

UNDERSTANDING VARIOUS TERMINOLOGY

Early Onset Muscle Weakness Syndrome (MW) & aAa

EARLY ONSET MUSCLE WEAKNESS SYNDROME

A new genetic condition was recently identified within the Holstein breed. Early on, referred to as Calf Recumbency, the Holstein Association USA now describes this condition as Early Onset Muscle Weakness Syndrome (MW). Some calves are unable to stand at birth or lose the ability to stand shortly after birth. No known treatments are available.

This condition is more complex than other known genetic conditions. It occurs within a haplotype that is common among a large portion of the Holstein breed. It is difficult to differentiate between a mutated haplotype from the normal haplotype. A gene test can identify carrier animals but an accurate haplotype test is not yet available. At the time of this catalog's printing, Holstein Association USA is referring to this condition as a "Genetic Condition Under Investigation."

The earliest known carrier was Southwind Bell of Bar-Lee. Through Southwind's most prominent descendants, Roylane Socra Robust and Seagull-Bay Supersire, the gene has spread throughout the breed.

Artificial insemination organizations are testing their sires. The dairy industry is working on a defined system to get test results from laboratories to the Council on Dairy Cattle Breeding (CDCB) and Holstein Association USA, so they can be made public.

Haplotype Positive Tested sires in the IPS line-up are:

566HO1246 CAN DO
566HO1286 RIVER
566HO1313 COMIC
566HO1326 MILKNMORE
566HO1333 LIVE NOW *pp
566HO1366 DEAL MAKER
566HO1367 RAMON

Please go to www.ipsires.com for updated information as it becomes available.

Outstanding Questions about Early Onset Muscle Weakness Syndrome

Holstein Association USA has identified several questions that need to be answered to gain a better understanding of this condition.

- A clear phenotypic description of the genetic condition under investigation needs to be outlined to avoid misclassifying animals who are affected and who are actually not.
- We would like to determine if there is an effect on early embryonic death.
- We still do not have a true picture of percent penetrance from a controlled research setting of carrier Sire x carrier Maternal Grand Sire matings.
- We still do not have an explanation of why some affected Homozygous animals are able to survive. There is a theory that different herd management can have an impact on its penetrance. Yet we do not have any advice on what management practices impact whether or not calves are affected.

aAa® DAIRY CATTLE BREEDING

One way to mate dairy cattle is by using the aAa® dairy cattle breeding guide. Each of the six aAa® numbers describes desirable qualities of form and function. The six aAa® numbers are:

1 - Dairy 2 - Tall 3 - Open 4 - Strong 5 - Smooth 6 - Style

For sires, aAa® numbers are listed in the order the bull possesses them, starting with the quality he possesses the most. Below is an aAa® reference guide for sires in the IPS catalog. Contact your IPS representative for a complete list of aAa codes for all bulls available at IPS.

STUD CODE	BULL NAME	aAa	STUD CODE	BULL NAME	aAa
566HO1313	COMIC	213465	566HO1322	GO TO GUY	324156
566HO1289	PRIMERIB PP *RC	213465	566HO1344	SHEPERD	324156
566HO1319	REAL MACOY	213465	566HO1305	THUMBS UP	324156
566HO1304	LAKE RED	213645	566HO1353	JUDO	342516
566HO1296	LOYAL P-RED	213645	566HO1349	SPOT ON *PP	342516
566HO1283	ON POINT	213645	566HO1262	DIVERSE	345
566HO1312	REDLIGHT-RED	213645	566HO1261	JODANDY	345126
566HO1362	OUTFIT	216345	566HO1281	DARK HORSE	345216
566HO1205	CLOUD NINE *PC *RC	216345	566HO1297	WINCHEL	345216
566HO1329	LIMITLESS	231465	566HO1288	LIVE ONE	351462
566HO1367	RAMON	231645	566HO1343	NOTMUCH	423156
566HO1302	RAHM	234	566HO1293	SEASAW	423156
566HO1360	DEDICATED	234165	566HO1359	TELEMARK PP *RC	423156
566HO1350	AINSLIE	234165	566HO1326	MILKNMORE	423615
566HO1337	BY THE WAY-RED *PP	234165	566HO1332	WHY NOT	423615
566HO1314	DRAGO	234165	566HO1361	CARSON *RC *PP	423651
566HO1347	HOUSE	234165	566HO1269	BOOST	423651
566HO1320	JUST IN TIME *PP *RC	234165	566HO1356	YES SIR	423651
566HO1335	LAYNE-RED	234165	566HO1363	DIAL IN	426315
566HO1327	REVELATION	234165	566HO1323	RUVEDA	426351
566HO1357	ELLSWORTH	234561	566HO1223	ALL GONE *RC	432156
566HO1301	KINGSTON	243156	566HO1330	ALWAYS RIGHT	432561
566HO1341	BIG ORBIT	243165	566HO1286	RIVER	432561
566HO1358	RIGHT ON-RED	243165	566HO1342	COULD BE	432651
566HO1336	RINGLEADER-RED	243165	566HO1348	COLLINS	435261
566HO1346	LEAN	243516	566HO1325	MYLAR	453612
566HO1295	FAME	243615	566HO1345	EVER-RED	456321
566HO1290	TON OF FUN	243615	566HO1366	DEAL MAKER	462351
566HO1279	DETAIL	246315	566HO1352	SHOWBIZ	462513
566HO1306	CAUGHT MY EYE	312546	566HO1284	ANIMAL	465123
566HO1303	PORSCHKE	315246	566HO1351	EASY OFF *RC *PP	516342
566HO1291	REASONS	315426	566HO1334	SPEAK UP	516342

UNDERSTANDING VARIOUS TRAITS

With Genomic mapping, more information is available to make genetic selections. This information explains traits in this catalog.

Net Merit \$ & TPI Formulas

Net Merit \$

The Net Merit \$ (NM\$) index was revised with the August 2021 genetic evaluation. NM\$ now has over 40 traits. The updated NM\$ formula includes three new traits: feed saved (FSAV), heifer livability (HLIV), and early first calving (EFC).

FSAV includes the economic value of cow body weight composite (BWC) with actual feed intake data. Residual feed intake (RFI) measures the difference between actual and expected feed intake. Feed Saved (FS) combines RFI and feed intake required for maintenance.

The new formula also reflects changes in emphasis given to traits. More emphasis is on longer Productive Life and smaller Body Weight Composite.

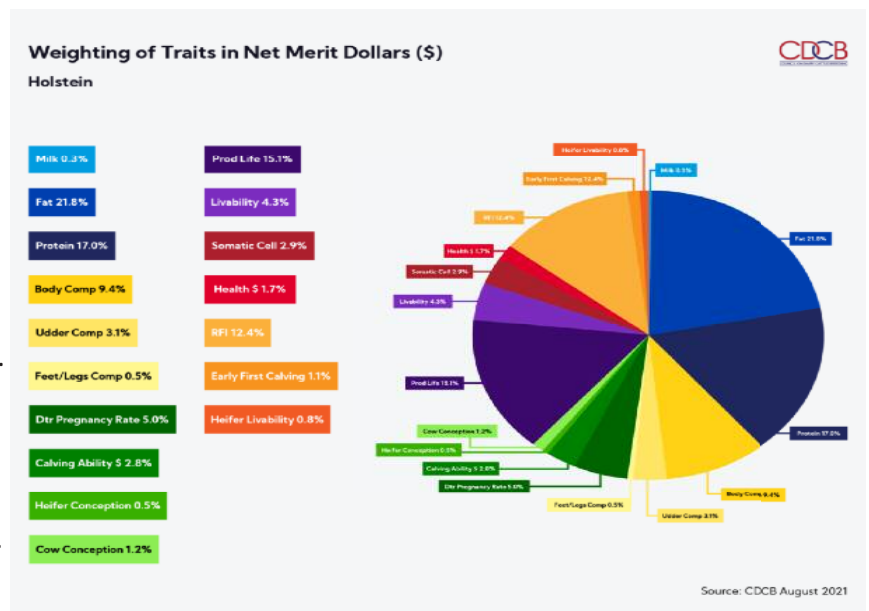
TPI/GTPI®

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. The graph below shows the current formula used to calculate TPI/GTPI, updated April 2021.

April 2021

TPI®

$$\left[\frac{19}{17}(PTAP) + \frac{19}{22}(PTAF) + \frac{8}{52}(FE) + \frac{8}{0.8}(PTAT) + \frac{11}{0.8}(UDC) + \frac{6}{0.8}(FLC) + \frac{5}{1.6}(PL) + \frac{2}{2.0}(HT) + \frac{3}{1.4}(LIV) - \frac{4}{0.13}(SCS) + \frac{13}{1.3}(FI) - \frac{0.5}{0.5}(DCE) - \frac{1.5}{0.8}(DSB) \right] 3.8 + 2363$$



Weighting of Major Categories in TPI/GTPI Formula:

Production 46% (Fat, Protein, BWC and FE)
 Health & Fertility 28% (SCS, PL, HT, LIV, FI, DCE and DSB)
 Conformation 26% (PTAT, UDC and FLC)

Traits included in the TPI/GTPI Formula:

PTAP = PTA Protein
 PTAF = PTA Fat
 FE\$ = Feed Efficiency \$
 PTAT = PTA Type
 UDC = Udder Composite
 FLC = Feet & Legs Composite
 PL = PTA Productive Life
 HT = Health Trait Index
 LIV = PTA Cow Livability
 SCS = PTA Somatic Cell Score
 FI = Fertility Index
 DCE = PTA Daughter Calving Ease
 DSB = PTA Daughter Stillbirth

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:

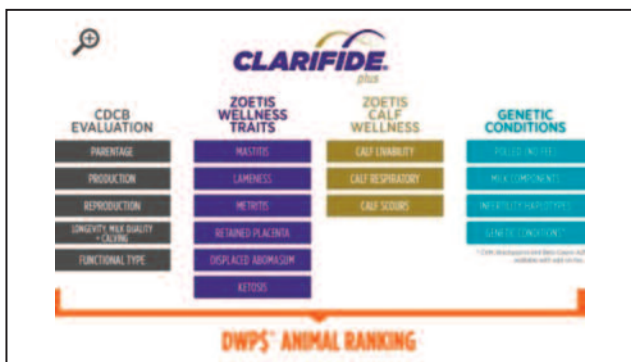
- Total Performance Index (TPI or GTPI)
- Net Merit \$ (NM\$)
- Cheese Merit \$ (CM\$)
- Grazing Merit \$ (GM\$)

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

Trait	NM\$	CM\$	GM\$
Milk	0.3%	-2.2%	0.3%
Fat	28.6%	27.2%	27.6%
Protein	19.6%	20.9%	18.9%
Productive Life (PL)	15.9%	15.1%	6.9%
Somatic Cell Score (SCS)	-2.8%	-3.5%	-2.8%
Body Weight Composite	-9.4%	-8.9%	-10.9%
Udder Composite (UDC)	3.4%	3.2%	3.8%
Foot & Leg Composite (FLC)	0.4%	0.4%	0.4%
Daughter Pregnancy Rate (DPR)	4.1%	3.9%	11.7%
Calving Ability \$ (CA\$)	2.9%	2.7%	2.6%
Heifer Conception Rate (HCR)	0.4%	0.4%	0.7%
Cow Conception Rate (CCR)	1.0%	0.9%	2.8%
Livability (LIV)	4.4%	4.2%	3.3%
Health Trait Subindex (HTH\$)	1.2%	1.2%	1.4%
Residual Feed Intake (RFI)	-3.8%	-3.6%	-4.2%
Early First Calving (EFC)	1.2%	1.1%	0.9%
Heifer Livability (HLIV)	0.5%	0.5%	0.4%

UNDERSTANDING VARIOUS TRAITS

Wellness Traits & DWPS



The **Dairy Wellness Profit Index™ (DWPS®)** is a comprehensive multi-trait selection index that estimates the potential lifetime profit of an individual animal. The index includes production, reproduction, functional type, longevity, calving ability, milk quality, cow wellness, new calf wellness traits and the economic value of Polled test results.

The **Wellness Trait Index™ (WT\$®)** focuses exclusively on the wellness traits of mastitis, lameness, metritis, retained placenta, ketosis and displaced abomasum. It estimates expected differences in lifetime profitability related to them.

CLARIFIDE® provides reliable assessments of genetic risk factors for economically relevant diseases in Holstein cattle. We share information on six wellness traits in our individual sire information. The six wellness traits are:

Dairy Wellness Traits	Label	Ave. Score*	Min.*	Max.*
Mastitis	MAST	100	71	114
Lameness	LAME	100	77	112
Metritis	MET	100	78	115
Retained Placenta	RP	100	72	112
Ketosis	KET	100	70	113
Displaced Abomasum	DA	100	62	109

* provided by CLARIFIDE® Plus

The **Calf Wellness Index™ (CW\$™)** focuses on calf wellness traits including calf livability, calf respiratory disease and calf scours. It estimates the potential profit contribution of the calf wellness traits for an individual animal.

Calf Wellness Traits	Label	Ave. Score*	Min.*	Max.*
Calf Livability	LIV	100	70	113
Calf Scours	SCOURS	100	79	116
Calf Respiratory Disease	RES	100	77	114

* provided by CLARIFIDE® Plus

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 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.

Kappa-Casein: BB, AB, AA, AE, BE, EE

Research shows a strong association between Kappa-Casein and milk that clots quickly, which yields higher and firmer cheese. BB is the most desirable, then AB and AA is less desirable. Milk with an E allele does not clot to make cheese.

HEALTH & FERTILITY TRAIT TERMS:

FE: 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)

FSAV: Feed Saved

Expected pounds of feed saved per lactation based on body weight composite (BWC) and residual feed intake (RFI) evaluations. Larger, positive numbers are favorable.

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.

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.

HLIV: Heifer Livability

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

SCS: Somatic Cell Count

A main indicator of milk quality. A lower number indicates better animal health.

MS: Milking Speed

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

MT: 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.

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.

DCE: Daughter Calving Ease

Measurement of the ability of a cow from a particular sire to calve easily.

As calving traits have been successfully improved, the August 2020 Holstein Calving Ease PTAs were adjusted. They average 2.2% for SCE and 2.7% for DCE. Most Holstein bulls will range from 1% to 4% SCE.

WHEN POLLED IS DOMINANT

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

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.

SCURS

Scurs are undeveloped horns that are usually blunt and rounded at the end and short in diameter. They are attached only to the skin and can be seen as early as 60 days after birth. Scurs are not an error in transmitting the horned characteristic and should be ignored.

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.

TC: Tested free of Cholesterol Deficiency

HCD: Cholesterol Deficiency

TY: Tested free of Brachyspina

BY: Brachyspina

TV: Tested free of CVM

CV: CVM or Complex Vertebral Malformation

TL: Tested free of BLADS

BL: BLADS or Bovine Leukocyte Adhesion Deficiency

TD: Tested free of DUMPS

DP: DUMPS or Deficiency of the Uridine Monophosphate Synthase

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 six 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

Holstein Haplotype 6 (HH6) - 0.5% freq., Cal-Clark Board Chairman

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.

VARIANT RED

566HO1345 EVER-RED is a Variant Red sire and labeled as DR1. Anytime a Variant Red sire is bred to a Black, Red Carrier or Red animal, there is a 50% chance for a Red calf and 50% for a Black calf. When a Red animal is the result of using a Variant Red sire, the Red gene is transmitted to the second generation differently than with traditional Red hair color. When a true Red sire is used on a Variant Red daughter, there is a 50% chance of offspring being Red and 50% offspring will be Black.