



Interpreting Holstein Association USA's Individual Genomic Prediction Report

When you genomic test an animal through Holstein Association USA, you will receive a report with a variety of traits and their genomic PTA values, as well as the animal's original parent average PTAs. The genomic PTAs will appear on the animal's pedigree and other performance products following the next national genetic evaluation run (which takes place in April, August and December).

You will receive genomic PTAs and STAs for the following traits:

- **Selection Indexes:** Genomic Total Performance Index® (GTPI) values may only be calculated officially by Holstein Association. Net Merit (NM\$) is calculated by USDA/CDCB. These indexes combine several economically important traits into a single value, helping dairy producers breed more profitable cattle.
- **Yield Traits:** Milk, Fat (lbs), Fat %, Protein (lbs), Protein %, Feed Efficiency Index (FE)
- **Health Traits:** Daughter Pregnancy Rate (DPR), Productive Life (PL), Somatic Cell Score (SCS), Heifer Conception Rate (HCR), Cow Conception Rate (CCR), Fertility Index (FI)
- **Calving Traits:** Daughter Calving Ease, Sire Calving Ease (males only), Daughter Stillbirth, Sire Stillbirth (males only)
- **20 Type Traits and Type Composite Indexes:** See sample report for the complete list of type traits and composite indexes reported.

You may receive your genomic prediction reports via email or postal mail, and also view them within the Enlight™ online genetic management tool. Learn more about Enlight at www.enlightdairy.com.

Explanation of the Genomic Prediction Report

The following information will help you interpret the report you receive after genomic testing an animal through Holstein Association USA. See the example report on the last two pages to follow along with the numbers below.

1 Animal Identification Information

On the top of the report you will find the name, registration number, herd management ID number, date of birth, sire and dam of the animal the report is issued for.

2 Genomic Future Inbreeding Coefficient

The GFI is comparable to the Expected Future Inbreeding (EFI) numbers that are assigned to non-genomic tested animals. This value is an estimate of the level of inbreeding the progeny of this animal will contribute in the population if mated at random, based on homozygosity and percentage of genes an animal has in common with the Holstein population.

3 Genomic Predicted Transmitting Abilities (PTA) and Official Parent Averages (PA) or PTAs

These columns provide a comparison between an animal's new genomic PTAs and their former parental averages or PTAs. Comparing between the two columns allows you to see how much an animal changed based on the actual genes they possessed. Genomic PTAs will not appear on Official Holstein Pedigrees™ until after they have gone through an official genetic evaluation, which happens in April, August and December.

4 Genomic and Traditional Reliabilities

These columns show the increase in reliability between an animal's traditional evaluation and their new genomic evaluation. The increased reliability indicates that more information has been added to the evaluation.

5 Other Information

This line describes which version of the SNP chip was used for the test, and the month the results were delivered.

Explanation of the Genetic Condition, Haplotype & Added Content Report

Many popular high and low density genomic tests come with a variety of added content that is provided to dairy producers with their genomic PTAs. Some conditions are included free with the genomic test and some tests are available for an additional cost. Additionally, USDA/CDCB provides haplotype results for the prominent genetic conditions found in Holstein cattle, as well as Haplotypes Impacting Fertility.

INTERPRETING OFFICIAL GENETIC CODES

Animals who have had a specific gene test performed for the condition in question will have a two- or three-character label, indicating whether they have been tested free or found to be a carrier for the condition. Following are examples of official genetic codes you may see on your Genetic Condition Report (if the specific gene test was requested).

- CVM – TV (tested free) or CV (tested carrier)
- Brachyspina – TY (tested free) or BY (tested carrier)
- BLAD – TL (tested free) or BL (tested carrier)
- DUMPS – TD (tested free) or DP (tested carrier)
- Mulefoot – TM (tested free) or MF (tested carrier)
- Horned/Polled – TP (tested free), PC (tested heterozygous, one copy of the polled allele), or PP (tested homozygous, two copies of the allele); additionally, animals may have the official genetic code of PO, meaning the breeder reported the animal as being Observed Polled, but the animal has not had the official test to confirm.
- Dominant Red – DR1 (tested heterozygous, one copy of Dominant Red allele), DR2 (tested homozygous, two copies of the allele). Animals who are not carriers for Dominant Red (DR0) will not be labelled.
- Recessive Red – TR (tested free) or RC (tested carrier)

UNDERSTANDING HAPLOTYPE CODES

A haplotype is a combination of alleles (DNA sequences) at different locations on a chromosome that are transmitted together as a group (linked). Genomics is giving us more insight into the genetics of our cattle than ever before, leading more informed, better decision-making on the farm.

Dairy researchers have discovered five **Haplotypes Impacting Fertility** (as of December 2014) which are officially recognized by Holstein Association USA and the greater dairy industry; referred to as HH1, HH2, HH3, HH4 and HH5, these haplotypes are believed to cause embryonic or fetal death when present in homozygous form, i.e., the offspring inherits the haplotype from both the sire and dam. In a herd, this would appear as if a cow did not conceive, resulting in greater days open and lower conception rates. Researchers have found that these haplotypes never occur in homozygous form amongst any living animal (that had their genome tested). That scenario is highly unlikely based on population probabilities, unless affected animals did not survive to birth.

In July 2015, dairy researchers identified a new deleterious haplotype, called **Holstein Haplotype Associated with Cholesterol Deficiency (HCD)**. This is a more serious defect than the Haplotypes Impacting Fertility, as animals who are homozygous for the unfavorable haplotype only survive a few months from birth. There are two versions of the haplotype, one which is lethal in homozygous form. The two haplotype versions look identical when examining only the surrounding marker genotypes. Pedigree information, combined with having knowledge of the haplotype status of earlier ancestors, allows for an accurate determination. Since the genetic variant causing this genetic defect is relatively new, the haplotype carrying the defect is difficult to track because both the normal version and the defected version occur frequently, especially in Canadian Holsteins. At this time, there is no direct genetic test for the exact genetic variant causing Cholesterol Deficiency. Dairy producers are encouraged to use haplotype information available to avoid mating carrier animals. Codes of 0 to 4 are being used to denote an animal's status on Holstein Association USA's reports, as noted below.

CODES FOR HAPLOTYPE ASSOCIATED WITH CHOLESTEROL DEFICIENCY (HCD)

Haplotype Code	Description
0	Non-carrier: free of HCD
1	HCD Carrier: haplotype confirmed with pedigree information
2	Homozygous for HCD: confirmed on both sides of pedigree
3	Suspect carrier: haplotype origin could not be confirmed from pedigree
4	Suspect homozygous: probable carrier and may be homozygous; origin of haplotypes could not be confirmed from pedigree

Haplotype results are also provided by USDA-CDCB at no charge for all traits for which an official genetic condition test is available, but not requested by the producer. Haplotype results can be useful for identifying animals that are good candidates for further genetic testing, and can also be used in conjunction with known genetic codes to trace different genetic conditions through the pedigree of an animal.

Haplotype results are not considered official; performing the actual gene test for a condition (when available) is required for labelling on pedigrees and other official Holstein performance products. It is also important to note that haplotype results are not a 100% accurate indicator of whether or not an animal is a carrier or free of a condition. In the case where an animal has an actual gene test result and a haplotype result, the actual gene test result should always be considered official.

Most haplotypes have simple result reporting: "T" indicates the animal is tested free of that haplotype and "C" indicates the animal is a carrier of the haplotype. For example, the haplotype associated with CVM is abbreviated as HHC; HHCT indicates an animal has tested free of that haplotype, and HHCC would indicate that an animal was found to carry that particular haplotype.

With three potential genotypes, the haplotype associated with Polled has an addition to the codes above, and can be interpreted as follows:

CODES FOR HAPLOTYPE ASSOCIATED WITH POLLED (HHP) CODES

Haplotype HHP Code	Expected Genotype	Expected Phenotype	Expected Genetic Code (if official polled gene test is performed)
T	p p – does not carry polled allele	Horned	TP
C	P p – carries one copy of the polled allele	Polled	PC
H	P P – carries two copies of the polled allele	Polled	PP

Dominant Red and Recessive Red also have more possible genotypes, and they are coded as follows:

CODES FOR HAPLOTYPE ASSOCIATED WITH RECESSIVE RED (HRR)

Haplotype HRR Code	Expected Genotype	Expected Phenotype	Expected Genetic Code (if official Recessive Red gene test is performed)
0	ED ED	Black	TR
1	ED EBR	Black	B/R
2	ED E+	Black	RC
3	ED e	Black	RC
4	EBR EBR	Black/Red	B/R
5	EBR E+	Black/Red	B/R RC
6	EBR e	Black/Red	B/R RC
7	E+ E+	Red	RED
8	E+ e	Red	RED
9	e e	Red	RED

CODES FOR HAPLOTYPE ASSOCIATED WITH DOMINANT RED (HDR)

Haplotype HDR Code	Expected Genotype	Expected Phenotype	Expected Genetic Code (if official Dominant Red gene test is performed)
0	DR0 – animal carries 0 copies of the Dominant Red allele	Black	None (DR0 is not labelled on pedigrees or other performance products)
1	DR1 – animal carries 1 copy of the Dominant Red allele	Red	DR1
2	DR2 – animal carries 2 copies of Dominant Red allele	Red	DR2

On the Genetic Condition report, available information, either specific gene test or haplotype result, is provided for the animal itself, as well as the sire and dam (when available).

**With questions or for more information
about your genomic predictions,
call 800.952.5200.**



Holstein Association USA

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EXAMPLE Individual Genomic Prediction

OCD LAMB FARMS 7821 840003009533641 F HMID: 7821
Oakfield Corners Dairy, Oakfield NY

DOB: 08/11/2012 GFI: 7.4
Sire: TIGER-LILY LADD P-RED-ET USA 69405976
Dam: OCD MAN-O-MAN FANTOM-ET 840003006989186

SELECTION INDEX	Genomic PTA	Aug 2014 PA/PTA	Genomic REL %	Aug 2014 REL %
Total Performance Index (TPI)	2202	2155	75	33
Net Merit (\$)	378	516	73	
YIELD TRAITS				
Milk	-244	518	77	39
Fat (lbs)	59	61	77	39
Fat (%)	0.28	0.16	77	
Protein (lbs)	22	39	77	39
Protein (%)	0.12	0.09	77	
Feed Efficiency	108.0		74	
HEALTH TRAITS				
Daughter Pregnancy Rate (%)	1.8	1.1	65	
Productive Life (months)	1.10	2.60	69	
Somatic Cell Score	2.9	2.9	72	
Heifer Conception Rate	0.2		59	
Cow Conception Rate	1.6		63	
Fertility Index	1.5		64	
CALVING TRAITS				
Daughter Calving Ease	6.9	6.4	55	33
Daughter Stillbirth	6.7	7.0	52	31
TYPE TRAITS				
Final Score (PTAT)	2.02	3.03	74	39
Feet/Legs Composite	1.17	2.06		
Udder Composite	1.23	2.46		
Stature	2.52	2.92		
Strength	1.97	1.48		
Body Depth	2.00	1.67		
Dairy Form	1.38	2.14		
Rump Angle	-1.43	-0.60		
Rump width	1.95	2.44		
Rear Legs Side View	0.77	0.58		
Rear Legs Rear View	1.03	2.09		
Foot Angle	1.28	2.06		
Feet/Leg Score	1.46	2.44		
Fore Attachment	1.30	2.68		
Rear Udder Height	1.86	3.70		
Udder Cleft	2.29	3.02		
Udder Depth	0.92	2.16	76	40
Front Teat Placement	1.44	1.79		
Rear Teat Placement	2.13	2.25		
Teat Length	0.70	0.49		

Genomic PTA calculated using 9K , Date Issued: January 2015
For more on interpreting this report, visit www.holsteinusa.com



EXAMPLE Individual Genomic Prediction - page 2

OCD LAMB FARMS 7821 840003009533641 F HMID: 7821
Oakfield Corners Dairy, Oakfield NY

DOB: 08/11/2012 GFI: 7.4
Sire: TIGER-LILY LADD P-RED-ET USA 69405976
Dam: OCD MAN-O-MAN FANTOM-ET 840003006989186

GENETIC CONDITIONS	7821	SIRE	DAM
CVM	HHCT(Non-Carrier)	TV HHCT	HHCT
Brachyspina	HH0T(Non-Carrier)	TY HH0T	HH0T
BLAD	HHBT(Non-Carrier)	TL HHBT	HHBT
DUMPS	HHDT(Non-Carrier)	TD HHDT	HHDT
Mulefoot	HHMT(Non-Carrier)	HHMT	HHMT
Horned / Polled	HHPT(Non-Carrier)	PC HHPC	HHPT
Dominant Red	HDRT(Non-Carrier)	HDRT	HDRT
Recessive Red	HRR2(RC)	HRR8	HRR0
HAPLOTYPES IMPACTING FERTILITY			
Haplotype 1	HH1T(Non-Carrier)	HH1T	HH1T
Haplotype 2	HH2T(Non-Carrier)	HH2T	HH2T
Haplotype 3	HH3T(Non-Carrier)	HH3T	HH3T
Haplotype 4	HH4T(Non-Carrier)	HH4T	HH4T
Haplotype 5	HH5T(Non-Carrier)	HH5T	HH5T

For more on interpreting this report, visit www.holsteinusa.com
Date Issued: January 2015

