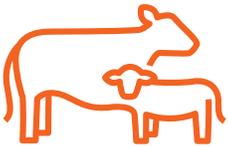


# TECHNICAL BULLETIN

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## i50K™ FOR ANGUS TECHNICAL SUMMARY

Dr. Jason Osterstock, Director, Global Genetics Technical Services

Dr. Kent Andersen, Associate Director, Genetic Technical Services

### Zoetis Genetics

333 Portage Street

Kalamazoo, MI 49007-4931

*i50K represents another step in the evolution and a significant leap forward in enhancing the value proposition associated with use of genomic data and GE-EPD to make informed breeding, management and marketing decisions in Angus cattle*

### KEY POINTS

- i50K™ provides Angus breeders with accurate predictions of genetic merit for economically relevant traits leveraging cost-effective genotyping platforms
- i50K uses a process called imputation to infer 50K genotypes from lower density genotypes with a high degree of accuracy, built upon the extensive foundation of reference genotypes from HD 50K
- i50K predictions utilize the same calibration as HD 50K and the resulting GE-EPD accuracies are unchanged

### INTRODUCTION

The adoption of genomic technologies among breeders serves as the basis for future innovation. By establishing a foundation of genotyped animals, breeders allow scientists and industry leaders to extend the technology, increasing accuracy of the resulting predictions, the relevance of those predictions throughout the supply chain, and the value ultimately delivered to breeders and commercial customers. This is best illustrated in the U.S. Angus population registered with the American Angus Association (AAA) and evaluated by Angus Genetics, Inc. (AGI). Angus genetic evaluations by AGI represent the most frequent and powerful beef breed evaluations in the world with more than 100,000 animals with HD 50K genotypes.

Economically relevant traits in cattle are controlled by many genes (i.e., polygenic). Thus, use of genomic data derived from many genetic markers is required to enable accurate, comprehensive estimation of genetic merit, which is especially valuable for breeding decisions regarding young animals. However, genotyping costs are related to the number of genetic markers analyzed. This challenge can now be resolved using

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imputation, a process by which higher density genotypes can be dependably estimated or inferred from lower density genotypes. Research and commercial partnerships between Zoetis and AGI are providing Angus breeders with access to imputation through the introduction of i50K.™

Imputation relies on two basic properties. The first is linkage whereby DNA is inherited not one base (i.e., SNP marker) at a time, but instead in blocks. This means that knowledge of an animal's genotype at a specific location also provides valuable information regarding the likely genotypes in adjacent regions. The second property is the genotyped reference population. The reference population determines the scope of observed genotype combinations that help to identify the most common genomic patterns within a given population. With a sufficiently large reference population, statistical algorithms can be applied to very accurately predict what a given genotype would be based on a strategically selected subset of desired markers.

In practical terms, imputation is a lot like reading a partially completed paragraph. There are specific words or combinations of words that are more commonly observed in a given language. Based on one's familiarity with that language, one can likely determine what those words are and almost certainly the meaning of the paragraph, even if selected letters are deleted throughout the passage. Imputation of genomic data simply fills in the missing letters in a given genotype.

Imputation itself is not new and has been used successfully in other livestock evaluation systems such as the Council on Dairy Cattle Breeding (CDCB) genetic evaluation. The key has been the

development of representative tested reference populations that are sufficiently robust as to allow the accurate imputation of genotypes. Thanks to adoption by American Angus Association members, a large number and diversity of animals with HD 50K genotypes accumulated over recent years have been evaluated by scientists at Zoetis, and it is apparent that current imputation systems perform exceptionally well in this population.

### **DIFFERENCES BETWEEN i50K AND HD 50K**

With the introduction of i50K, Zoetis and AGI will help usher in a new era for obtaining GE-EPD, accuracy values, dollar indexes and included parentage verification for registered Angus cattle. Samples will be evaluated using a custom, low density Illumina® panel designed by scientists at Zoetis Genetics. Genotypes will then be analyzed using the Zoetis imputation platform based on the extensive reference set of HD 50K genotypes from historically tested Angus cattle. Identical to incorporation of HD 50K, the resulting imputed marker information (i50K) will be used to derive Molecular Value Predictions (MVP®) for traits supported in the AGI evaluation. Subsequent correlated trait blending informs estimation of GE-EPD reported weekly by AGI.

An important consideration when evaluating the use of low density genotypes is imputation accuracy. Importantly, this must be assessed in two ways. The first is by evaluating the proportion of 50K markers that are correctly imputed from analysis of the lower density genotypes. This is performed by comparing actual and imputed 50K genotypes from animals tested on both platforms.

Extensive quality control testing of the Angus imputation pipeline at Zoetis Genetics using low density genotypes demonstrates a high degree of concordance (agreement), with more than 98% of 50K markers correctly imputed!

The second component of assessing imputation accuracy is evaluation of the correlation between genomic predictions derived from imputed genotypes and those from actual 50K genotypes. This is important because although there may be slight differences in the imputed genotypes, the critical question involves the impacts of these differences on the MVP for various traits. It is exciting to confidently report that for the current AGI calibration, the correlation between MVP derived from imputed genotypes with those obtained from actual HD 50K genotypes ranged between 0.99 and 1.00 for all traits supported by the AGI evaluation! Effectively this means that there is no difference in estimated genetic merit based on i50K vs. HD 50K genotypes.

### **KEY COMPONENTS UNCHANGED**

Although the genotyping platform associated with i50K represents a change from that employed with HD 50K, very little else has changed in the delivery of GE-EPD. AGI will continue to employ the calibration developed in collaboration with Zoetis utilizing genomic data from almost 50,000 genotyped animals. In addition, the genetic parameters used to weight genomic data within the AGI evaluation are also unchanged due to the high correlation between i50K and HD 50K MVP. As a result, the increase in accuracy associated with use of i50K will be the same as HD 50K across the entire range of evaluated traits.

Another important constant between i50K and HD 50K is the ability to use available marker information to inform parent verification. The custom low density Illumina panel developed by Zoetis contains all standard USDA SNP parentage markers and therefore supports parent verification in exactly the same way as HD 50K. In addition, the markers used for GeneMax® Focus™ and GeneMax® Advantage™ are also directly included in the i50K genotyping platform, meaning sire assignment (the Sire Match feature) remains an exclusive benefit for the progeny of i50K- and HD 50K-tested bulls when using these products.

Finally, HD 50K will remain available commercially and will not be affected by the introduction of i50K, and some may choose to continue to rely on HD 50K for their GE-EPD. Regardless of producer preferences, it will continue to be important to maintain a contemporary database of 50K-tested animals to populate the imputation reference set. To ensure that the value of this resource is preserved, Zoetis and AGI have agreed to select a subset of i50K-tested animals each year for HD 50K genotyping. AGI will select these animals based on the number of progeny produced, and Zoetis will provide HD 50K genotyping at no cost in support of this initiative. AGI will continue to identify HD 50K-tested animals using the PF50 designation, while i50K will be used for animals tested using this new platform.

***Effectively this means that there is no difference in estimated genetic merit based on i50K vs. HD 50K genotypes***

## USE OF i50K

Angus breeders will use i50K™ and associated GE-EPD, accuracy values and indexes to inform the same selection, mating, management and marketing decisions for which they have come to rely on with HD 50K. It is anticipated that by being able to access that same information and accuracy with a more cost-effective genotyping platform, breeders will be able to expand their use of the technology, including greater testing of females. Testing females delivers an enticing direct value proposition to breeders, as it provides more information than would typically be available in a cow's lifetime and helps to better inform every mating decision, as well as allow earlier enrollment of elite females in embryo transfer (ET) donor programs.

It is also expected that a greater number of young Angus sire prospects will be genotyped with the availability of i50K. This is particularly beneficial for commercial producers purchasing registered Angus bulls, and especially

for those looking to apply GeneMax® Advantage™ and/or GeneMax Focus™ as part of their replacement heifer and feeder/fed cattle marketing strategies. Sire Match with i50K for GeneMax-tested progeny provides valuable insight into selection and mating decisions. Expanded access to tested sires enhances the value of these genomic tools in commercial herds leveraging Angus genetics.

## CONCLUSIONS

Genomic technologies in beef cattle continue to evolve, providing more information to Angus breeders and their commercial customers. The introduction of i50K represents another step in that evolution and a significant leap forward in enhancing the value proposition associated with use of genomic data and GE-EPD to make informed breeding, management and marketing decisions in Angus cattle. The demonstrated imputation accuracy coupled with the accuracy of the genomic calibration used in the AGI genetic evaluations has produced an extremely powerful tool for Angus breeders.

***With a more cost-effective genotyping platform, breeders will be able to expand their use of the technology, including greater testing of males and females***

***i50K represents a significant leap forward in using genomic data and GE-EPD to make informed breeding, management and marketing decisions***