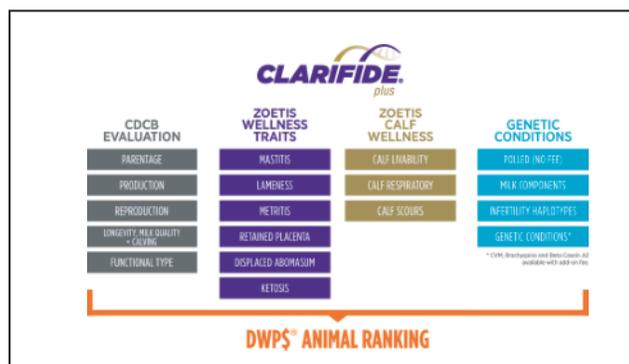


UNDERSTANDING VARIOUS TRAITS

With genomic mapping, more information is available when making genetic selections. This information helps explain some of the traits included in this catalog.

Wellness Traits & DWP\$



The **Dairy Wellness Profit Index™ (DWP\$)** is a multi-trait index that includes production, fertility, type, longevity, calving ability, milk quality, the dairy wellness traits, including Polled test results. By combining the Wellness Traits with traits used to calculate Net Merit (NM\$), DWP\$ estimates the potential profit contribution an individual animal will pass along to the next generation.

The **Wellness Trait Index™ (WT\$)** focuses on the six wellness traits of mastitis, lameness, metritis, retained placenta, ketosis and displaced abomasum, in addition to polled test results. It estimates the difference in expected lifetime profit associated with the risk of these diseases.

CLARIFIDE® provides reliable assessments of genetic risk factors for economically relevant diseases in Holstein cattle for six wellness traits.

The six wellness traits are:

Dairy Wellness Traits	Label	Ave. Score*	Min.*	Max.*
Mastitis	MAST	100	76	115
Lameness	LAME	100	73	115
Metritis	MET	100	75	115
Retained Placenta	RP	100	71	116
Ketosis	KET	100	72	113
Displaced Abomasum	DA	100	69	111

* Information provided by CLARIFIDE® Plus

The **Calf Wellness Index™ (CW\$™)**, also a multi-trait selection index, exclusively focuses on calf wellness traits of calf livability, calf respiratory disease and calf scours. It estimates the potential profit contribution of the calf wellness traits for an individual animal, to help improve heifer survival and lower net herd replacement cost.

Calf Wellness Traits	Label	Ave. Score*	Min.*	Max.*
Calf Livability	LIV	100	66	116
Calf Scours	SCOURS	100	85	117
Calf Respiratory Disease	RES	100	83	116

* Information provided by CLARIFIDE® Plus

Net Merit \$ vs Cheese Merit \$ vs Grazing Merit \$

Genetic indexes help dairy producers focus on a total approach to genetic improvement, rather than limiting progress by single trait selection. Every dairy operation is unique with different management environments, situations and goals. Knowing what traits are included and the weight of each trait in an index helps producers evaluate if an index matches your operation's goals.

In our information, we include four indexes:

- Total Performance Index (TPI or GTPI)
- Net Merit \$(NM\$)
- Cheese Merit \$(CM\$)
- Grazing Merit \$(GM\$)

The graph indicates the traits and weighting of those traits for NM\$, CM\$ and GM\$. HTH\$ is a Health-Trait Sub-Index that incorporates mastitis, metritis, displaced abomasum, retained placenta, ketosis and milk fever.

Trait	NM\$	CM\$	GM\$
Production	45%	50%	38%
Protein	16.9%	22.8%	14.4%
Fat	26.8%	20.9%	22.9%
Milk	-0.7%	-7.9%	-0.7%
Health Traits	40.0%	37%	48%
Productive Life (PL)	12.1%	10.3%	6.6%
Livability (LIV)	7.3%	6.2%	4.9%
Daughter Pregnancy Rate (DPR)	6.7%	5.7%	17.8%
Somatic Cell Score (SCS)	-4.0%	-4.4%	-3.5%
Calving Ability	4.8%	4.1%	4.5%
Cow Conception Rate	1.6%	1.4%	4.3%
Heifer Conception Rate	1.4%	1.2%	2.4%
HTH\$	2.3%	1.9%	2.1%
Type Traits	15%	13%	14%
Udder Composite (UDC)	7.4%	6.3%	7.4%
Body Weight Composite	-5.3%	-4.5%	-5.8%
Foot & Leg Composite (FLC)	2.7%	2.3%	2.8%

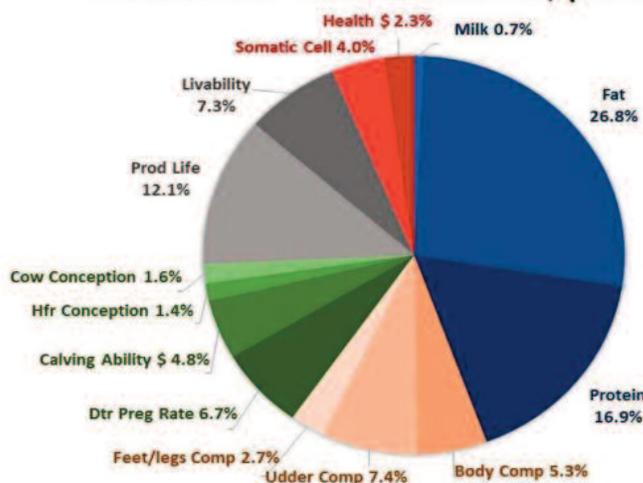
UNDERSTANDING VARIOUS TRAITS

Net Merit \$ & TPI Formulas

Net Merit \$

The Net Merit \$ (NM\$) index was last revised with the August 2018 genetic evaluations. It incorporates the CDCB disease resistance traits of mastitis, ketosis, retained placenta, metritis, displaced abomasum and milk fever. The revised formula also updates the economic values in calculations. Fourteen traits are used in calculating NM\$.

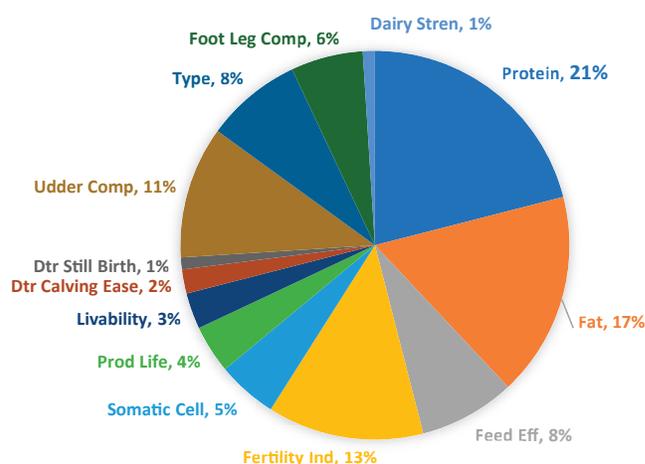
WEIGHTING OF TRAITS IN 2018 NM\$ (HOLSTEINS)



TPI/GTPI®

The primary selection index recommended by Holstein USA is the Total Performance Index (TPI or GTPI.) TPI/GTPI is not aimed at breeding individual cows but as a tool to advance the entire genetic pool. Thirteen traits are weighted in the TPI formula.

WEIGHTINGS OF TRAITS IN GTPI



Sire Summary Terminology

GENERAL TERMS:

PTA: Predicted Transmitting Ability

- M: Milk production in pounds
- F: Fat production in pounds
- F%: Genetic variance for transmitting fat
- P: Protein production in pounds
- P%: Genetic variance for transmitting protein
- Rel: Percent reliability of a sire's proof
- T: Type
- UDC: Udder composite Index
- FLC: Foot and leg Composite Index

EFI: Effective Future Inbreeding

An estimate based on pedigree of the level of inbreeding that the progeny of a given animal will contribute in the population if mated at random.

Beta-Casein: A1A1, A1A2 or A2A2

A major casein protein that makes up 30% of total milk protein. Studies have shown health benefits for A2.

HEALTH & FERTILITY TRAIT TERMS:

PL: Productive Life

Time a cow stays in herd as a "productive" animal. Number represents how many months (additional or fewer, if negative) of lifetime expected.

LIV: Cow Livability

A cow's ability to remain alive while in the milking herd.

DPR: Daughter Pregnancy Rate

A percentage of non-pregnant cows that become pregnant during each 21-day period. DPR considers how quickly cows come back into heat after calving and conception rate when bred. A DPR of +1.0 implies daughters of this bull are 1% more likely to become pregnant during that estrus cycle than a bull with +0.0. DPR ranges from +3.0 to -3.0.

LIV: Cow Livability

A cow's ability to remain alive while in the milking herd.

Milking Speed

Evaluated in terms of the percentage of first lactation daughters as average or fast. A value of 100 indicates average.

Milking Temperament

The expected percentage of future daughters that will be average, calm or very calm during their first lactation. A value of 100 indicates average.

Feed Efficiency

The net profit a dairy producer receives from an increase in production. Calculation: Feed Efficiency = (Dollar Value of milk produced) – (Feed costs of extra milk) – (Extra maintenance costs)

Common Haplotypes & Calving Ease

DEFINITIONS:

What is a haplotype?

A haplotype is a stretch of chromosome or DNA that is transmitted as a unit from one generation to the next. In our context, we are referring to a set of single-nucleotide polymorphisms (SNPs) on a single chromosome that is inherited together as a unit.

Homozygous vs. heterozygous

Cattle have two versions of each chromosome. One chromosome was inherited from the sire and one was inherited from the dam. Homozygous and heterozygous are used to describe DNA at specific points along the chromosome. Homozygous means the DNA on each chromosome is the same. Heterozygous indicates the DNA on each chromosome is different at a specific site.

CALVING TRAIT TERMS:

SCE: Sire Calving Ease

Percentage of a bull's calves considered difficult when born to a first lactation animal. Bulls with an SCE of 8% or less are considered "calving ease" bulls.

DCE: Daughter Calving Ease

Measurement of the ability of a cow from a particular sire to calve easily. DCE is evaluated on the same scale as SCE.

WHEN POLLED IS DOMINANT

Polled trait or naturally hornless is a dominant trait. The Holstein Association USA identifies Polled animals one of three ways:

- PO: Observed Polled (Homozygous Carrier)
- PC: Tested Heterozygous Polled
- PP: Tested Homozygous Polled

When a heterozygous polled bull (PC) is bred to a horned female, 50% of the offspring are Polled. When a homozygous Polled bull (PP) is bred to a horned female, 100% of the offspring are Polled. Only one parent must have the Polled gene for offspring to be Polled.

RECESSIVE HAPLOTYPES

The following codes show on a sire summary evaluation if an animal is a carrier or tested positive for a specific Haplotype. If the animal tested free, the codes will be indicated on the animal's pedigree.

- CD: Cholesterol Deficiency
- TC: Tested free of Cholesterol Deficiency
- BY: Brachyspina
- TY: Tested free of Brachyspina
- BL: BLADS or Bovine Leukocyte Adhesion Deficiency
- TL: Tested free of BLADS
- CV: CVM or Complex Vertebral Malformation
- TV: Tested free of CVM
- DP: DUMPS or Deficiency of the Uridine Monophosphate Synthase
- TD: Tested free of DUMPS
- MF: Mulefoot
- TM: Tested free of Mulefoot

HHH & RECESSIVES

USDA researchers and international collaborators identified nine haplotypes that cause embryo loss or stillbirths when homozygous. The exact genetic or biological cause of why the embryos or fetuses are not viable is unknown. These are five common Haplotypes, their frequency and source sires of the Haplotype:

- Holstein Haplotype 1 (HH1) - 4.5% freq., Pawnee Farm Arlinda Chief
- Holstein Haplotype 2 (HH2) - 4.5% freq., Willowholme Mark Anthony
- Holstein Haplotype 3 (HH3) - 4.7% freq., Gray View Skyliner & Glendell Arlinda Chief
- Holstein Haplotype 4 (HH4) - 0.7% freq., Besne Buck
- Holstein Haplotype 5 (HH5) - 4.8% freq., Thronlea Texal Supreme

Recessive haplotypes appear to be normal. Those with two haplotype copies are lost as embryos or are stillborn. Their negative impact is accounted for in sire conception rate (SCR) and daughter pregnancy rate (DPR). Only when both parents are heterozygous Haplotype carriers may offspring be affected.

HCD RECESSIVES

Haplotype for Cholesterol Deficiency (HCD), causes young calves to die if HCD homozygous. It traces back to the Canadian-bred bull Maughlin Storm. Animals that have been determined to have the haplotype and are from Storm bloodlines are labeled as carriers.