MACE For Conformation Traits

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Introduction

Multiple across country evaluations (MACE) for production traits are now routinely computed and used in many countries. However, for conformation traits most countries resort to conversion formulas. Advantages associated with MACE include:

- 1. Utilization of all information among countries to generate international breeding values.
- 2. Utilization of a bull's pedigree information as well as his own information.
- 3. Re-ranking of bulls allowing for possible genotype by environment interaction and differences in trait definition.
- 4. Simultaneous analysis of proofs from multiple countries.

This paper describes the implementation of MACE for conformation traits in the USA.

Model

The standard model (Schaeffer and Zhang, 1993) for international genetic evaluations was used to analyze the data. This can be represented by:

 $y = C\mu + ZQg + Zs + e$

where:

- y: vector of de-regressed proofs
- μ : vector of country effects

- g : vector of genetic group effects for phantom parents
- s : vector of random sire effects
- *e* : vector of residual effects for de-regressed proofs
- *C* : incidence matrix associating de-regressed proofs with country effects
- *Z* : incidence matrix associating de-regressed with sire proofs
- Q : incidence matrix assigning sires to phantom groups

Distributions for the random variables are assumed to be:

$$\begin{pmatrix} y \\ s \\ e \end{pmatrix} \sim MVN \begin{cases} C\mu + ZQg \\ 0 \\ 0 \end{cases}, \begin{pmatrix} ZGZ^T + R & GZ^T & R \\ G & 0 \\ symm. & R \end{cases} \end{cases}$$

where:

- *G* : is the genetic (co)-variance matrix among elements of *s*, $G = G_o \otimes A$ where G_o is the genetic (co)-variance matrix among the traits of interest and *A* is the numerator relationship matrix among the unique animals represented in *s*
- R: is a diagonal matrix with diagonals equal to the ratio of the residual variance in a country divided by the number of daughters in that country

The mixed model equations for the equivalent model described by Quaas (1988) are (Sigurdsson and Banos, 1995):

$$\begin{pmatrix} C^{T}R^{-1}C & 0 & C^{T}R^{-1}Z \\ Q^{T}A^{-1}Q \otimes G_{o}^{-1} & -Q^{T}A^{-1} \otimes G_{o}^{-1} \\ symm. & Z^{T}R^{-1}Z + A^{-1} \otimes G_{o}^{-1} \end{pmatrix} \begin{pmatrix} \hat{c} \\ \hat{g} \\ Q\hat{g} + \hat{s} \end{pmatrix} = \begin{pmatrix} C^{T}R^{-1}y \\ 0 \\ Z^{T}R^{-1}y \end{pmatrix}$$

Implementation

Official conformation data was obtained from Canada (CAN), France (FRA), Germany (DEU), Italy (ITA), The Netherlands (NLD), and the United States (USA). Traits considered were the 12 standard and two optional traits recommended by the committee on the world-wide harmonization of linear type classification (Cnossen et al., 1993), as well as four additional traits, Rear Legs Rear View, Feet and Leg Score, Rear Udder Width, and Final Score (Appendix 1). These last four traits are necessary to determine the USA type and production index (TPI, Holstein Association USA, Inc. 1997). Selection of trait combinations for each of the 18 USA traits was based on correlations of proofs for bulls evaluated in both countries. For each USA trait the foreign trait showing highest proof correlation was chosen. (Appendix 1). In addition to the direct computation of the 18 traits, two composites, udder and feet & legs, were computed based on the MACE of the individual traits in the composite (Holstein Association USA, Inc. 1997).

Edits performed on the data were similar to those used for the production traits by INTERBULL. However, records based on less than 10 daughters, records on bulls not on an official AI testing scheme, or second country proofs based on less than 75 daughters in less than 50 herds were all included as long as the proof was reported in the official type performance file from each country. Records on bulls born before 1980 were eliminated to reduce time period effects (Weigel, 1996).

Phantom parent groups were assigned based on unknown ancestor (sire, maternal grandsire, maternal granddam), year of birth, and country of origin. Birth years were divided into three year intervals.

De-regressed proofs were computed using the deregression procedure described by Rozzi and Schaeffer (1996). Subsequently (co)-variance matrices G_o were estimated from the de-regressed data using the EM-REML algorithm presented by Klei and Weigel (1998) using information on all bulls in all countries. MACE solutions were computed through an LU decomposition (Golub and Van Loan, 1987) of the mixed model equations using sparse matrix techniques (FSPAK, Perez-Enciso et al., 1994). Reliabilities of the MACE proofs were obtained by inverting the mixed model equations using FSPAK to obtain the appropriate diagonal elements. Official reliabilities are based on the reliability for PTAT.

Results and Discussion

Appendix I shows the proof correlations for each of the 18 trait combinations. From these tables it can be observed that most of the udder traits measured show high correlations among the countries reflecting great uniformity in observing these traits.

Body traits, except Stature, show high correlations among some of the countries while other countries are moderate to lowly correlation. In this category France has no trait that adequately correlates with Dairy Form (Angularity) and subsequently bulls with only observations in France will have an evaluation based on the US pedigree index for this trait when reported on the USA base.

For feet and legs correlations are, again, high for some for some of the countries while low among others. The only exception among these traits is Rear Leg Side View, one of the standard traits. In this group of traits no corresponding traits could be found for Rear Leg Rear View and Feet and Leg Score in both Germany and France resulting in pedigree indices for bulls with only observations in those countries.

In the USA, Final Score is evaluated as a separate trait. To be consistent with the national evaluation it was decided that this should also be the case with Final Score evaluated in MACE. Correlations for USA Final Score with the overall type traits in the other countries were all higher then .75 and deemed adequate. In situations where countries compute an overall type trait as a composite of linear evaluations this method could be applied.

France only supplied second country proofs on USA bulls. This resulted in a limited number of ties with other countries. Additional data on second country proofs from France for bulls from these countries could boost the proof correlations

Figure 1 through Figure 3 show converted proofs and MACE proofs on ten bulls from three of the countries for Udder Composite. One of the

reasons to use a MACE model is that it is a refinement of the method of using conversion formulas. This is well illustrated in Figure 1. From this figure it can be observed that none of these ten bulls change rank, however bulls C and D, which were equal under the conversion method, show differences when using MACE to determine evaluations on foreign bulls.



Figure 1. Comparison of converted and MACE proofs for udder composite for 10 bulls from country I.

Figure 2 shows that animals can re-re-rank when using MACE. If selection for udder composite was based on a culling level of +1.00, converted proofs would have recommended the use of bull A through G. MACE, however, would have recommended the use of A through D, G and H. Even though individual differences for these two evaluation methods are not large, selection decisions will be influenced. A similar situation can be observed for country III (Figure 3). Ranking of the top five bulls based on converted proofs would be A, B, C, D, E while using conversion methods, while the ranking when using MACE is B, A, D, C, E.



Figure 2. Comparison of converted and MACE proofs for udder composite for 10 bulls from country II.



Figure 3. Comparison of converted and MACE proofs for udder composite for 10 bulls from country III.

Conclusions

MACE can be used to compute evaluations for conformation traits. MACE provides a refinement in determining genetic potential of foreign bulls through a refinement of the statistical model used to describe the data. As opposed to conversion methods, MACE allows for the re-ranking of bulls resulting in a modification of selection decisions both when using independent culling levels and when usage of sires is dependent on the proof of the bull.

Acknowledgments

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Appendix I **MACE Correlations For Conformation Traits**

August 1997 Heritabilities on diagonal

trait	country	USA	CAN	NLD	DEU	ITA	FRA	proof
								variance
Stature	USA	.42	.98	.92	.91	.97	.92	1.35
Stature	CAN	-	.40	.93	.92	.96	.92	28.14
Stature	NLD			.60	.95	.92	.95	22.07
Stature	DEU				.43	.92	.92	131.00
Stature	ITA					.38	92	1 89
Sacrum Height	FRA						.02 47	1.00
Sucrummergin	110/1							1.7 1
tuait	o o u notive i		CAN	NID	DEU		ED A	nnoof
trait	country	USA	CAN	NLD	DEU	IIA	FКА	proor
								variance
Strength	USA	.31	.91	.80	.78	.95	.78	1.29
Chest Width	CAN		.21	.67	.66	.89	.79	32.02
Chest Width	NLD			.30	.87	.75	.55	17.07
Chest Width	DEU				.21	.76	.56	237.11
Strength	ITA					.31	.81	1.80
Chest Width	FRA						.36	1 26
Chest Width	110/1						.00	1.20
troit	country		CAN	NID	DEU	IT A	ED A	proof
trait	country	USA	CAN	INLD	DEU	IIA	гкА	proor
								variance
Body Depth	USA	.37	.89	.76	.71	.95	.81	1.12
Capacity	CAN		.32	.49	.44	.83	.80	29.02
Body Depth	NLD			.35	.86	.81	.57	18.10
Body Depth	DEU				.31	.76	.60	201.67
Body Depth	ITA					.31	.79	1.73
Chest Width	FRA						36	1 26
onest width	110/1						.00	1.20
trait	country	LISA	CAN	NLD	DELI	ITΛ	FDΛ	proof
trait	country	USA	CAN	INLD	DEU	пл	IIIA	proor
								Varianca
								variance
Dairy Form	USA	.29	.92	.70	.86	.93		1.76
Dairv Form Dairy Character	USA CAN	.29	.92 .23	.70 .69	.86 .83	.93 .87		1.76 29.64
Dairv Form Dairy Character Type Milk	USA CAN NLD	.29	.92 .23	.70 .69 .30	.86 .83 .75	.93 .87 .69		1.76 29.64 18.88
Dairv Form Dairy Character Type Milk Angularity	USA CAN NLD DEU	.29	.92 .23	.70 .69 .30	.86 .83 .75 .32	.93 .87 .69 .83		1.76 29.64 18.88 152.31
Dairy Form Dairy Character Type Milk Angularity Angularity	USA CAN NLD DEU ITA	.29	.92 .23	.70 .69 .30	.86 .83 .75 .32	.93 .87 .69 .83 . 30		1.76 29.64 18.88 152.31 1.51
Dairy Form Dairy Character Type Milk Angularity Angularity	USA CAN NLD DEU ITA FRA	.29	.92 .23	.70 .69 .30	.86 .83 .75 .32	.93 .87 .69 .83 .30		1.76 29.64 18.88 152.31 1.51
Dairy Form Dairy Character Type Milk Angularity Angularity Missin	USA CAN NLD DEU ITA FRA	.29	.92 .23	.70 .69 .30	.86 .83 .75 .32	.93 .87 .69 .83 .30	d be det	1.76 29.64 18.88 152.31 1.51 ermined.
Dairy Form Dairy Character Type Milk Angularity Angularity Missin	USA CAN NLD DEU ITA FRA ng values in	.29	.92 .23	.70 .69 . 30 orrespon	.86 .83 .75 .32 nding tra	.93 .87 .69 .83 .30 ait could	d be det	1.76 29.64 18.88 152.31 1.51 ermined.
Dairy Form Dairy Character Type Milk Angularity Angularity Missin	USA CAN NLD DEU ITA FRA ng values in	.29 ndicate	.92 .23	.70 .69 .30 orrespoi	.86 .83 .75 . 32 nding tra	.93 .87 .69 .83 .30 ait could	d be det	1.76 29.64 18.88 152.31 1.51 ermined.
Dairv Form Dairy Character Type Milk Angularity Angularity Missin trait	USA CAN NLD DEU ITA FRA ng values in country	.29 ndicate	.92 .23 that no c CAN	.70 .69 .30 orrespoi	.86 .83 .75 . 32 nding tra	.93 .87 .69 .83 . 30 ait could	d be dete FRA	1.76 29.64 18.88 152.31 1.51 ermined.
Dairy Form Dairy Character Type Milk Angularity Angularity Missin trait	USA CAN NLD DEU ITA FRA ng values in country	.29 ndicate USA	.92 .23 that no c CAN	.70 .69 .30 orrespor	.86 .83 .75 . 32 nding tra DEU	.93 .87 .69 .83 . 30 ait could	d be det FRA	1.76 29.64 18.88 152.31 1.51 ermined. proof variance
Dairy Form Dairy Character Type Milk Angularity Angularity Missin trait Rump Angle	USA CAN NLD DEU ITA FRA ng values in country USA	.29 ndicate USA .33	.92 .23 that no c CAN .97	.70 .69 .30 orrespor NLD .96	.86 .83 .75 . 32 nding tra DEU .96	.93 .87 .69 .83 .30 ait could ITA	d be deto FRA .94	1.76 29.64 18.88 152.31 1.51 ermined. proof variance 1.85
Dairv Form Dairy Character Type Milk Angularity Angularity Missin trait Rump Angle Pin Setting	USA CAN NLD DEU ITA FRA ng values in country USA CAN	.29 ndicate USA .33	.92 .23 that no c CAN .97 .30	.70 .69 .30 orrespor NLD .96 .96	.86 .83 .75 . 32 nding tra DEU .96 .95	.93 .87 .69 .83 .30 ait could ITA .96 .95	d be deto FRA .94 .93	1.76 29.64 18.88 152.31 1.51 ermined. proof variance 1.85 32.82
Dairv Form Dairy Character Type Milk Angularity Angularity Missin trait Rump Angle Pin Setting Rump Angle	USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD	.29 ndicate USA .33	.92 .23 that no c CAN .97 .30	.70 .69 .30 orrespor NLD .96 .96 .35	.86 .83 .75 .32 nding tra DEU .96 .95 .95	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95	d be deto FRA .94 .93 .95	1.76 29.64 18.88 152.31 1.51 ermined. proof variance 1.85 32.82 22.06
Dairv Form Dairy Character Type Milk Angularity Angularity Missin trait Rump Angle Pin Setting Rump Angle Rump Angle	USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU	.29 ndicate USA .33	.92 .23 that no c CAN .97 .30	.70 .69 .30 orrespon NLD .96 .96 .35	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .95 .13	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .94	d be deto FRA .94 .93 .95 .93	1.76 29.64 18.88 152.31 1.51 ermined. proof variance 1.85 32.82 22.06 270.79
Dairv Form Dairy Character Type Milk Angularity Angularity Missin trait Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle	USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA	.29 ndicate USA .33	.92 .23 that no c CAN .97 .30	.70 .69 .30 orrespor NLD .96 .96 .35	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .94 .25	d be deto FRA .94 .93 .95 .93 .93	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68
Dairv Form Dairy Character Type Milk Angularity Angularity Missin trait Rump Angle Pin Setting Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle	USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA FRA	.29 ndicate USA .33	.92 .23 that no c CAN .97 .30	.70 .69 .30 orrespon NLD .96 .96 .35	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .94 .25	d be dete FRA .94 .93 .95 .93 .93 .34	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88
Dairv Form Dairy Character Type Milk Angularity Angularity Missin trait Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle	USA CAN NLD DEU ITA FRA mg values in country USA CAN NLD DEU ITA FRA	.29 ndicate f USA .33	.92 .23 that no c CAN .97 .30	.70 .69 .30 orrespon NLD .96 .96 .35	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13	.93 .87 .69 .83 . 30 ait could ITA .96 .95 .95 .95 .94 .25	d be dete FRA .94 .93 .95 .93 .93 .93 .34	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88
Dairy Form Dairy Character Type Milk Angularity Missin trait Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle	USA CAN NLD DEU ITA FRA mg values in country USA CAN NLD DEU ITA FRA	.29 Indicate 1 USA .33	.92 .23 that no c CAN .97 .30	.70 .69 .30 orrespoi NLD .96 .96 .35	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .94 .25	d be dete FRA .94 .93 .95 .93 .93 .34 FRA	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88
Dairy Form Dairy Character Type Milk Angularity Missin trait Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle	USA CAN NLD DEU ITA FRA mg values in country USA CAN NLD DEU ITA FRA country	.29 Indicate of USA .33 USA	.92 .23 that no c CAN .97 .30 CAN	.70 .69 .30 orrespon NLD .96 .96 .35	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13 DEU	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .94 .25 ITA	d be deta FRA .94 .93 .95 .93 .93 .34 FRA	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88
Dairy Form Dairy Character Type Milk Angularity Missin trait Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle	USA CAN NLD DEU ITA FRA mg values in country USA CAN NLD DEU ITA FRA Country	.29 Indicate 1 USA .33 USA	.92 .23 that no c CAN .97 .30 CAN	.70 .69 .30 orrespoi NLD .96 .96 .35 NLD	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13 DEU	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .94 .25 ITA	d be deta FRA .94 .93 .95 .93 .93 .34 FRA	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88 1.20
Dairy Form Dairy Character Type Milk Angularity Missin trait Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle	USA CAN NLD DEU ITA FRA mg values in country USA CAN NLD DEU ITA FRA country USA	.29 Indicate 1 USA .33 USA .26	.92 .23 that no c CAN .97 .30 CAN	.70 .69 .30 orrespoi NLD .96 .96 .35 NLD .81 .83	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13 DEU .82 .70	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .94 .25 ITA ITA	d be deta FRA .94 .93 .95 .93 .93 .34 FRA	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88 1.39 27.02
Dairy Form Dairy Character Type Milk Angularity Missin trait Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle trait Rump Width	USA CAN NLD DEU ITA FRA mg values in country USA CAN NLD DEU ITA FRA country USA CAN	.29 Indicate 1 USA .33 USA .26	.92 .23 that no c CAN .97 .30 CAN .86 .24	.70 .69 .30 orrespoi NLD .96 .96 .35 NLD .81 .83	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13 DEU .82 .79	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .95 .94 .25 ITA ITA	d be deta FRA .94 .93 .95 .93 .93 .34 FRA .67 .66	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88 1.39 27.28 20.41
Dairy Form Dairy Character Type Milk Angularity Missin trait Rump Angle Pin Setting Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle trait Rump Width Pin Width Rump Width	USA CAN NLD DEU ITA FRA mg values in country USA CAN NLD DEU ITA FRA country USA CAN NLD	.29 Indicate 1 USA .33 USA .26	.92 .23 that no c CAN .97 .30 CAN .86 .24	.70 .69 .30 orrespon NLD .96 .96 .35 .35 .81 .83 .30	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13 DEU .82 .79 .88	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .95 .94 .25 ITA ITA .88 .87 .91	d be deta FRA .94 .93 .95 .93 .93 .34 FRA .67 .66 .57	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88 1.39 27.28 22.94
Dairy Form Dairy Character Type Milk Angularity Angularity Missin trait Rump Angle Pin Setting Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Midth Pin Width Rump Width	USA CAN NLD DEU ITA FRA mg values in country USA CAN NLD DEU ITA FRA country USA CAN NLD DEU	.29 Indicate 1 USA .33 USA .26	.92 .23 that no c CAN .97 .30 CAN .86 .24	.70 .69 .30 orrespon NLD .96 .96 .35 NLD .81 .83 .30	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13 DEU .82 .79 .88 .24	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .94 .25 ITA ITA .88 .87 .91 .84	d be deta FRA .94 .93 .95 .93 .93 .34 FRA .67 .66 .57 .56	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88 1.39 27.28 22.94 193.66
Dairy Form Dairy Character Type Milk Angularity Angularity Missin trait Rump Angle Pin Setting Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Angle Rump Midth Pin Width Rump Width Rump Width Thurl Width	USA CAN NLD DEU ITA FRA mg values in country USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA	.29 Indicate 1 USA .33 USA .26	.92 .23 that no c CAN .97 .30 CAN .86 .24	.70 .69 .30 orrespon NLD .96 .96 .35 NLD .81 .83 .30	.86 .83 .75 .32 nding tra DEU .96 .95 .95 .13 DEU .82 .79 .88 .24	.93 .87 .69 .83 .30 ait could ITA .96 .95 .95 .94 .25 ITA ITA .88 .87 .91 .84 .29	d be dete FRA .94 .93 .95 .93 .93 .34 FRA .67 .66 .57 .56 .66	1.76 29.64 18.88 152.31 1.51 ermined. 1.85 32.82 22.06 270.79 2.68 .88 1.39 27.28 22.94 193.66 1.67

MACE Correlations For Conformation Traits Continued

		TICA	C +) 		DEU	TOTA A		0
trait	country	USA	CAN	NLD	DEU	ΓΓΑ	FRA	proof
								variance
Rear Leg Side View	USA	.21	.96	.87	.90	.93	.84	2.50
Rear Leg Set	CAN	-	.16	.88	.90	.92	.84	40.34
Rear Leg Set	NLD			.35	90	89	88	23 23
Rear Leg Set	DEL				13	.00	.00 87	265 38
Leg Set					.15	.32 10	.07	203.30
Legs Side						.10	.87	3.03
Rear Leg Set	FRA						.07	1.58
trait	country	USA	CAN	NLD	DEU	ITA	FRA	proof
	J							variance
Deers Leer Deers Wiener	TICA	11	50	07		00		0 5 4
Rear Leg Rear View	USA	.11	.59	.07		.08		3.54
Foot Angle	CAN		.07	.57		.76		38.13
Feet and Legs	NLD			.30		.42		14.31
	DEU							
Foot Angle	ITA					.18		2.66
	FRA							
Missi	ng values i	ndicate	hat no c	orrespoi	nding tra	ait coul	d be det	ermined.
111001		larouto		orrespo		are cour	a be det	ci i i i i i i i i i i i i i i i i i i
		LICA	CAN	NUD	DEU			C
trait	country	USA	CAN	NLD	DEU	IIA	FRA	proof
								variance
Foot Angle	USA	.15	.90	.67	.59	.91	.79	2.24
Foot Angle	CAN		07	76	63	79	79	38 25
Claw Diagonal	NID			20	.00	51	62	20.37
				.20	12	61	.02	251 19
					.15	.04	.07	204.40
Foot Angle						.18	.70	2.64
Heel Depth	FRA						.10	1.35
trait	country	USA	CAN	NLD	DEU	ITA	FRA	proof
trait	country	USA	CAN	NLD	DEU	ITA	FRA	proof
trait	country	USA	CAN	NLD	DEU	ITA	FRA	proof variance
trait Feet and Leg Score	country USA	USA .17	CAN .84	NLD .70	DEU	ITA .71	FRA	proof variance 2.71
trait Feet and Leg Score Foot Angle	country USA CAN	USA .17	CAN .84 .07	NLD .70 .58	DEU	ITA .71 .77	FRA	proof variance 2.71 38.98
trait Feet and Leg Score Foot Angle Feet and Legs	country USA CAN NLD	USA .17	CAN .84 .07	.70 .58 . 30	DEU	ITA .71 .77 .44	FRA	proof variance 2.71 38.98 14.38
trait Feet and Leg Score Foot Angle Feet and Legs	country USA CAN NLD DEU	USA .17	.84 .07	NLD .70 .58 . 30	DEU	.71 .77 .44	FRA	proof variance 2.71 38.98 14.38
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle	country USA CAN NLD DEU ITA	USA .17	.84 .07	NLD .70 .58 .30	DEU	.71 .77 .44 .18	FRA	proof variance 2.71 38.98 14.38 2.66
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle	country USA CAN NLD DEU ITA FRA	USA .17	.84 .07	NLD .70 .58 .30	DEU	ITA .71 .77 .44 .18	FRA	proof variance 2.71 38.98 14.38 2.66
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin	country USA CAN NLD DEU ITA FRA	USA .17	CAN .84 .07	NLD .70 .58 .30	DEU DEU	ITA .71 .77 .44 .18	FRA d be det	proof variance 2.71 38.98 14.38 2.66 ermined.
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin	country USA CAN NLD DEU ITA FRA ng values it	USA .17 ndicate	CAN .84 .07	NLD .70 .58 .30	DEU nding tra	ITA .71 .77 .44 .18 ait could	FRA d be dete	proof variance 2.71 38.98 14.38 2.66 ermined.
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin	country USA CAN NLD DEU ITA FRA ng values in	USA .17 ndicate	CAN .84 .07	NLD .70 .58 .30	DEU nding tra	ITA .71 .77 .44 .18 ait could	FRA d be dete	proof variance 2.71 38.98 14.38 2.66 ermined.
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait	country USA CAN NLD DEU ITA FRA ng values in country	USA .17 ndicate	CAN .84 .07 .hat no c CAN	NLD .70 .58 .30 orrespoi	DEU nding tra DEU	ITA .71 .77 .44 .18 ait coule	FRA d be deto FRA	proof variance 2.71 38.98 14.38 2.66 ermined. proof
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait	country USA CAN NLD DEU ITA FRA ng values in country	USA .17 ndicate	CAN .84 .07 .hat no c CAN	NLD .70 .58 .30 orrespor	DEU nding tra DEU	ITA .71 .77 .44 .18 ait could	FRA d be deto FRA	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder	country USA CAN NLD DEU ITA FRA ng values in country USA	USA .17 ndicate USA .29	CAN .84 .07 .hat no c CAN .93	NLD .70 .58 .30 orrespor NLD .85	DEU nding tra DEU .83	ITA .71 .77 .44 .18 ait could ITA .92	FRA d be deto FRA .83	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Attachment	country USA CAN NLD DEU ITA FRA ng values in country USA CAN	USA .17 ndicate USA .29	CAN .84 .07 .hat no c CAN .93 .14	NLD .70 .58 .30 orrespon NLD .85 .83	DEU nding tra DEU .83 .83	ITA .71 .77 .44 .18 ait could ITA .92 .90	FRA d be deto FRA .83 .79	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Attachment Fore Udder	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NI D	USA .17 ndicate USA .29	CAN .84 .07 .hat no c CAN .93 .14	NLD .70 .58 .30 orrespon NLD .85 .83 35	DEU nding tra DEU .83 .83 91	ITA .71 .77 .44 .18 ait could ITA .92 .90 75	FRA d be deta FRA .83 .79 71	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Odder Fore Udder Fore Udder	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU	USA .17 ndicate USA .29	CAN .84 .07 .07 .07 .07 .07 .07 .07 .07 .07 .07	NLD .70 .58 .30 orrespon NLD .85 .83 .35	DEU nding tra DEU .83 .83 .91 20	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 81	FRA d be deta FRA .83 .79 .71 76	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 24.72
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Udder Fore Udder	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU UTA	USA .17 ndicate USA .29	CAN .84 .07 .07 .07 .07 .07 .03 .14	NLD .70 .58 .30 orrespon NLD .85 .83 .35	DEU nding tra DEU .83 .91 .20	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15	FRA d be deta FRA .83 .79 .71 .76 .95	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 24.72 24.73 242.73
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA	USA .17 ndicate USA .29	CAN .84 .07 .07 .07 .07 .07 .03 .14	NLD .70 .58 .30 orrespon NLD .85 .83 .35	DEU nding tra DEU .83 .91 .20	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15	FRA d be deta FRA .83 .79 .71 .76 .85	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA FRA	USA .17 ndicate USA .29	CAN .84 .07 .hat no c CAN .93 .14	NLD .70 .58 .30 orrespon NLD .85 .83 .35	DEU nding tra DEU .83 .91 .20	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15	FRA d be deta FRA .83 .79 .71 .76 .85 .35	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Attachment Udder Depth	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA FRA	USA .17 ndicate USA .29	CAN .84 .07 .hat no c CAN .93 .14	NLD .70 .58 .30 orrespon NLD .85 .83 .35	DEU nding tra DEU .83 .91 .20	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15	FRA d be deta FRA .83 .79 .71 .76 .85 .35	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Attachment Udder Depth trait	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA FRA	USA .17 ndicate USA .29 USA	CAN .84 .07 .07 .07 .07 .03 .14 .03 .14	NLD .70 .58 .30 orrespon NLD .85 .83 .35 .83 .35	DEU nding tra DEU .83 .91 .20 DEU	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15 ITA	FRA d be deta FRA .83 .79 .71 .76 .85 .35 FRA	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Attachment Udder Depth trait	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA FRA COUNTRY	USA .17 ndicate USA .29 USA	CAN .84 .07 .07 .07 .07 .07 .03 .14 .03 .14	NLD .70 .58 .30 orrespon NLD .85 .83 .35 .83 .35	DEU nding tra DEU .83 .91 .20 DEU	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15 ITA	FRA d be deta FRA .83 .79 .71 .76 .85 .35 FRA	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77 proof variance
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Attachment Udder Depth trait	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA FRA country	USA .17 ndicate USA .29 USA	CAN .84 .07 .07 .07 .07 .07 .03 .14 .03 .14	NLD .70 .58 .30 orrespon NLD .85 .83 .35 .83 .35	DEU nding tra DEU .83 .91 .20 DEU	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15 ITA	FRA d be deta FRA .83 .79 .71 .76 .85 .35 FRA	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77 proof variance
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Attachment Udder Depth trait	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA FRA country USA	USA .17 ndicate USA .29 USA .28	CAN .84 .07 .07 .07 .07 .07 .07 .07 .07 .07 .07	NLD .70 .58 .30 orrespon NLD .85 .83 .35 .83 .35	DEU nding tra DEU .83 .91 .20 DEU .83	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15 ITA .86 .22	FRA d be deta FRA .83 .79 .71 .76 .85 .35 FRA .80 .70	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77 proof variance 1.83
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Attachment Udder Depth trait	country USA CAN NLD DEU ITA FRA og values in country USA CAN NLD DEU ITA FRA country USA CAN	USA .17 ndicate USA .29 USA .28	CAN .84 .07 .hat no c CAN .93 .14 CAN .92 .19	NLD .70 .58 .30 orrespoi NLD .85 .83 .35 .83 .35	DEU nding tra DEU .83 .91 .20 DEU .83 .83 .83 .83	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15 ITA ITA .86 .82	FRA d be deta FRA .83 .79 .71 .76 .85 .35 FRA FRA .80 .76	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77 proof variance 1.83 3.0.41
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Attachment Udder Depth trait	country USA CAN NLD DEU ITA FRA og values in country USA CAN NLD DEU ITA FRA country USA CAN NLD	USA .17 ndicate USA .29 USA .28	CAN .84 .07 .hat no c CAN .93 .14 CAN .92 .19	NLD .70 .58 .30 orrespoi NLD .85 .83 .35 .83 .35 .83 .35	DEU nding tra DEU .83 .83 .91 .20 DEU .83 .83 .83 .83 .83 .83 .83 .83	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15 ITA ITA .86 .82 .86	FRA d be deta FRA .83 .79 .71 .76 .85 .35 FRA FRA .80 .76 .74	proof variance 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77 proof variance 1.83 30.41 22.26
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Udder Fore Attachment Udder Depth trait	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA	USA .17 ndicate USA .29 USA .28	CAN .84 .07 .hat no c CAN .93 .14 CAN .92 .19	NLD .70 .58 .30 orrespon NLD .85 .83 .35 .83 .35 .83 .35	DEU nding tra DEU .83 .83 .91 .20 DEU .83 .83 .83 .83 .83 .83 .83 .83	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15 ITA ITA .86 .82 .86 .82	FRA d be deta FRA .83 .79 .71 .76 .85 .35 FRA FRA .80 .76 .74 .72	proof 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77 proof variance 1.83 30.41 22.26 210.56
trait Feet and Leg Score Foot Angle Feet and Legs Foot Angle Missin trait Fore Attachment Fore Udder Fore Udder Fore Udder Fore Udder Fore Attachment Udder Depth trait	country USA CAN NLD DEU ITA FRA ng values in country USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA	USA .17 ndicate USA .29 USA .28	CAN .84 .07 .hat no c CAN .93 .14 CAN .92 .19	NLD .70 .58 .30 orrespon NLD .85 .83 .35 .83 .35 .83 .35	DEU nding tra DEU .83 .83 .91 .20 DEU .83 .83 .83 .83 .83 .83 .83 .83	ITA .71 .77 .44 .18 ait could ITA .92 .90 .75 .81 .15 ITA ITA .86 .82 .86 .82 .20	FRA d be deta FRA .83 .79 .71 .76 .85 .35 FRA FRA .80 .76 .74 .72 .71	proof 2.71 38.98 14.38 2.66 ermined. proof variance 1.71 41.01 24.72 247.73 3.30 .77 proof variance 1.83 30.41 22.26 210.56 2.57

MACE Correlations For Conformation Traits Continued

troit								
liall	country	USA	CAN	NLD	DEU	ſΓΑ	FRA	proof
								variance
Rear Udder Width	USA	.23	.90	.74	.74	.82	.66	1.86
Rear Attachment	CAN		.15	64	63	78	57	35 36
Rear Udder Height	NID		.10	35	86	59	77	22 49
Door Uddor Hoight	DEU			.00	.00 10	.00	71	210.06
					.10	.00	./1	210.90
Rear Udder Width	IIA					.23	.41	1.87
Rear Udder Height	FRA						.20	1.12
trait	country	USA	CAN	NLD	DEU	ITA	FRA	proof
	j							variance
	T LO A		0.0	0.4	70	0.0	0.0	Variance
Udder Cleft	USA	.24	.90	.91	.76	.90	.90	1.93
Median Suspensory	CAN		.15	.88	.75	.86	.87	31.66
Udder Cleft	NLD			.25	.85	.89	.91	19.06
Central Ligament	DEU				.20	.82	.80	205.86
Ligament	ITA					.15	.91	3.50
Udder Cleft	FRA						.26	.86
troit	country		CAN	NLD	DEIT	IT A	ED A	proof
liall	country	USA	CAN	NLD	DEU	IIA	гкА	proor
								variance
Udder Depth	USA	.28	.91	.97	.93	.97	.96	2.34
Udder Depth	CAN		.27	.89	.82	.91	.90	35.62
Udder Depth	NLD			.45	.94	.95	.96	22.16
Udder Depth	DEU				31	92	92	195 41
Udder Depth					.01	.02 99	.0 <i>2</i> 95	2 2 3
Udden Depth						.20	.33 25	2.23
Odder Depui	гля						.33	.//
	[
trait	country	USA	CAN	NLD	DEU	ITA	FRA	proof
	5							.
	5							variance
Front Test Placement		26	9/	89	90	91	80	variance
Front Teat Placement	USA	.26	.94 24	.89	.90	.91	.89	variance 1.97 33.9
Front Teat Placement Fore Teat Placement	USA CAN	.26	.94 .24	.89 .94	.90 .92	.91 .86	.89 .94	variance 1.97 33.9
Front Teat Placement Fore Teat Placement Teat Placement	USA CAN NLD	.26	.94 .24	.89 .94 .45	.90 .92 .93	.91 .86 .81	.89 .94 .95	variance 1.97 33.9 20.09
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement	USA CAN NLD DEU	.26	.94 .24	.89 .94 .45	.90 .92 .93 .27	.91 .86 .81 .82	.89 .94 .95 .91	variance 1.97 33.9 20.09 199.84
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position	USA CAN NLD DEU ITA	.26	.94 .24	.89 .94 .45	.90 .92 .93 .27	.91 .86 .81 .82 .22	.89 .94 .95 .91 .81	variance 1.97 33.9 20.09 199.84 2.27
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front	USA CAN NLD DEU ITA FRA	.26	.94 .24	.89 .94 .45	.90 .92 .93 .27	.91 .86 .81 .82 .22	.89 .94 .95 .91 .81 .30	variance 1.97 33.9 20.09 199.84 2.27 1.14
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front	USA CAN NLD DEU ITA FRA	.26	.94 .24	.89 .94 .45	.90 .92 .93 .27	.91 .86 .81 .82 .22	.89 .94 .95 .91 .81 .30	variance 1.97 33.9 20.09 199.84 2.27 1.14
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait	USA CAN NLD DEU ITA FRA	.26 USA	.94 .24	.89 .94 .45	.90 .92 .93 .27	.91 .86 .81 .82 .22	.89 .94 .95 .91 .81 .30 FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait	USA CAN NLD DEU ITA FRA country	.26 USA	.94 .24 CAN	.89 .94 .45 NLD	.90 .92 .93 .27 DEU	.91 .86 .81 .82 .22	.89 .94 .95 .91 .81 .30 FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait	USA CAN NLD DEU ITA FRA country	.26 USA	.94 .24 CAN	.89 .94 .45 NLD	.90 .92 .93 .27 DEU	.91 .86 .81 .82 .22 ITA	.89 .94 .95 .91 .81 .30 FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait	USA CAN NLD DEU ITA FRA country	.26 USA .26	.94 .24 CAN	.89 .94 .45 NLD	.90 .92 .93 .27 DEU	.91 .86 .81 .82 .22	.89 .94 .95 .91 .81 .30 FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Fore Teat Length	USA CAN NLD DEU ITA FRA country USA CAN	.26 USA .26	.94 .24 CAN .91 .28	.89 .94 .45 NLD	.90 .92 .93 .27 DEU .95 .91	.91 .86 .81 .82 .22 ITA .95 .87	.89 .94 .95 .91 .81 .30 FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Fore Teat Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD	.26 USA .26	.94 .24 CAN .91 .28	.89 .94 .45 .96 .93 .45	.90 .92 .93 .27 DEU .95 .91 .94	.91 .86 .81 .82 .22 ITA .95 .87 .92	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Fore Teat Length Teat Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU	.26 USA .26	.94 .24 CAN .91 .28	.89 .94 .45 .96 .93 .45	.90 .92 .93 .27 DEU .95 .91 .94 .24	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .94	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Fore Teat Length Teat Length Teat Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA	.26 USA .26	.94 .24 CAN .91 .28	.89 .94 .45 .96 .93 .45	.90 .92 .93 .27 DEU .95 .91 .94 .24	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92 .22	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .94 .93	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Fore Teat Length Teat Length Teat Length Teats Length Teats Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA	.26 USA .26	.94 .24 CAN .91 .28	.89 .94 .45 .96 .93 .45	.90 .92 .93 .27 DEU .95 .91 .94 .24	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92 .22	.89 .94 .95 .91 .81 .30 FRA FRA .96 .92 .96 .92 .96 .94 .93 .30	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Fore Teat Length Teat Length Teats Length Teats Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA	.26 USA .26	.94 .24 CAN .91 .28	.89 .94 .45 .96 .93 .45	.90 .92 .93 .27 DEU .95 .91 .94 .24	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92 .22	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Fore Teat Length Teat Length Teat Length Teats Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA	.26 USA .26	.94 .24 CAN .91 .28	.89 .94 .45 .96 .93 .45	.90 .92 .93 .27 DEU .95 .91 .94 .24	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92 .92 .22	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Teat Length Teat Length Teat Length Teats Length Teat Length Teat Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA Country	.26 USA .26 USA	.94 .24 CAN .91 .28 CAN	.89 .94 .45 .96 .93 .45 .NLD	.90 .92 .93 .27 DEU .95 .91 .94 .24 DEU	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92 .92 .22	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30 FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11 proof
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA country	.26 USA .26 USA	.94 .24 CAN .91 .28 CAN	.89 .94 .45 .96 .93 .45 .NLD	.90 .92 .93 .27 DEU .95 .91 .94 .24 DEU	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92 .92 .22	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30 FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11 proof variance
Front Teat Placement Fore Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA country USA	.26 USA .26 USA	.94 .24 CAN .91 .28 CAN	.89 .94 .45 NLD .96 .93 .45 NLD .78	.90 .92 .93 .27 DEU .95 .91 .94 .24 DEU .76	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92 .92 .22	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30 FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11 proof variance .81
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA country USA CAN	.26 USA .26 USA	.94 .24 CAN .91 .28 CAN CAN	.89 .94 .45 .80 .93 .45 .83 .45 .83 .45	.90 .92 .93 .27 DEU .95 .91 .94 .24 DEU DEU	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92 .92 .22 ITA .85 .74	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30 FRA .78 .80	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11 proof variance .81 31.60
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Teat Sength Teat Sength	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA country USA CAN NLD	.26 USA .26 USA .29	.94 .24 CAN .91 .28 CAN CAN	.89 .94 .45 .80 .93 .45 .93 .45 .09 .30	.90 .92 .93 .27 DEU .95 .91 .94 .24 DEU .76 .62 .56	.91 .86 .81 .82 .22 .22 .1TA .95 .87 .92 .92 .92 .22 .1TA .85 .74 .73	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30 FRA FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11 proof variance 81 31.60 19.52
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teats Position Teat Placement Front trait Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Sength Teat Length Teat Length	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA country USA CAN NLD DEU	.26 USA .26 USA .29	.94 .24 CAN .91 .28 CAN CAN	.89 .94 .45 .80 .93 .45 .93 .45 .09 .30	.90 .92 .93 .27 DEU .95 .91 .94 .24 DEU DEU .76 .62 .56 .30	.91 .86 .81 .82 .22 .22 .1TA .95 .87 .92 .92 .92 .22 .1TA .85 .74 .73 .68	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30 FRA FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11 proof variance 81 31.60 19.52 1.34 68
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teat Placement Teat Placement Front trait Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Sength Teat Sength Teat Sength Teat Sength Teat Sength Teat Sength Score Body Type Final Score	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA country USA CAN NLD DEU IT△	.26 USA .26 USA .29	.94 .24 CAN .91 .28 CAN CAN	.89 .94 .45 .80 .93 .45 .93 .45 .93 .45 .09 .30	.90 .92 .93 .27 DEU .95 .91 .94 .24 DEU .76 .62 .56 .30	.91 .86 .81 .82 .22 .1TA .95 .87 .92 .92 .22 .1TA .1TA .85 .74 .73 .68 15	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30 FRA FRA	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11 proof variance 81 31.60 19.52 134.68 60
Front Teat Placement Fore Teat Placement Teat Placement Teat Placement Teat Placement Teat Placement Front trait Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Length Teat Sength Teat Sength Teat Length Teat Sength Teat Sength T	USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA country USA CAN NLD DEU ITA FRA	.26 USA .26 USA .29	.94 .24 CAN .91 .28 CAN CAN	.89 .94 .45 .80 .93 .45 .83 .45 .12 .78 .69 .30	.90 .92 .93 .27 DEU .95 .91 .94 .24 DEU .76 .62 .56 .30	.91 .86 .81 .82 .22 ITA .95 .87 .92 .92 .22 ITA ITA .85 .74 .73 .68 .15	.89 .94 .95 .91 .81 .30 FRA .96 .92 .96 .92 .96 .94 .93 .30 FRA .80 .64 .53 .65 .30	variance 1.97 33.9 20.09 199.84 2.27 1.14 proof variance 2.34 31.85 25.94 215.35 4.32 1.11 proof variance .81 31.60 19.52 134.68 .60 .75