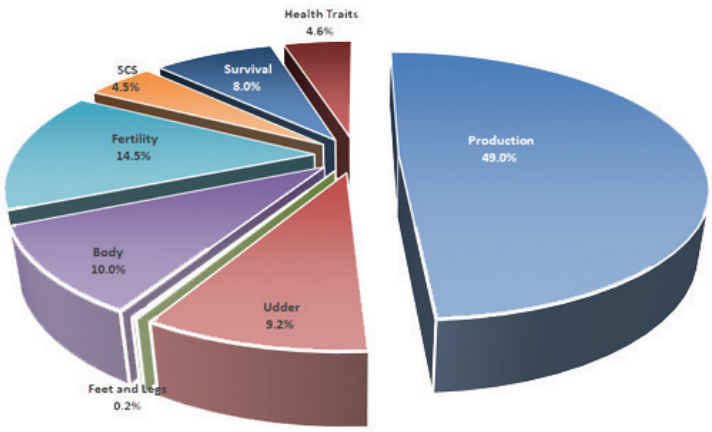
Overall, 49% of the emphasis in JPI_{2020} is on production, 27% on fitness, 19.4% on functional type and 4.6% on disease resistance.

The goal behind the update to JPI formula was logical. It allows Jersey breed progress to continue, while ensuring tomorrow's Jersey cattle are genetically predisposed to remain healthy, fertile and function while producing high levels of milk solids.

Dr. Kent Weigel, University of Wisconsin-Madison, led the research and development of JPI_{2020}. The updated formula is derived from a prediction of efficiency for more than 300,000 Jersey females born since 2010 who have lactation and type information.

Lifetime production was tallied for each female. Individual type traits were used to predict body weight, which was then used to determine their lifetime feed intake. The ratio of lifetime production to lifetime feed intake was predicted using a model that included individual genetic evaluations for production traits, linear type traits, somatic cell score, productive life, livability and fertility measures. Contribution of the six health traits was determined by the amount of variation they explained in productive life and livability.

JPI is **based on the ratio of lifetime combined fat and protein to lifetime dry matter intake**, relative to other cows in the same herd born in the same year. Feed during the rearing period is considered, as are differences in maintenance intake for cows of different predicted body size. For cows that are still alive, we take how much they have produced and eaten to date.



Milk Density

Milk Density (3% of the index), formerly named CFP Milk, is a breed-specific adjustment to PTA Milk based on the target that every pound of PTA milk must include 0.09 pounds of combined fat

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Table 1. History of Traits and Weights (%) Used to Calculate Production Type Index (1998) and Jersey Performance Index™.

Year	Protein	Fat	CFP Milk/ Milk Density	FTI	PL	LIV	SCS	FUI	DPR	CCR	HCR	HTI
1998	55.5	22.2		16.7			5.6					
2002	50.0	20.0		15.0	5.0		5.0	5.0				
2005	50.0	20.0		15.0	3.75		3.75	3.75	3.75			
2006	40.0	20.0		15.0	12.0		3.0	3.0	7.0			
2010	42.0	15.0		15.0	12.0		6.0		10.0			
2015	43.0	15.0		15.0	10.0		6.0		7.0	2.0	2.0	
2017	30.0	15.0	8.0	20.0	6.0	4.0	6.0		7.0	2.0	2.0	
2020	27.0	19.0	3.0	19.4	5.0	3.0	4.5		9.0	3.5	2.0	4.6

and protein. Milk Density is based on the idea it is preferable to have total yield of pounds fat and pounds protein come from more concentrated milk instead of a greater volume of watery milk.

For example, two bulls each have 75 pounds of combined fat and protein, but a large difference in their PTA Milk of 250 compared to 1,250 pounds. Relative to the target of 0.09 pounds of combined fat and protein in one-pound PTA milk, the bull with a PTA Milk of 250 exceeds that concentration and will gain approximately three JPI™ points. The other bull, at PTA Milk of 1,250 pounds, transmits more water relative to components. Therefore, he will lose approximately two JPI™ points.

The Milk Density attribution will result in a difference of five JPI™ points between the two example bulls.

Type Within Production

Of the components of JPI™, only one—the AJCA Functional Trait Index (FTI)—captures the effects of type traits within production on lifetime efficiency. It assesses how functional type traits are important to the Jersey cow's economic survival. As such, it pinpoints where improvement is needed and needed most, and where opportunities for further gains are possible.

Table 2 shows going forward, what will make the most difference in improving Jersey profitability is increasing selection pressure on udder and body traits. Some traits are more important than others. Among traits in the Jersey Udder Index™ (JUI), which is derived from FTI, Udder Depth is the most important, followed by Fore Udder Attachment and Rear Udder Height. JUI is reported as JPI™ points; in other words, how many points udder traits add (or subtract) from Jersey Performance Index™.

Table 2. Relative weights for specific traits and trait groups in Jersey Performance Index$_{2020}$.

Trait Group	Relative Weight (%)	Specific Trait (Direction)	Overall Weight (%)
Production	**49.0**	Protein (+)	27.0
		Fat (+)	19.0
		Milk Density (-)	3.0
Fertility	**14.5**		
		Daughter Pregnancy Rate (+)	9.0
		Cow Conception Rate (+)	3.5
		Heifer Conception Rate (+)	2.0
Survival	**8.0**	Productive Life (+)	5.0
		Livability (+)	3.0
Somatic Cell Score	**4.5**		
Jersey Health Traits	**4.6**	Milk Fever (+)	1.0
		Displaced Abomasum	1.0
		Ketosis	0.4
		Mastitis	1.9
		Metritis	0.2
		Retained Placenta	0.1
Functional Trait Index	**19.4**		
Jersey Udder Index	*9.2*	*Body*	*10.0*
Udder Depth (+)	2.5	Strength (-)	3.0
Fore Udder Attachment (+)	1.7	Dairy Form (+)	1.5
Udder Cleft (+)	0.2	Stature (-)	3.0
Rear Udder Height (+)	2.5	Rump Width (-)	2.5
F. Teat Placement (+)	0.2		
Teat Length (-)	0.6	*Feet and Legs*	*0.2*
Rear Udder Width (+)	0.1	Foot Angle (+)	0.1
R. Teat Position Side View (+)	0.8	Rear Legs (-)	0.1
R. Teat Position Rear View (+)	0.6		

Health Traits

The April 2020 genetic evaluations mark the release of six health traits that will help alleviate costly health conditions impacting Jerseys. These traits will help build resistance against displaced abomasum, milk fever, ketosis, mastitis, metritis and retained placenta.

PTAs for each of the health traits will be the predicted daughter difference for resistance above or below the Jersey breed average. The larger the positive values, the more favorable the genetic resistance to the disorder. These genetic evaluations can help identify individuals that transmit costly difference and help manage their use in breeding programs.

The traits and their weights in JPI$_{2020}$ are:

• Milk Fever or Hypocalcemia: (1.0%) Typically results after calving due to low total blood calcium levels.

• Displaced abomasum: (1.0%) Enlargement of the abomasum with fluid and/or gas that caused its movement to the left or right of the abdominal cavity; the twisting blocks the digestive process and usually requires veterinary intervention.

• Ketosis: (0.4%) Build-up of ketone bodies that typically occurs due to negative energy balance in early lactation.

• Mastitis: (1.9%) Infectious disease that causes inflammation of the mammary gland; one of the most common and costly diseases of dairy cattle.

• Metritis: (0.2%) Infection of the endometrium (lining of the uterus) after calving.

• Retained placenta: (0.1%) Retention of fetal membranes more than 24 hours after calving.

Combined as the Health Trait Index (HTI), it is reported as JPI™ points like JUI™ and represents 4.6% of JPI$_{2020}$.

Major Categories

The objective of Jersey Performance Index™ is to increase lifetime efficiency. Regrouping traits by functional categories reveals a set of six factors that determine whether cows put money into your pocket, and how much. **Production** receives 49% of the emphasis in the new formula. There is 13.7 % on **udder health** by combining direct selection for lower Somatic Cell Score (especially important to capture quality premiums) and JUI™. **Fertility** at 14.5% includes Daughter Pregnancy Rate, Cow Conception Rate and Heifer Conception Rate. **Survival** is weighted at 8.2% through PTAs for Productive Life and Livability plus the mobility traits (foot angle, rear legs) in FTI. Lastly, the Jersey-specific Body Weight Composite, at 10%, selects for **optimum body size**, which is directly related to feed intake directed to body maintenance versus production. Lastly, the Health Trait Index at 4.6% selects for **disease resistance**.

Summary

Jersey Performance Index™ (JPI™) is a breed-specific selection tool that has been continually reviewed and updated based on sound science and relative to current economic conditions. "Jersey Performance Index$_{2020}$ focuses on the Lifetime Efficiency of the Jersey cow in a way no prior versions have done," said Neal Smith, Executive Secretary and CEO of the American Jersey Cattle Association.

"The updated formula combines leading-edge methods which result in a healthier cow who can produce higher concentrations of components in her milk. While accomplishing all this, JPI$_{2020}$ helps achieve optimum body size for greater feed and overall efficiency and sustainability, while improving on the Jersey cow's long appreciated fertility."

Calculation of the Jersey Udder Index™

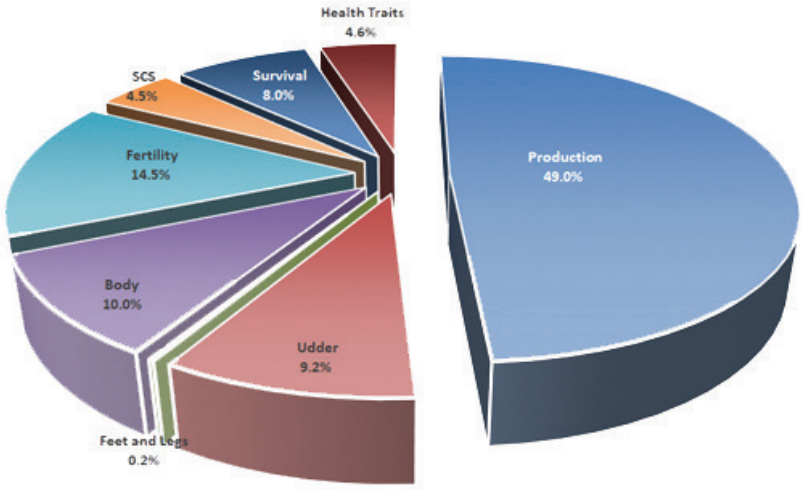
This index is the sum of PTAs for udder traits multiplied by their percentage contribution to the animal's Jersey Performance Index$_{2020}$:

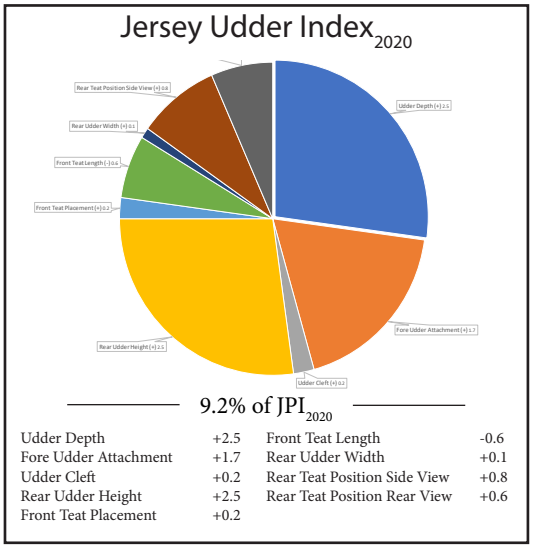
JUI_{20} = [[(1.7 x FU / SD) + (2.5 x RH / SD) + (0.1 x RUW / SD)
+ (2.5 x UD / SD) + (0.2 x UC / SD) + (0.2 x TP/SD)
+ (0.8 x RTPS/SD) + (0.6 x RTPR/SD) + (-0.6 x TL/SD)]

Jersey Performance Index

2020 vs 2017

Jersey Perfomance Index$_{2020}$





9.2% of JPI$_{2020}$

Udder Depth	+2.5	Front Teat Length	-0.6
Fore Udder Attachment	+1.7	Rear Udder Width	+0.1
Udder Cleft	+0.2	Rear Teat Position Side View	+0.8
Rear Udder Height	+2.5	Rear Teat Position Rear View	+0.6
Front Teat Placement	+0.2		

49 % Production
- 27 - PTA Protein
- 19 - PTA Fat
- -3 - Milk Density

19.4 % Functional Trait Index
- 9.2 - Udder
- 10 - Body
- 0.2 - Feet and Legs

14.5 % Fertility
- 9 - Daughter Pregnancy Rate
- 3.5 - Cow Conception Rate
- 2.0 - Heifer Conception Rate

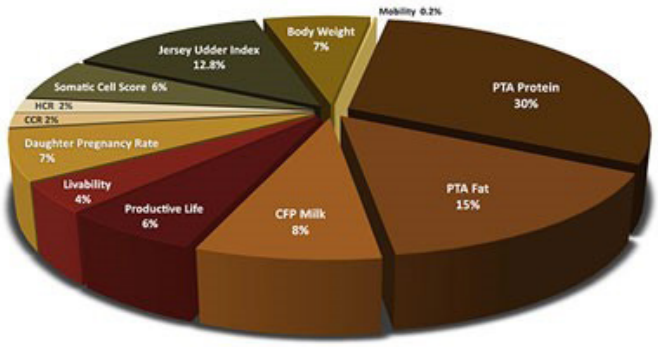
8 % Survival
- 5 - Productive Life
- 3 - Livability

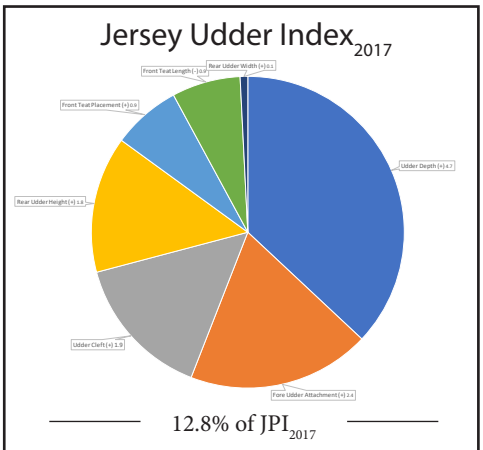
4.5 % Somatic Cell Score

4.6 % Jersey Health Traits
- 1.0 - Milk Fever
- 1.0 - Displaced Abomasum
- 0.4 - Ketosis
- 1.9 - Mastitis
- 0.2 - Metritis
- 0.1 - Retained Placenta

**Milk Density is calculated by subtracting the sum of PTA Protein and PTA Fat divided by .09 from PTA Milk.*

Jersey Perfomance Index$_{2017}$





12.8% of JPI$_{2017}$

Udder Depth	+4.7	Front Teat Placement	+0.9
Fore Udder Attachment	+2.4	Front Teat Length	-0.9
Udder Cleft	+1.9	Rear Udder Width	+0.1
Rear Udder Height	+1.8		

53 % Production
- 30 - PTA Protein
- 15 - PTA Fat
- 8 - CFP Milk

20 % Functional Trait Index
- 12.8 - Jersey Udder Index
- 7 - Body Weight
- 0.2 - Mobility

27 % Fitness
- 6 - Productive Life
- 4 - Livability
- 6 - Somatic Cell Score
- 7 - Daughter Pregnancy Rate
- 2 - Cow Conception Rate
- 2 - Heifer Conception Rate