Igenity® Dairy Heifer Program
Results Key

The **Igenity Dairy Heifer Program** family of products contains comprehensive, powerful and easy-to-use tools for genetic evaluation, at any time in an animal's lifetime. No matter if you use the Igenity-Elite, Igenity-Prime or Igenity-Select, all animals receive a Genomic Predicted Transmitting Ability (PTA) based on DNA tests that use from 5,000 to nearly 150,000 markers from the bovine genome.

Data from the genomic tests conducted on the samples you provide from your animals are submitted to the USDA-Animal Genomics Imprvement Laboratory (AGIL), where a genomic PTA is derived that gives an accurate measure of that animal's true genetic potential. The genomic PTA contains information on the animal's parents, its relatives, any progeny records that might be available, as well as an estimate of the animal's genetic merit based on the direct examination of the genetic markers in its DNA.

The traits evaluated include a wide variety of measures for productivity, health and type traits, along with composite indexes that include Net Merit, Cheese Merit, Fluid Merit and Production Indexes. In addition, with the Igenity Dairy Heifer Program, you can derive a "Custom Index" specific to your herd's need and breeding objectives, to give you the ultimate flexibility in selection for genetic improvement.

What is a Genomic PTA?

A Genomic Predicted Transmitting Ability (PTA) is a measure of the genetic merit of an animal in a breeding program, and in particular, how the animal and its progeny are likely to perform. It is always reported as the deviation from a pre-determined base (the base is updated every 5 years) and is an objective measure that allows you to rank the animal against all others that are in the database of the breed, within the USDA-AIPL.

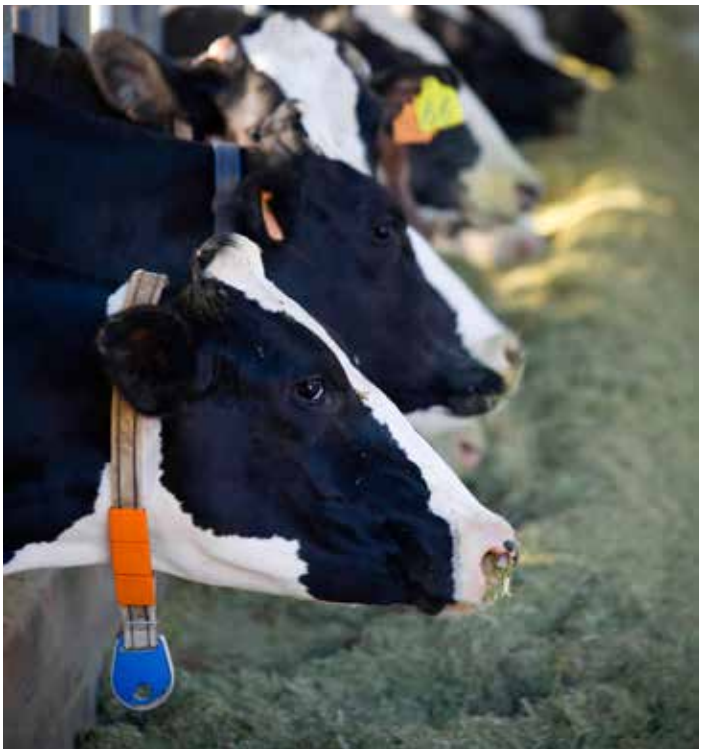
A wide range of traits are measured, based on data provided by dairy producers, and are reported on the base in which the trait is measured. For example, a PTA for milk yield is reported in pounds, a PTA for fat yield is likewise reported in pounds, and a PTA for productive life is measured in months. In a newborn animal, the best estimate of that animal's true genetic merit is the Parent Average and in the absence of any other information, the PTA will reflect the parent average. As the animal grows and enters into production, its own production records will contribute information about its merit and those data will improve the accuracy or reliability of the prediction. If any offspring of the animal have their own performance data (such as daughters of sires), then the information on the progeny will likewise be included.

Finally, in the case of genomic data, the specific results from DNA markers are a direct prediction of genetic merit. What is particularly powerful in dairy heifers is that the information from the DNA markers is equivalent to many progeny records, when predicting the true merit of an animal. So — a DNA test on a day-old calf is the equivalent of years' worth of production records!

Looking at the Igenity Dairy Heifer Profile Genetic Evaluation Report

When you receive your Igenity Profile Genetic Evaluation Report, the first thing you will see is information related to **Order Number** (this is a useful reference if you have questions, or if you wish to go online later to view your results), **Order Date** and your contact information. In addition, each animal record includes the animal's **Farm ID** (this is usually the short ID such as an ear tag), the **Official ID** (this is the animal ID as it is in the national database), **Breed** (HO for Holstein, JE for Jersey and BS for Brown Swiss) and **Birth Date**. After that, the results are grouped in to various categories, depending on their particular focus.

Farm ID	Official ID	Breed	Birth Date
1501	HOUSA0000xxxxxxxx	HO	6/12/2014
1502	HOUSA0000xxxxxxxx	HO	10/30/2013
1503	HOUSA0000xxxxxxxx	HO	11/6/2013
1504	HOUSA0000xxxxxxxx	HO	5/31/2014
1505	HOUSA0000xxxxxxxx	HO	4/1/2013



NEOGEN®

Key Traits

The first category of reports for the Igenity Dairy Heifer Program contains the Key Traits that are most often used for the purpose of evaluation of animals.

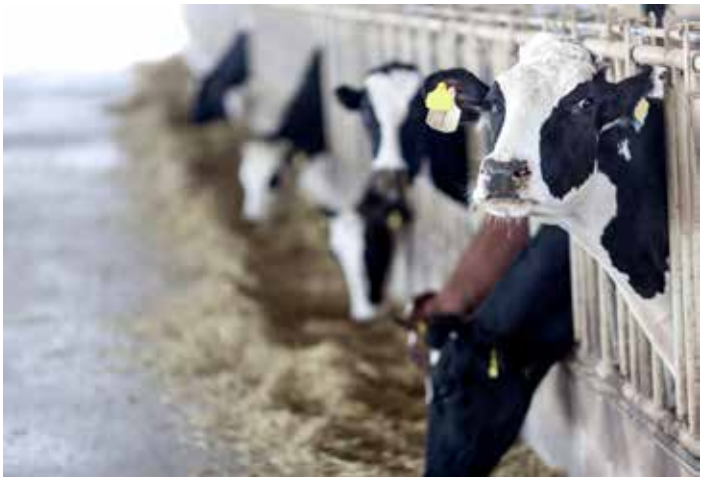
- **Custom Index.** This column is for a "user-defined" custom index. You determine the weighting you wish to apply to each trait, and an index is created that combines PTA results for your desired traits into a single index.
- **Net Merit $.** Net merit is a composite trait meaning that the results for a number of component traits are combined to provide an estimate of the lifetime profit of the animal, in dollars. The traits included in the calculation, along with their relative weighting, are pounds of Protein (20%), pounds of Fat (22%), Milk Yield (-1%), Productive Life (19%), Somatic Cell Score (-7%), Udder Composite (8%), Feet/legs Composite (3%), Body Size Composite (-5%), Daughter Pregnancy Rate (7%), Heifer Conception Rate (2%), Cow Conception Rate (1%) and Calving Ability Dollars (5%).
- **Net Merit Report Rank.** All of the animals included in the report you receive back are ranked from top to bottom. If there are 100 animals in the report, the animal with the best Net Merit $ score will be ranked #1 and the animal with the lowest Net Merit $ score will be ranked #100.
- **Genomic Reliability (%).** A PTA reported for any trait, for any animal, always comes with a reliability measure. If only parent average is available, the reliability of the estimate of genetic merit provided by the PTA will be low — around 30%. With the addition of genomic data from DNA markers, the reliability of the prediction will frequently approach, which is a significant improvement and means that you can have confidence that the Genomic PTA reported for Net Merit $ will be a reliable measure.
- **Net Merit $ US Percent Rank.** In addition to the Report Rank for Net Merit $, the animals in your report are individually scored against the database of all animals with scores for Net Merit. The result is reported as the US Percent Rank, and gives the percent of the animal in the national herd that are below this individual animal for Net Merit. For example, a score of 99% means this animal is in the top 1% and that 99% of all US animals score lower for Net Merit. A score of 50% means that half of the animals in the US score below this animal, while half score better than this animal for Net Merit.
- **Milk Yield.** The PTA for milk yield is the estimated difference in pounds of milk produced per mature 305-day lactation.
- **Fat Yield.** The PTA for fat yield is the estimated difference in pounds of fat produced per mature 305-day lactation. The estimate of the actual amount of fat produced will be a result of the predicted milk yield, as well as the predicted percent of fat in the milk (fat %). Fat percent is a report that is typically reported separately, but most dairymen are interested in total fat yield per lactation.
- **Protein Yield.** The PTA for protein yield — like fat yield — is the estimated difference in pounds of protein produced per mature 305-day lactation.
- **Somatic Cell Score (SCS).** The PTA for Somatic Cell Score is an estimate of the number of somatic cells per milliliter of milk (divided by 100,000) and is an estimate of udder health. Somatic cells are natural defense mechanisms during times of udder infection (mastitis), and animals with a lower SCS suggests improved resistance to udder infections and mastitis. For SCS, a lower score is preferred.

KEY TRAITS															
Farm ID	NM$	NM$ Report Rank	Genomic REL %	NM $ US Percent Rank	Milk Yield	Fat (lbs)	Pro (lbs)	SCS	PL	DPR	DCE	GM$	IPI	PTA Type	GFI
1501	488	1	67	97	1838	74	56	3.04	1.6	-1	5.3	465	2051	2.46	2.5
1502	361	2	69	86	201	44	18	2.73	2.2	-0.2	6.5	264	1798	1.58	5.9
1503	243	3	68	63	759	37	21	2.88	0.7	-1	7.8	218	1728	1.7	6
1504	217	4	68	57	686	23	22	3.02	1	1.1	6.8	164	1654	1.04	2.3
1505	62	5	70	21	236	52	13	3.3	-1.9	-0.9	6	49	1451	0.63	3.4

Key traits sheet shows some of the most important traits to consider when evaluating your dairy herd. When reports are returned, the animals are sorted by Net Merit($). In this case, the top ranking heifer (#1501) has a NM$ of $488 while the bottom heifer (#1505) has a NM$ of $62. Based on this example, we would expect #1501 to produce $852 [($488-$62) x2] more profit than #1505 over her lifetime. The difference in NM$ is multiplied by 2 since the estimate of the animals own performance is 2 times the PTA, or what they would contribute to their progeny.

Igenity® Dairy Heifer Program
Results Key

- **Productive Life (PL).** The PTA for Productive Life is a prediction of the longevity of the animal (and its progeny) in the herd and is measured in months. Longer is better in this case since herds with greater longevity on average, require fewer replacement females which is a very important component of the cost of production.
- **Daughter Pregnancy Rate (DPR).** The trait of Daughter Pregnancy Rate measures the percent of open cows that become pregnant each 21 days. Animals — and herds — with higher DPR are more fertile and better able to conceive following calving.
- **Daughter Calving Ease (DCE).** Daughter calving ease is a measure of the ability of an animal to have an unassisted birth. The trait measures the percentage of difficult births among heifers; therefore, a lower score is desirable.
- **Grazing Merit Dollars (GM$).** Like net merit, grazing merit is a composite index that caters to herds that use seasonal calving based around grass production. The selection is around fertility and those traits that favor efficient milk production off grass. The traits included in the calculation, along with their relative weighting, are pounds of Protein (18%), Fat (20%), Milk Yield (-1%), Productive Life (10%), Somatic Cell Score (-6%), Udder Composite (8%), Feet and Legs Composite (3%), Body Size (-4%), Daughter Pregnancy Rate (19%), Heifer Conception Rate (3%), Cow Conception Rate (5%); Calving ability dollars (5%).
- **Igenity Production Index (IPI).** The Igenity Production Index — like Net Merit — is a composite trait that combines and weights the values for individual traits to come up with an overall estimate of genetic merit based on specific breed standards. For Holstein, the weighting for the major categories include: 46% on production traits, 28% on health and fertility traits and 26% on confirmation traits. For Jersey, 58% of the composite is based on production traits, 27% on health and fertility traits and 15% on confirmation traits. For Brown Swiss, 62% of the composite is based on production traits, 24% on health and fertility traits and 14% on confirmation traits.



- **PTA Type (PTAT).** The PTA for Type is a composite score of up to 19 individual structural and anatomic traits, related to things such as feet and legs, udder, body frame and other measures that are known to be positively associated with longevity and performance in dairy cattle. Daughters of sires are scored by classifiers from groups such as Holstein USA, relative to their overall type, and that information is then used to predict structural soundness of dairy animals and their progeny. A higher score for type is preferred and is included in the category of Key Traits because it is the best measure of overall conformation.
- **Genomic Future Inbreeding (GFI).** GFI is a measure of the level of inbreeding in an individual animal, and is derived in this case directly from the DNA marker information. Animals that are more inbred tend to be homozygous (meaning the same gene is inherited from both parents) and this inbreeding is known to reduce performance. In this case, a lower score is desired as a means of reducing inbreeding in the herd.

Tips for wading through genomic data: Use composite indexes

Genomic reports contain a large amount of information that can make it intimidating to get started. Looking at composite indexes can be a great way to summarize this information in a way that is useful to your specific breeding goals. The following composite indexes with relative traits and their associated weightings are included with the Igenity Dairy Heifer Program:

Trait	Net Merit (NM$)	Cheese Merit (CM$)	Fluid Merit (FM$)	Grazing Merit (GM$)
Milk (lbs)	-1	-9	23	-1
Fat (lbs)	22	19	23	20
Protein (lbs)	20	24	0	18
Productive life (months)	19	16	20	10
Somatic cell score	-7	-7	-3	-6
Udder composite	8	6	8	8
Feet/legs composite	3	2	3	3
Body size composite	-5	-4	-5	-4
Daughter pregnancy rate	7	6	7	19
Heifer conception rate	2	1	2	3
Cow conception rate	1	1	2	5
Calving ability dollars	5	4	5	5

Health Traits

There are several health traits that are particularly important for dairy production, and these traits are grouped together within the Health Trait category. These include **Daughter Pregnancy Rate** (defined as the percent of open cows that become pregnant each 21 days, **Productive Life** (prediction of the longevity of the animal and its progeny in the herd and is measured in months) and **Somatic Cell Score** (a measure of the number of somatic cells per milliliter of milk, reflecting udder health).

HEALTH TRAITS			
Farm ID	DPR	PL	SCS
1501	-1	1.6	3.04
1502	-0.2	2.2	2.73
1503	-1	0.7	2.88
1504	1.1	1	3.02
1505	-0.9	-1.9	3.3

Looking at Productive Life (PL) in the herd above, we would expect #1502 to be in the herd 8.2 months longer than #1505 [(2.2-(-1.9))x2]. The difference in PL is multiplied by 2 since the estimate of the animal's own performance is 2 times the PTA, or what they would contribute to their progeny.

Yield Traits

Various yield traits are combined into a single grouping and as defined above, this includes traits such as **Milk Yield** (number of pounds of milk in a standard 305-day lactation, above or below the industry baseline), **Fat Yield** (number of pounds of fat in a standard 305-day lactation, above or below the industry baseline) and **Protein Yield** (number of pounds of protein in a standard 305-day lactation, above or below the industry baseline). Additional traits in this category include:

- **Fat Percent.** This is a PTA for the fat content of the milk and when combined with the yield figures, will result in the estimate of the total lactation yield of fat, in pounds. This is a percentage scale, and generally a higher value is more beneficial.
- **Protein Percent.** This is a PTA for protein content of the milk and when combined with the yield figures, will result in the estimate of the total lactation yield of protein, in pounds. This is a percentage scale, and generally a higher value is more beneficial.
- **Cheese Merit Dollars (CM$).** Like Net Merit, Cheese Merit is a composite index and because of the economic value of components such as fat and protein for further processing, it places emphasis on the value of components and penalizes animals for excess milk yield. The traits included in the calculation, along with their relative weighting, are pounds of Protein (24%), pounds of Fat (19%), Milk Yield (-9%), Productive Life (16%), Somatic Cell Score (-7%), Udder Composite (6%), Feet/legs Composite (2%), Body Size Composite (-4%), Daughter Pregnancy Rate (6%), Heifer Conception Rate (1%), Cow Conception Rate (1%) and Calving Ability Dollars (4%).
- **Fluid Merit Dollars (FM$).** As the name implies, fluid merit is targeted to producers whose marketing system favors milk yield and who do not receive premiums for protein production. The traits included in the calculation, along with their relative weighting, are pounds of Fat (23%), Milk Yield (23%), Productive Life (20%), Somatic Cell Score (-3%), Udder Composite (8%), Feet/legs Composite (3%), Body Size Composite (-5%), Daughter Pregnancy Rate (7%), Heifer Conception Rate (2%), Cow Conception Rate (2%) and Calving Ability Dollars (5%).

Fertility Traits

This grouping of traits is intended to bring together several measures of reproductive success and includes **Daughter Calving Ease** (measure of the ability to have an unassisted birth). Other measures in this classification include:

- **Sire Calving Ease (SCE).** The trait measures of the ability of calves of a particular sire to have an unassisted birth— lower scores indicate an easier calving.

YIELD TRAITS							
Farm ID	Milk Yield	Fat (lbs.)	Fat %	Pro (lbs.)	Pro %	Cheese Merit	Fluid Merit
1501	1838	74	0.02	56	0	262	363
1502	201	44	0.14	18	0.05	38	50
1503	759	37	0.03	21	-0.01	107	150
1504	686	23	-0.01	22	0	97	135
1505	236	52	0.17	13	0.03	42	58

For operations looking to improve fluid milk production, milk yield is a very important trait. In the herd above, we would expect #1501 to produce 3,274 pounds [(1838-201)x2] more milk than the industry baseline over a 305-day lactation when compared with #1502. That is approximately 10.7 pounds of milk per each day of the lactation, or $2.30 per day for fluid milk at $22.53 cwt.

Igenity® Dairy Heifer Program
Results Key

- **Heifer Conception Rate (HCR).** The trait measures a maiden heifer's ability to conceive measured by the percentage of inseminated heifers that become pregnant at each service. A score of 1 suggests that the heifer is 1% more likely to become pregnant than heifers with an evaluation of 0.
- **Cow Conception Rate (CCR).** Similar to Heifer Conception Rate, the trait measures the percentage of cows that become pregnant at each service. A score of 1 suggests that the cow is 1% more likely to become pregnant than cows with an evaluation of 0.
- **Daughter Stillbirth.** This trait measures the ability of a cow, or daughters of a bull, to have a live calf that survives past 48 hours. In this case, a lower score is obviously more desirable.
- **Sire Stillbirth.** The trait measures the ability of calves from a particular sire to be born live and survive past 48 hours. In this case, a lower score is more desirable.
- **Haplotype Status.** Researchers have thoroughly evaluated the database of genotypes and identified that certain combinations of genotypes (referred to as haplotypes) that should be present in the population are simply not present. The absence of the haplotype suggests that the unique combination of those genotypes is somehow lethal to the developing embryo. When the researchers investigate, they are able to identify bulls (or females) that are carriers of the haplotype are less fertile, suggesting embryonic mortality. In several instances, they have actually been able to identify the causative mutation and confirm that the change in the DNA does result in a lethal mutation. There are five of these haplotypes known to exist in Holstein (named HH1 through HH5), two in Jersey (named JH1 and JH2) and two in Brown Swiss (BH1 and BH2). The animal that is normal for the haplotypes is reported as a "T", an animal that is a carrier for the haplotypes is reported as a "C" and an animal that is homozygous affected is reported as an "A".

Type Traits

The USDA-AIPL evaluations use the information on the structural or "type" classification performed by classifiers from the breed associations, and elsewhere, to derive a series of type classifications that describe the conformation and structural makeup of the animal. These type classifications are derived in a way that will relate to longevity and productivity, since dairy animal strength and fitness will definitely influence performance. The Igenity Dairy Heifer Program lists a series of the key type traits as follows:

- **PTA Type (PTAT)** is a compilation of at least 16 different trait evaluations and provides an overall measure of fitness. A larger value is preferred.
- **Feet and Legs Composite (FLC)** consists of Foot Angle, Rear Legs Rear View and Rear Legs Side View. A larger value is generally preferred, indicating strength in the legs and feet, normal claw conformation and health, and appropriate angularity in the leg.
- **Udder Composite (UDC)** like feet and legs composite—rejoins scores for a number of components of quality udders including udder depth, udder cleft, fore udder attachment, rear udder height, rear udder width, front teat placement, rear teat placement and teat length. A higher value is preferred.
- **Stature (STA)** is essentially a measure of height or vertical depth. In order that there is sufficient room for a large and functional rumen, lungs and other organs, a dairy cow needs sufficient body size to accommodate that, without being excessively large. Stature is a measure of this. A higher value indicates a taller animal.
- **Strength (STR)** is a measure of traits such as muscle tone, width of chest, strength or linearity of topline and other measures that imply a strong and robust animal, capable of easily moving to and from feeding areas, handling the capacity of a large and functional rumen and other traits that support a long and productive life. A higher value indicates a stronger animal.
- **Body Depth (BDE)** — along with stature — is essentially the amount of capacity in the body for lungs, rumen and other abdominal organs. A highly productive cow needs capacity for large organs required to produce the energy for top quality milk production. A higher value indicates the animal has a greater amount of capacity.

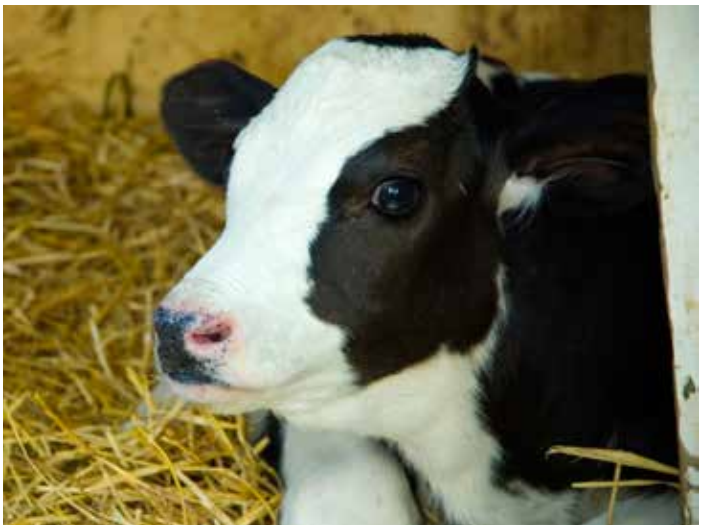
FERTILITY TRAITS							
Farm ID	DCE	SCE	HCR	CCR	Daughter Stillbirth	Sire Stillbirth	Haplotype Status
1501	5.3	5.2	0.5	1.4	6	7.8	HH1T HH2T HH3T HH4T HH5T
1502	6.5	7.9	1.1	0.7	7	7.4	HH1T HH2T HH3T HH4T HH5C
1503	7.8	6.1	0.5	1.4	8.2	7.8	HH1T HH2T HH3T HH4T HH5T
1504	6.8	8.7	-1.5	-3.2	7.1	8.1	HH1T HH2T HH3T HH4T HH5T
1505	6	8.7	-0.7	-2.3	8.3	7.8	HH1T HH2T HH3T HH4T HH5T

In the example above, #1502 is a carrier for Holstein Haplotype 5. This information can be used to make optimum herd mating decisions.

Additional Type Traits

In addition to the key type traits listed above, the Igenity Dairy Heifer Program includes a number of other type or conformation traits as listed below:

- **Dairy Form (DFM)** is a measure of the amount of angularity in the female. Animals should be moderately angular suggesting high production, as opposed to being somewhat round (excessive fat cover) or skeletal (insufficient fat cover). A higher value indicates more angular animal.
- **Rump Angle (RPA)** is the slope from the hip bone (ilium) to the pin bone (ischium). A value close to 0 indicates a more desirable slope from hips to pins.
- **Rump-Thurl Width (RTW)** refers to the width of the hips. A higher value indicates a wider animal between the pins.
- **Rear Legs Side View (RLS)** refers the angle of the hock as viewed from the side. Higher values will apear more sickled hocked while lower values will appear post legged. A value nearer to 0 is more desirable.
- **Rear Legs Rear View (RLR)** refers to differences in width of stance between the rear legs as viewed from behind. A higher value indicates the animal tracts straighter on its rear legs.
- **Foot Angle (FTA)** is the steepness of the angle of the rear foot from the hairline. A higher value indicates greater hoof angle.
- **Feet and Legs Score (FLS)** measures overall feet and legs by combining mobility and feet and leg structure. A higher value is preferred.
- **Fore Udder Attachment (FUA)** is an evaluation of the strength of attachment of the fore udder to the body wall. A higher value indicates a stronger attachment of the fore udder.
- **Rear Udder Height (RUH)** is measured as viewed from the rear at the crease where the udder meets the leg, in relation to the midpoint between the point of hock and pins. A higher value indicates a higher rear udder.
- **Udder Cleft (UCL)** is a measure of the depth of cleft of the udder between the rear teats. A higher value indicates a stronger udder cleft.
- **Udder Depth (UDP)** is a measure of the depth of udder floor relative to the hock. A higher value indicates a more desirable depth between the lowest point of the udder floor and the point of the hock.
- **Front Teat Placement (FTP)** is a measurement of the placement of the front teats on the quarter. A higher value indicates a closer distance between the front teats.
- **Rear Teat Placement (RTP)** is a measurement of the placement of the rear teats on the quarter. A higher value indicates a closer distance between the rear teats.
- **Teat Length (TLG)** is the length of the front teats from the base to the end of the teat. A value close to 0 is preferred.



TYPE TRAITS																				
Farm ID	PTAT	FLC	UDC	STA	STR	BDE	DFM	RPA	RTW	RLS	RLR	FTA	FLS	FUA	RUH	UCL	UDP	FTP	RTP	TLG
1501	1.64	0.99	1.52	0.74	1.11	0.88	0.34	0.77	0.98	-0.16	0.93	1.22	1.03	1.88	2.28	1.88	1.38	1.37	1.67	0.23
1502	1.78	1.09	1.43	0.55	0.18	0.42	1.3	0.45	1.42	0.83	1.45	0.49	1.54	1.92	2.04	1.98	1.26	1.34	1.64	0.29
1503	2.35	1.26	1.88	1.71	0.51	1.00	2.31	0.23	2.13	1	1.4	1.27	1.54	2.28	2.95	1.89	1.72	0.98	1.42	-0.21
1504	0.64	0.47	0.35	0.01	0.7	0.33	-0.39	0.77	0.43	-1.07	0.72	0.18	0.43	0.81	0.21	0.91	0.31	1.27	1.28	-0.44
1505	1.4	1.39	1.24	0.86	0.91	0.91	1.14	-0.22	1.33	0.29	1.61	1.48	1.52	1.53	1.93	1.49	1.04	0.2	0.44	1.45

For the example above, Rear Legs Side View (RLS) is low for #1504 at -1.07 and high for #1503 at 1. We would expect #1504 to physically appear more post legged than #1503 who would likely appear sickle hocked. #1501 has the closest value to 0 so her legs should appear most ideal when viewed from the side.

Igenity® Dairy Heifer Program
Results Key

Genetic Conditions

Coat Color (including Black/Red). The Igenity Dairy Heifer Program uses haplotypes to determine black or red coat color. The four alleles present on MCR1 are dominant black (E^D), Black/Red (E^{BR}), wild type red (E^+), and recessive red (e). The black (E^D) gene is dominant over red (e). Black/Red, also known as Telstar (E^{BR}), results in red coat color at birth that changes to black, usually by 3-6 months. Wild type red (E^+E^+) produces red animals that are darker at the extremities particularly as the animal ages. The order of dominance is $E^D > E^{BR} > E^+ > e$. Animals will appear as described below only in the absence of dominant red.

E^DE^D Homozygous Black— will not produce red offspring. Over 90% of Holsteins have this genotype.
E^DE^{BR} Black, Black/Red carrier
E^DE^+ Black, Wild Type carrier
E^De Black, Recessive red carrier
$E^{BR}E^{BR}$ Black/Red—this animal cannot produce true red offspring.
$E^{BR}E^+$ Black/Red, wild type carrier
$E^{BR}e$ Black/Red, recessive red carrier
E^+E^+ Wild type red
E^+e Wild type red, carrier of recessive red
ee Recessive red. When bred to another ee will only produce red offspring.

Dominant Red Coat Color. As the name implies, dominant red coat color that occurs in Holsteins will lead to a red coat regardless of the alleles expressed for traditional coat color.

N/N. No copies of Dominant Red present. Color is dependent on the gene for traditional coat color.
N/DR. One copy of Dominant Red present. The animal will appear red and white, but only produce red and white offspring 50% of the time.
DR/DR. Two copies of Dominant Red present. The animal will appear red and white and will always produce red and white offspring.

Polled. A dominant trait in cattle— only animals with two horned recessive genes will appear horned. Animals appearing polled will not require the labor associated with dehorning. Animals will be reported as "HH" (meaning they carry two horned genes), "HP" (meaning they appear polled, but carry the horned gene) or "PP" (meaning they carry two polled genes). If a HP animal is mated with a HH animal, 50% of offspring will be HP. If an animal is PP, all of its offspring will appear polled (HP or PP). The polled trait can be reported in two ways from the Igenity Dairy Heifer Program:

Causative Polled. An independent test for the causative mutation associated with the polled condition in dairy cattle. It is the definitive test for horned/polled that can be performed in any breed of cattle.

Haplotype Polled. The haplotype for the polled trait that is derived from the USDA evaluation. (For purebred breeding purposes, a confirmation test using the causative polled test is suggested.)

HH: Horned **HP:** Horned carrier **PP:** Polled

Brachyspina. A lethal recessive that usually causes abortion within the first 40 days of gestation. Carrier animals have no symptoms, but will have a 25% chance of producing an affected offspring if bred to another carrier.

Causative Brachyspina. An independent test for the causative mutation associated with brachyspina. It is the definitive test for the disease.

Haplotype Brachyspina. The haplotype for Brachyspina that is derived from the USDA evaluation.

T: Tested Free **C:** Carrier **A:** Affected

Complex Vertebral Malformation (CVM) A lethal hereditary syndrome found in Holstein that is responsible for malformed calves that usually are aborted or die shortly after birth. Carrier animals have no symptoms, but will have a 25% chance of producing an affected offspring if bred to another carrier.

Causative CVM. An independent test for the causative mutation associated with complex vertebral malformation. It is the definitive test for the disease.

Haplotype CVM. The haplotype for CVM that is derived from the USDA evaluation.

T: Tested Free **C:** Carrier **A:** Affected

Bovine Leukocyte Adhesion Deficiency (BLAD). BLAD is a disease which results in impaired function of the white blood cells of the immune system. In order for an animal to demonstrate clinical signs of the disease, it must have two copies of the gene. Carriers (animals with one copy of the gene) are normal, but will have a 25% chance of producing an affected offspring if bred to another carrier.

T: Tested Free **C:** Carrier **A:** Affected

Deficiency of Uridine Monophosphate Synthase (DUMPS). DUMPS is characterized by early embryonic death in animals that have two copies of the gene. Animals with one copy of the gene (carriers) are normal, but will have a 25% chance of producing an affected offspring if bred to another carrier.

T: Tested Free **C:** Carrier **A:** Affected

Igenity® Dairy Heifer Program
Results Key

Mulefoot. Mulefoot is a recessive congenital disease in Holstein cattle that causes fusion of the hoof. It is not lethal, but leads to locomotive difficulties in affected animals.

T: Tested Free **C:** Carrier **A:** Affected

A2 Beta-Casein. A beta-casein protein that is less common than the A1 beta-casein protein typically found in milk. Some studies have demonstrated health benefits associated with A2 milk, although this is debated. The milk does sell for a premium which is why some producers are choosing to select for it.

A2/A2: A2 Milk **A2/A1:** A2 carrier **A1/A1:** A1 Milk

Y SNP. The DNA markers in the Igenity Dairy Heifer Program contain a number that are specific to the Y chromosome. Analysis of the results from sub-optimally fertile female cattle indicate that in a portion of these animals, it is possible to identify Y markers in their DNA— indicating that pieces of Y chromosome are present in the DNA of these females and could be negatively impacting fertility. This phenomenon is distinct from the classic freemartin female born twin to a male. The results for this test combine two analysis — one looks at the percentage of homozygous Y SNP markers to verify sex (male versus female). Then any female that contains one or more Y SNP markers is reported as a "Y SNP carrier", following a confirmation assay to verify the presence of Y chromosome segments in female.

Y SNP carrier: the female is positive for one or more Y SNP markers

Y SNP negative: the female does not posess any Y SNP markers

Kappa casein. There are several forms of kappa casein – A, B and E – that are associated with milk protein and quality. These variants are related to renneting process for cheese production. Studies have also shown that cheddar cheese yield can be up to 8% higher and mozzarella up to 12% higher with BB milk versus AA milk. The E variant has an adverse effect on cheese production.

BB: preferred result for cheese production

AB and BE: intermediate for cheese production.

AA and AE: least favorable result for cheese production.

Beta casein. Like kappa casein, there are several different forms of beta casein (A and B). Higher milk yield is associated with the A variant while higher protein and casein yields are associated with the B variant. Beta casein B is similar in effect to Kappa casein B.

Beta lactoglobulin. A major whey protein that has a significant effect on casein number and cheese yield. The B variant has higher casein and cheese yields.

Beta lactoglobulin and Beta casein

BB: most favorable result for casein and cheese yield.
AB: intermediate result for casein and cheese yield.
AA: least favorable result for casein and cheese yield.

Spinal Muscular Atrophy (SMA). A neurological condition affecting the nervous system that is characterized by skeletal muscle atrophy, decreased spinal reflexes and motor weakness. This haplotype is derived from the USDA evaluation and only known to be present in Brown Swiss cattle. Animals with one copy of the gene (carriers) are normal, but will have a 25% chance of producing an affected offspring if bred to another carrier.

T: Tested Free **C:** Carrier **A:** Affected

Spinal Dysmyelination (SDM). A neurodegenerative disease in cattle that leads to inability to stand immediately upon birth. This haplotype is derived from the USDA evaluation and only known to be present in Brown Swiss cattle. Animals with one copy of the gene (carriers) are normal, but will have a 25% chance of producing an affected offspring if bred to another carrier.

T: Tested Free **C:** Carrier **A:** Affected

Weaver. Also known as Bovine Progressive Degenerative Myelo-encephalopathy, it is characterized by a noticeable weaving gait of the affected animal. This haplotype is derived from the USDA evaluation and only known to be present in Brown Swiss cattle. Animals with one copy of the gene (carriers) are normal, but will have a 25% chance of producing an affected offspring if bred to another carrier.

T: Tested Free **C:** Carrier **A:** Affected

Other Measures

In addition to the USDA-AIPL production and conformation traits, other items are available from the Igenity Dairy Heifer Program Report:

- **BVD-PI Status.** If you selected the option for BVD-PI testing, then a laboratory examination will be conducted and you will receive a report indicating the status of your animal, relative to persistent infection with BVD (Bovine Viral Diarrhea) Virus. If the animal is suspected to be positive, genomic testing will not proceed unless advised otherwise. It is advisable to cull persistently affected animals as they are sub-optimal performers and a source of infection for other animals.

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AG135-0415