Nutrient Specifications Manual

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Introduction

This publication provides a summary of nutrient recommendations for PIC pigs. Recommendations are based primarily on published and PIC internal research, research from Universities and Ajinomoto Heartland with commercial PIC products. The nutrient specifications have been validated in commercial environments. The NRC publication (1998) serves as the basis for certain information. Concepts and the basis for recommendations are discussed in greater detail in other Technical Memos.

2013

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Response of Feeding High vs Low Energy Finishing Diets x PIC Sire Line

Below is a summary of recent growth trials from PIC280, PIC327 and PIC337RG sire lines. All sires were bred to PIC Camborough sows.

Pigs were assigned to:

1. A series of high-energy diets - corn, soybean meal, 6% DDGS with 4.5% added fat (NRC ME ranged from 1546-1567, from 60 lb to market, respectively).
2. A series of low-energy diets - corn, soybean meal, 6% DDGS, no fat, 16% wheat midds. (NRC ME ranged from 1429 to 1456 from 60 lb to market, respectively).
3. 270 lb market weight
4. 290 lb market weight
5. Diets were balanced on a SID Lysine:Mcal basis according to PIC recommendations.
6. Minimum SID AA ratios of AA were maintained in all diets.

Diets are shown in the Appendix 1.

Table 1

Response to High and Low Energy Diets[a]			
	Dietary Energy Level		
Target Market Weight of 270 lbs	**High Energy**	**Low Energy**	**Probability**
Entry Weight	59.2 lbs	59.3 lbs	P = 0.86
Market Weight[b]	274.4 lbs	275.7 lbs	P = 0.27
ADG, lb/day	2.07	2.00	P = 0.0001
DFI, lb/day	5.09	5.51	P = 0.0001
Feed Conversion	2.46	2.76	P = 0.0001
Target Market Weight of 290 lbs			
Entry Weight	59.2 lbs	59.2 lbs	P = 0.82
Market Weight[b]	296.3 lbs	294.2 lbs	P = 0.09
ADG, lb/day	2.08	2.00	P = 0.0001
DFI, lb/day	5.20	5.60	P = 0.0001
Feed Conversion	2.51	2.81	P = 0.0001

[a] PIC Executive Summary 49, 50, 51, 52, 53, 54, 55.
[b] Pigs fed the lower energy diet took ~ 6 days longer to achieve similar market weight.

In this trial feeding a series of high-energy diets resulted in a faster ADG by 4% ($P < 0.0001$), a lower ADFI ($P < 0.0001$) and improved feed conversion by 12% ($P < 0.0001$).

However the caloric efficiency was similar ($P > 0.5$) among the high energy (3980) and low energy (4010) diet series. This information demonstrates that the same daily calories were consumed and the same amount of calories was used to deposit the same amount of live weight gain. Even though feed conversion was different does not mean the pigs on the lower energy diets were less efficient.

The results indicate PIC pigs perform well across a wide range of intakes and adjust well to any dietary energy level.

PIC pigs also remain very efficient going to heavy market weights as indicated by the growth curve results.

An important note from this trial reminds us when lower energy diets are fed this will cause an increase in **feed intake** and this must be communicated to all production personnel to allow the proper feeder space and feeder adjustments. If feed is restricted in any case this will hurt pig performance.

More information on feeder space can be found in the PIC Wean to Finish Manual.

There was no sire line x dietary energy interactions in this trial.

The growth curves for each sire line by energy levels and gender are in the appendix.

Formulating to a SID Amino Acid Pattern

To obtain optimum performance, all amino acids must meet or exceed the requirement.

The NRC (1998) has defined the ideal balance of amino acids for each physiological phase. NRC (1998) served as the basis for PIC recommendations when access to data were limited but recent research based modifications have been made for lactation sows and growing pigs based on the work of PIC, Ajinomoto Heartland and Universities. Requirements are normally expressed in relation to the level of lysine since it is most likely to be first limiting in the diet. Since ingredient amino acids differ in their digestibility, standardized ileal digestible (SID) amino acid values are preferred when accurately formulating diets.

This guide specifies the SID lysine requirement, which is satisfactory for corn-soy formulations. The suggested ratio of dietary amino acids for each phase is as follows:

Table 2

Ideal Pattern for Breeding Herd Basedon SID Amino Acid Formulations [a,b]

	Gestation [c]		Lactation [d]		
Amino Acid	**Gilt**	**Herd**	**Gilt**	**Herd**	**Boar Stud**
Lysine	100	100	100	100	100
Methionine + Cystine	70	70	49	49	70
Threonine	76	76	64	64	74
Tryptophan	18	18	16	16	20
Valine	68	68	64	64	67
Isoleucine	58	58	56	56	58

[a] Lysine set equal to 100% and other amino acids expressed as a percent of Lysine.
[b] Ratio's are appropriate if applied to standardized ileal digestible (SID) amino acids (Corn-Soy-DDGS based) or which is suggested for more complex diets.
[c] Assumption: Gilt - 300 lbs body weight (bw) at breeding and 75 lbs net maternal gain
Sow - 400 lbs bw at breeding and 20 lbs net maternal gain
[d] Assumption: 385 lbs bw post-farrowing, 22 lbs weight loss and 2500-2800 g/d litter growth.

Table 3

Ideal Pattern for Nursery and Finishing Pigs Based on SID Amino Acid Formations						
	Nursery	Finish				Paylean®
Amino Acid	8 - 50 lbs	50 - 90 lbs	90 - 130 lbs	130 - 180 lbs	180 - 230 lbs	230 lbs - Market
Lysine	100	100	100	100	100	100
Methionine + Cystine	58	55	55	55	55	55
Threonine	60	61	63	63	64	68
Tryptophan	17	17	17	17	17	17
Valine	65	65	65	65	65	65
Isoleucine	55	56	56	56	56	56

Paylean® is a registered trade mark of Elanco.

Camborough® Gilt Product Development Specifications

Gilt nutrition during development has a significant impact on early and lifetime performance of females.

Gilt development and management begins in the early stages of a gilts life and ends when the gilt completes her first lactation. Boyd and Williams have discussed this topic at the 2008 Banff conference.

Recommended developing gilt growth and body composition targets are set out below.

- Birth to first service (3 to 300 lb) daily gains of 1.40 to 1.50 pounds/day.
- Achieve a body weight of 300 pounds at first service (210 days of age).

Nutrient requirements for development are found in Table 4.

- The requirements are designed to meet nutrient demands for adequate protein growth and not designed to maximize average daily gain (as would be the goal of a commercial feeding program).

Vitamin and trace mineral requirements are higher than commercial recommendations in order to prepare the gilt for reproductive function (see vitamin and trace mineral requirement table).

For further information relating the nutrition management of the developing gilt please refer to the Gilt and Sow manual published by PIC.

Table 4

PIC Nutrient Specifications for Gilt Development [a]

		Weight Range				
Nutrient	**Unit**	**50 - 90 lbs**	**90 - 150 lbs**	**150 - 200 lbs**	**200 - 260 lbs**	**260 - 300 lbs**
SID lysine [b]	%	1.12	0.95	0.80	0.70	0.62
Calcium	%	0.70	0.70	0.70	0.70	0.70
aPhosphorus	%	0.35	0.35	0.35	0.35	0.35

[a] Amounts are expressed as the concentration per pound of complete diet. Corn-Soy-DDGS at 30%

[b] Lysine levels are provided as the bases for normal lean:fat ratios (SID = standard ileal digestible and a = available). Other nutrients are the nutrients most related to proper bone development.

See Vitamin and Trace mineral addition rates for Replacement Sows and Gilts (Page 24).

Note: Goal for first service is 210 days, 300 lb and one heat no service recorded. All targets need to be accomplished for proper gilt development (See PIC Sow and Gilt manual). Depending on the environment, square footage, etc, nutrition (especially energy and amino acids) will need to be adjusted.

Adjustments will vary from producer to producer depending on gilt growth.

Camborough® Sow Product Specifications

The sow feeding program is a phase feeding system. Feeding involves a gestation diet and 1 or preferably 2 lactation diets. Pregnant sow feeding requires (1) feeding the proper amount of diet to meet energy needs and, (2) then matching nutrient level to the amount fed so that daily nutrient need is met (in g/day). Lactation is especially demanding and requires full-feeding beginning day 1 after farrowing. The recommended feeding program of lactating sows is to feed 6 lb on day of farrowing and then allowing access to feed at all times. PIC research has proved that prolific PIC gilts and sows produce high levels of milk, which requires improved diets (Boyd et al., 2000). Further, the typical lactation diet is inadequate for gilts so a second diet is advised when feasible especially for start-up farms with all gilts and parity segregation farms. The main difference between gilt or P1 lactation diet and older sows is the amount of digestible lysine in the diet. There is also a cost savings involved with parity segregation feeding with approximate savings of $3.40 per sow per year.

Target for sow feed/weaned pig: 75 lb.

Table 5

Sow Feeding Milestones			
Milestone	**Amount, lbs[a]**	**NRC Calories**	**Feed Type**
Pre-breeding Gilt	Full Feed		Gilt Developer[e]
Gestation: 0 to 28d Post-breed	5	7325	Gestation
Thin Sows	6	8790	Gestation
Gilt	4	5860	Gestation
Gestation: 29d to 90[b]	4	5860	Gestation
Thin Sows	6	8790	Gestation
Fat Sows	3.5	5127	Gestation
Gilt	4	5860	Gestation
Gestation: 90d to 114[c]	6	8790	Gestation
Fat Sows	3.5	5127	Gestation
Gilt	6	8790	Gestation
Pre-farrow 2 to 4d	4-5	7625	Lactation
Lactation: 1d to weaning	Full Feed[d]		Lactation
Weaning through breeding	Full Feed		Gestation[f]

[a] Assumes 1465 Kcal NRC ME/lb for gestation and 1525 Kcal NRC ME/lb for Lactation diets
[b] Objective is to reclaim body reserves (fat, protein, bone minerals) by 28d pregnant.
[c] Average gestation length, 116d.
[d] Full feeding or having self feeders in lactation is common in many farms in North America. This allows the lactating female access to feed 24 hours a day. There should be no restriction for a lactating female. As long as gestation body condition is in line the females will eat as much as they want without a reduced feed intake later in lactation.
[e] After 170 days of age gilts can be switched to the gestation diet.
[f] Where possible the weaned sow should be fed 2 to 3 times per day; the pregnant sow can be fed once or twice daily.

Daily Nutrient Needs and Diet Specifications for Gestation

Nutrient specifications for pregnancy are presented in Table 6. Gilt specifications can be used when stocking units. Specifications for herds are a compromise between needs for gilts vs. older sows. Gilts are challenged to a greater extent during lactation than sows. Feed gilts 4.0 lbs/day until day 90 of pregnancy, then increase feed to 6.0 lb, this will allow for significant growth to prepare for the rigor of first lactation.

Table 6

Recommendations for Gestating PIC Gilts and Sows			
Nutrient	**Unit**	**Gilt**	**Herd**
NRC ME Diet [a]	Kcal/lb	1465	1465
NRC ME	Kcal/d 0-28	5860	7325
NRC ME	Kcal/d 28-90	5860	5860
NRC ME	Kcal/d 90-115	8790	8790
Calcium	%	0.85	0.85
aPhosphorus	%	0.40	0.40
Crude Fiber	%	4-6	4-6
Added salt	%	0.45	0.45
L-Lysine inclusion [a]	%	0.15 to 0.25	0.15 to 0.25
Average Feed intake [b]	lb	4.8	4.8
SID lysine [c]	%	0.60	0.60
SID lysine [d]			
d 0 to 90	grams/day	13	13
d 90 to 116	grams/day	17	17

[a] NRC ME is based on a Corn-Soy diet with 40% DDGS.
[b] Average for 116 day gestation length.
[c] SID = standardized ileal digestible. Formulate to SID lysine levels. The 0.60% SID lysine level is based on 4.8 lb per day average intake.
[d] Usry et al., 2009.

Increasing Feed during Late Gestation

At day 90 of gestation the amount of feed should be increased to normal body condition gilts and sows to support fetal growth during the last 3 weeks of gestation. There is limited data in this area. Shelton et al., 2009 reported an increase in birth weight in gilt litters when feed was increased at day 90 by 2 lb. The litters from sows did not respond.

Table 7

Effects of Increasing Feed at day 90					
	Gilt		Sow		P <
	Normal	+ 2.0 lb	Normal	+ 2.0 lb	Level x Parity
Gestation Feed Intake, d 35	4.6	4.5	5.7	5.7	-
Gestation Feed Intake, d 90	4.6	6.5	5.7	7.7	-
Total Born	14.6	14.0	11.9	12.9	0.20
Pig Birth Weight, lb	3.10	3.28	3.37	3.13	0.04

Shelton et al., 2009

Soto et al., 2011 also reported an increase in pig birth weight from gilt litters when feed was increased starting at day 100 but no improvement in birth weight from sow litters.

Table 8

Effects of Increasing Feed at day 100				
	Day 100 Feed Increase, lb			
Gilt Litters	0	2	4	P - value
Pig Birth Weight	2.89	3.06	3.17	0.0001
Total Born	12.24	12.40	12.96	0.81

Soto et al., 2011.

Improve Satiety in Gestation Sows with Fiber

Since feed intake is restricted during gestation, to prevent excess body weight gain, sows can often appear restless. For this reason, ingredients that have high levels of insoluble non-starch components are often used at the rate of 15 to 40% of the diet. This tends to increase satiety and shifts some of the digestion to the cecum from which volatile fatty acids arise.

Below is an example of a gestation diet formulated to a SID lysine 0.60%. The use of fiber is recommended and in this example DDGS is used, other fibrous ingredients that will work are soy hulls, wheat midds, alfalfa meal and oat hulls.

Table 9

PIC Gestation Example Diet	
Ingredient	**Percent**
Corn	50.60
SBM (2.62% SID Lysine)	6.10
DDGS	40.00
Monocalcium Phosphate	0.20
Limestone	2.00
Salt	0.45
L-lysine	0.25
VTM + Choline + Phytase	0.40
	100.00

Daily Nutrient Needs and Diet Specifications for Lactation

Nutrient specifications are presented in Table 10. Daily ME intake is the multiple of (1) expected daily feed intake (based on intakes achieved in commercial sow systems) and (2) the ME content of a Corn-Soy-20% DDGS and 2% added fat diet. The level of Lysine for gilts is based on PIC research to optimize second litter-size (21 d lactation). Two lactation diets are recommended when stocking units and should be a consideration when designing new units. A single herd diet will increase loss of body protein in gilts, which may result in a second litter-size 'dip or plateau'.

The goal for lactation is to wean 420 pounds of pigs/sow/year. By following the nutrition specs and working with the PIC Technical Service group, this will be achieved. For more information on achieving these and other reproductive targets, please refer to the PIC Sow and Gilt Manual.

14 lbs x 12 pigs weaned x 2.50 litters/sow/year = 420 lbs

Table 10

Recommendations for Lactating PIC Gilts and Sows[a]				
Nutrient	**Unit**	**Gilt**	**Sow**	**Herd**
Net weight body loss[b]	%	<10	<10	<10
Fat loss, max.[b]	mm	0-2	0-2	0-2
Litter Growth[b]	lb/day	5.50	6.00	5.75
	grams/day	2500	2725	2610
NRC ME[a]	Kcal/lb	1525	1525	1525
Average feed intake[c]	lb/day	12.5	14.5	13.2
(21 Day Lactation)	kg/day	5.7	6.6	6.0
NRC ME	Kcal/day	19062	22112	20130
SID Lysine	grams/day	63	63	63
SID Lysine	%	1.12	0.95	1.05
Calcium	%	0.85	0.85	0.85
aPhosphorus	%	0.40	0.40	0.40
Added Salt	%	0.45	0.45	0.45
Max L-lysine inclusion[a d e]	%	0.40 to 0.45	0.40 to 0.45	0.40 to 0.45

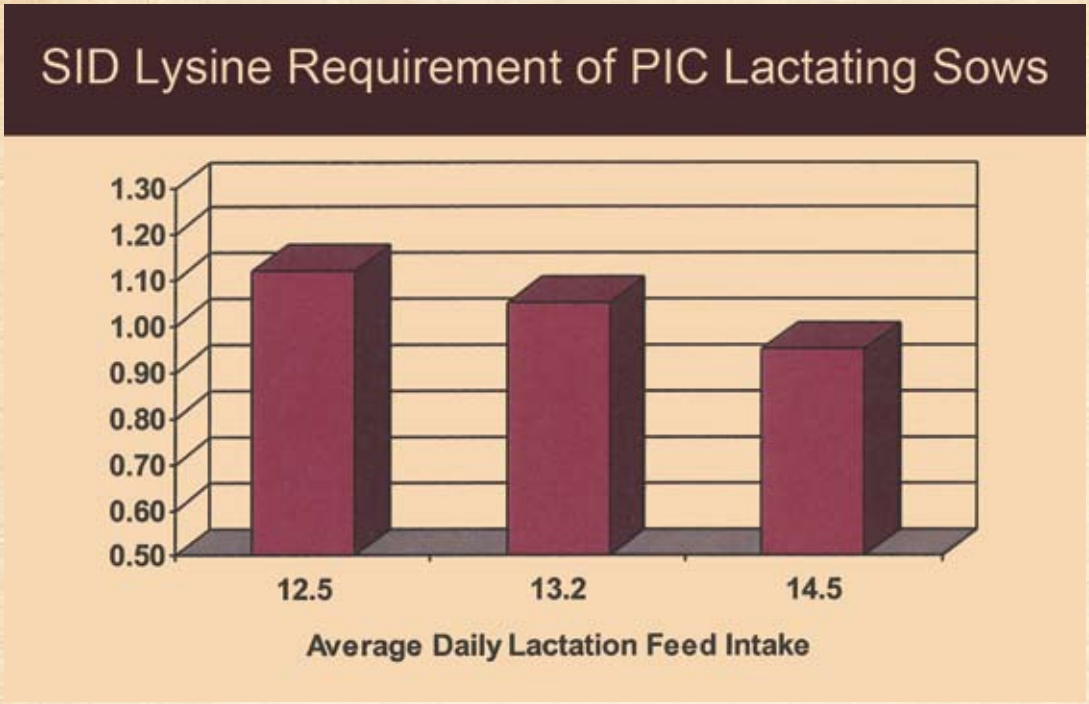
[a] Corn-Soy-DDGS at 20%-added fat at 2%.
[b] PIC Internal Research.
[c] Average feed intake over suckling period of 21 days, not maximum intake achieved within the period.
[d] L – threonine should be included to maintain a 64% ratio.
[e] Greiner et al., 2010 and 2011.

How does the SID lysine requirement differ with each parity?

Srichana et al., 2006 and Greiner et al., 2009 and 2010 demonstrated with PIC Camborough sows the SID lysine in lactation on a grams per day basis is similar for each parity (60 to 63 grams/day). Therefore feed intake needs to be known to figure percent SID lysine of the lactation diet (see figure below).

For Example using a 21 day lactation length:
Average Intake of 12.5 lb needs 1.12%.
Average Intake of 13.2 lb needs 1.05%.
Average Intake of 14.5 lb needs 0.95%.

Graph 1



Below is an example of a diet for PIC sows formulated to a SID lysine level of 1.05%

Table 11

PIC Lactation Example Diet	
Ingredient	**Percent**
Corn	53.72
SBM (2.62% SID Lysine)	20.75
DDGS	20.00
Fat	2.00
Monocalcium Phosphate	0.60
Limestone	1.60
Salt	0.45
L-lysine	0.40
L-threonine	0.08
VTM + Choline + Phytase	0.40
	100.00

Boar Stud Specifications

Energy needs to support body condition without compromising sperm output have been calculated and validated in AI studs (PIC Technical Memo 142.)

With the nutrient levels provided, the typical feed intake is 5.5 to 6.0 lb. Example of body condition and feeding levels are on the next page.

Very little information exists on which to base nutrient specifications. Those in Table 12 are used by PIC and given for reference only. Energy and amino acid levels are based on limited University research.

Table 12

Boar Stud Minimum Diet Specifications[a]		
Nutrient	**Unit**	
NRC ME	Kcal/lb	1400
Protein	%	16
Fiber	%	4.5-6.0
SID lysine[b]	%	0.62
Calcium	%	0.80
aPhosphorus[c]	%	0.40
Added salt	%	0.45
Linoleic acid	%	1.90

[a] Amount / lb of complete diet. See Vitamin & Trace mineral section for specifications.
[b] SID = Standardized ileal digestible.
[c] a = available

Vitamin and trace mineral levels are presented in the final section of this document for all phases of production including the boar stud.

Organic mineral sources are recommended especially for selenium, copper, zinc and manganese.

Table 13

Example Boar Stud Diet	
Ingredient	**Percent**
Corn	69.32
Soybean meal (2.62% SID Lysine)	13.75
Soybean Oil	1.00
Monocalcium Phosphate, 21% P	1.10
Limestone	1.20
Salt	0.45
Lysine HCl	0.11
DL-Methionine	0.02
L-Threonine	0.05
Soy Hulls	12.50
PIC Boar Stud VTM + Phytase	0.50
	100.00

Picture 1:
Body Condition Score

Normal Body Condition – 5.5 lb

Thin Body Condition – 6.0 lb

Fat Body Condition – 5.0 lb

Nursery Diet Specifications

Nutrient specifications are shown in Table 14. A feeding program and budget is illustrated in Table 15. They are based on extensive research information from production companies and published literature. A soybean maximum is suggested for each phase as a starting point for commercial conditions. Higher levels may result in 'looseness' but should be tested so that a farm-specific maximum can be set.

Diets must be matched to body weight and the correct amount fed within each phase. Feeding the fall behind pigs an extra 0.5 to 1.0 lb more of the Phase 1 diet is advised even through the general population has advanced to phase 2, this is for optimum growth and livability. Typical weight variation at weaning means that feeding to the average pig weight will result in feeding the diet that matches requirements for only 65-70% of the pigs (Table 15, footnote b). This will result in increased variation in nursery end weight.

Table 14

Diet Specifications for a 3 to 4 Phase Nursery Program					
Nutrient	Unit	Phase 1 8-12 lbs	Phase 2 12-16 lbs	Phase 3 16-25 lbs	Phase 4 25-50 lbs
Growth Rate	lb/d	0.34	0.50	0.90	1.45
Feed Intake [a]	lb/d	0.35	0.58	1.18	2.20
Feed:Gain	Ratio	1.03	1.16	1.31	1.52
Lactose [b]	%	20.0	15.0	7.5	0.0
Total Fat	%	3-6	3-6	2-4	1-4
SID lysine [c d]	%	1.46	1.46	1.42	1.30 [g]
SID Meth + Crystine:lysine	Ratio	0.58	0.58	0.58	0.58
SID Threonine:lysine	Ratio	0.60	0.60	0.60	0.60
SID Tryptophan:lysine	Ratio	0.17	0.17	0.17	0.17
SID Valine:lysine	Ratio	0.65	0.65	0.65	0.65
SID Isoleucine:lysine [e]	Ratio	0.55	0.55	0.55	0.55
Calcium	%	0.85	0.85	0.75	0.65
aPhosphorus	%	0.55	0.55	0.40	0.32
Sodium	%	0.35-0.60	0.35-0.40	0.25-0.30	0.25
Chloride	%	0.40	0.40	0.36	0.36
Added salt	%	0.20	0.25	0.40	0.50
Potassium	%	0.70	0.70	0.65	0.65
Soybean meal [f]	%	15	20	28	28-32

[a] Average Intake shown for 25-50 lb pig assumes pelleted. Add 5% for grind and mix.
[b] Lactose or equivalent sugars. Sucrose can replace 50% Lactose after 5-7 d of feeding to induce digestive enzyme.
[c] SID = standard ileal digestible.
[d] Kendall et al., 2008. PIC Executive Summary 56. Jones et al., 2011.
[e] Diet with < 2% blood cells. If great than 2% blood cells the SID Isoleucine:Lysine should be 0.60.
[f] Suggested levels for commercial production and good to high health. High health pigs can tolerate higher levels of SBM (16-25lbs, 30% ; 25-50lbs,32%)
[g] After 25 lb a SID Lysine:Calorie ratio can be used at 3.75 g/Mcal.

Feed Budgeting

Providing the proper amount of each diet and avoiding excesses is important to economics. Feed budgets allow a producer to predict and control feed cost. The budgeted amount should be verified at the outset by weighing a representative sample of pigs at each diet switch. The actual amount fed of each diet should be within 5% of target.

An example feed budget is shown in Table 15 for three weaning scenarios. The budgeted amount of feed per phase is driven by feed conversion (FCR) data in Table 14. The percentage of pigs that are expected to be smaller than the average is also considered (Table 15, footnote b). A change in FCR will result if diet energy density is different than shown in Table 14 (especially for 25-50 lbs phase) so the budgeted amount must be changed to reflect the difference.

Table 15

Example Feeding Program and Feed Budget [a, b]				
Diet Phase	**% Lactose**	**Feed Budget per Pig**		
Phase 1	20%	3.0	2.0	1.0
Phase 2	15%	4.0	4.0	3.0
Phase 3	7.5%	7.0	7.0	7.0
Phase 4	0%	40.0	40.0	40.0
Total Feed		54.0	53.0	51.0
Total Gain		38.0	36.5	35.0
Feed:Gain		1.42	1.45	1.46
Avg Wean Age		**18 d**	**21 d**	**24 d**
Avg Wean Weight		**12.0 lbs**	**14.0 lbs**	**16.5 lbs**

[a] Budget assumes 50 lbs end weight for Nursery and FCR shown in Table 14.
[b] Early wean diet allocated assuming FCR=1.05 and a population percent by wean weight as follows:

Population %, avg 12 lbs wean weight:	9 lbs	10 lbs	11 lbs	12 lbs	13 lbs	14 lbs	15 lbs
	5%	10%	20%	30%	20%	10%	5%

Grow-Finish Specifications: Nutrient Levels for Optimum Lean Deposition

Nutrient specifications in Tables 16 and 17 are for lean growth optimization for market gilts and barrows, respectively. Performance was determined under conditions of good health, within a thermo-neutral environment and fed corn-soy diets.

Lysine specifications are presented as grams per Mcal of NRC ME. An example of how to calculate the percent SID lysine level of a diet is provided in a footnote at the bottom of the tables. When formulating diets of variable energy levels, one should follow the SID lysine:calorie ratio that is provided in the tables. Actual dietary energy levels require a number of considerations that are specific to market and environment (Usry et al., 1997).

To prevent any type of a vice and to maximize performance the minimum nutrient specs below should be followed. Typically vices occur when amino acids, sodium and/or phosphorus levels are not adequate and level of a by-product is changed too rapidly. Other environmental conditions can cause vices which are discussed in the PIC Wean to Finish Manual.

Table 16

PIC Market Gilt Specifications[a]						
		Phase of growth, lbs				
Item	Unit	50-90	90-130	130-180	180-230	230-Market[d]
Growth Rate	lb/d	1.78	1.91	2.15	2.08	1.98
Feed Intake	lb/d	3.00	4.28	5.59	5.72	5.98
Feed:Gain	Ratio	1.69	2.24	2.60	2.75	3.02
SID lysine/Mcal ME[b]	g/Mcal	3.17	2.76	2.39	2.11	1.96
SID Meth + Cystine:lysine[c]	Ratio	0.55	0.55	0.55	0.55	0.55
SID Threonine:lysine	Ratio	0.61	0.62	0.63	0.64	0.66
SID Tryptophan:lysine	Ratio	0.17	0.17	0.17	0.17	0.17
SID Valine:lysine	Ratio	0.65	0.65	0.65	0.65	0.65
SID Isoleucine:lysine	Ratio	0.56	0.56	0.56	0.56	0.56
Calcium	%	0.60	0.58	0.54	0.50	0.48
aPhosphorus	%	0.30	0.28	0.26	0.25	0.24
Added salt	%	0.50	0.50	0.50	0.50	0.50
Sodium	%	0.25	0.25	0.25	0.25	0.25
L-lysine max	%	0.45	0.40	0.35	0.275	0.25

[a] Lysine specifications are based on a series of 20 trials and reports, abstracts, papers, Master's and PhD dissertations from students of Gary Allee with support from Ajinomoto Heartland that developed the curve.
[b] Equation used: 0.000027*weight^2-0.015318*weight+4.114302
[c] SID = Standardize ileal digestible value.
[d] Diet without Paylean®.

Lysine to Calorie equation for Market Gilts:
0.000027*weight^2-0.015318*weight+4.114302

Figuring SID Lysine % for the diet for the 50 – 90 lb weight phase:
(Lysine:Calorie ratio * NRC ME of diet/lb *2.2)/10000

Example = (3.17*1500*2.2)/10000= 1.05% SID Lysine

Table 17

PIC Barrow Specifications[a]

		Phase of growth, lbs				
Item	**Unit**	**50-90**	**90-130**	**130-180**	**180-230**	**230-Market**[d]
Growth Rate	lb/d	1.82	1.98	2.25	2.15	2.00
Feed Intake	lb/d	3.15	4.55	5.81	5.88	6.10
Feed:Gain	Ratio	1.73	2.30	2.58	2.73	3.05
SID lysine/Mcal ME[b]	g/Mcal	3.17	2.66	2.24	1.97	1.89
SID Meth + Cystine:lysine[c]	Ratio	0.55	0.55	0.55	0.55	0.55
SID Threonine:lysine	Ratio	0.61	0.62	0.63	0.64	0.66
SID Tryptophan:lysine	Ratio	0.17	0.17	0.17	0.17	0.17
SID Valine:lysine	Ratio	0.65	0.65	0.65	0.65	0.65
SID Isoleucine:lysine	Ratio	0.56	0.56	0.56	0.56	0.56
Calcium	%	0.60	0.58	0.56	0.50	0.48
aPhosphorus	%	0.30	0.28	0.26	0.25	0.24
Added salt	%	0.50	0.50	0.50	0.50	0.50
Sodium	%	0.25	0.25	0.25	0.25	0.25
L-lysine max	%	0.45	0.40	0.35	0.275	0.25

[a] Lysine specifications are based on a series of 20 trials and reports, abstracts, papers, Master's and PhD dissertations from students of Gary Allee with support from Ajinomoto Heartland that developed the curve.
[b] Equation used: 0.00004*weight^2-0.019913*weight+4.369743
Equation used: (SID lysine per NRC ME*NRC ME per lb*2.2)/10000
Example for 50-90 lb pig with ME level of 1500 kCal/lb: 3.17*1500*2.2/10000=1.05% SID Lysine
[c] SID=Standardized ileal digestible value
[d] Diet without Paylean®.

Lysine to Calorie equation for Barrows:
0.00004*weight^2-0.019913*weight+4.369743

Figuring SID Lysine % for the diet for the 50 – 90 lb weight phase:
(Lysine:Calorie ratio * NRC ME of diet/lb *2.2)/10000

Example = (3.17*1500*2.2)/10000= 1.05% SID Lysine

Paylean®

Paylean is a product with proven results when diets are formulated correctly. With the new Paylean labeling approval in 2006, market pigs can be fed to heavier weights.

Please keep in mind that Paylean should not be fed to replacement gilts or boars.

Below is a guideline when feeding Paylean for less than 21 days or greater than 21 days. With the SID lysine in the Paylean diet being high, there is a risk of adding too much soybean meal and causing a yield reduction (Gaines et al., 2004 and 2007). Synthetic amino acids should be used to reduce the amount of soybean meal in diets with Paylean (Table 18).

Table 18

Diet Specifications for Diets with Paylean			
Paylean	**Unit**	**<21 Days**	**>21 Days**
Growth Rate	lb/Day	2.25	2.15
Feed Intake	lb/Day	6.10	6.20
Feed:Gain Ratio	F/G	2.71	2.88
SID Lysine	%	0.95	0.85
Added Fat	%	0 to 3	0 to 3
SID Meth + Cystine:Lysine	Ratio	0.58	
SID Threonine:Lysine	Ratio	0.68	
SID Tryptophan:Lysine	Ratio	0.17	
SID Valine:Lysine	Ratio	0.65	
SID Isoleucine:Lysine	Ratio	0.56	
Calcium	%	0.50	
aPhosphorus	%	0.24	
Added Salt	%	0.50	
Min L-lysine	%	0.30	
Max L-lysine	%	0.45	

Paylean® is Elanco's trade mark for ractopamine HCl.

Vitamin and Trace Mineral Addition Rates

Nursery and Grow-Finish

PIC North America recommendations were established after extensive comparison with universities and major nutrition groups. A systematic allowance was made in relation to the NRC recognizing that this information is based on studies under nearly ideal conditions.

Table 19

Suggested Specifications: Amount per lb of Complete Diet [a b]					
		Nursery		Grow-Finish	
Nutrient	Unit	<12 lbs	12-60 lbs	60-150 lbs	150 lbs-Market
Vitamin A	IU/lb	5000	4500	3000	2490
Vitamin D	IU/lb	800	750	550	456
Vitamin E	IU/lb	38	35	15	12.5
Vitamin K	mg/lb	2.5	2.0	1.5	1.25
Choline	mg/lb	200	150	0	0
Niacin	mg/lb	32	20	12	10
Riboflavin	mg/lb	6	4.5	2.6	2.2
d-Pantothenate	mg/lb	18	15	9	7.5
Vitamin B12	mcg/lb	25	20	12	10
Folic Acid	mcg/lb	475	350	0	0
d-Biotin	mcg/lb	125	70	0	0
Thiamine	mg/lb	1.6	1.5	0	0
Pyridoxide	mg/lb	3.2	2.0	0	0
Zinc	PPM	150[c]	130[c]	120	100
Iron	PPM	200[d]	175[d]	80	66
Manganese	PPM	50	45	30	25
Copper	PPM	18[c]	15[c]	12	10
Iodine	PPM	0.65	0.55	0.40	0.33
Selenium	PPM	0.30	0.30	0.30	0.25

[a] B-Vitamins supplemented at approximately 3.5 x NRC (1998) for < 12 lbs pigs. Multiples for other groups approx. as follows:
12-60 lbs, 3 x NRC.
60-150 lbs, 2.5 x NRC.
Sows tend to be 2.5 x NRC for Vitamins in general.
Add 2.3 IU of Vitamin E/lb of complete diet for each 1% fat above 3% total dietary fat.

[b] Pelleting and(or) expanding decreases vitamin stability by 10-12% and 15-20% respectively. Consult vitamin manufacturer to verify the extent by vitamin so additional fortification can be made as required.

[c] Nutritional levels are shown for Zinc and copper. Chemotherapeutic levels of Zinc as follows: < 12 lbs 2600 PPM; 12-16 lbs., 2200 PPM; 16-22 lbs, 1600 PPM.
Chemotherapeutic levels of copper is 220 PPM for each phase. Inorganic forms assumed.

[d] Supplemental iron are near to NRC levels because of the substantial iron content of di-calcium phosphate and because high iron intake encourages E.coli proliferation in the young pig.

Replacement Gilts, Sows, and Boar Stud

PIC North America recommendations were established after extensive comparison with university and major nutrition groups. A systematic allowance was made relative to the NRC levels shown assume micronutrient additions and give no credit for ingredient content.

Table 20

Suggested Specifications: Amount per lb of Complete Diet [a b]				
		Gilt		
Nutrient	Unit	150 lbs-Breeding	Gest-Lact	Boar Stud
Vitamin A	IU/lb	4500	4500	5000
Vitamin D	IU/lb	900	900	800
Vitamin E	IU/lb	30	30	50
Vitamin K	mg/lb	2.0	2.0	2.0
Choline	mg/lb	300	300	300
Niacin	mg/lb	20	20	20
Riboflavin	mg/lb	4.5	4.5	4.5
d-Pantothenate	mg/lb	15	15	15
Vitamin B12	mcg/lb	17	17	17
Folic Acid	mcg/lb	600	600	750
d-Biotin	mcg/lb	100	100	250
Thiamine	mg/lb	1.0	1.0	1.0
Pyridoxide	mg/lb	1.5	1.5	1.5
Zinc [c]	PPM	125	125	125
Iron [c]	PPM	100	100	100
Manganese [c]	PPM	50	50	50
Copper [c]	PPM	15	15	15
Iodine	PPM	0.35	0.35	0.65
Selenium [c]	PPM	0.30	0.30	0.30

[a] Multiplication VTM starts at 150 lb of body weight with the Sow VTM being fed to the replacement gilts.
- Sows tend to be 2.5 x NRC for Vitamins in general.
- Boars are similar to sows with extra margins set for several micronutrients.

Add 2.3 IU of Vitamin E / lb of complete diet for each 1% fat above 3% total dietary fat.

[b] Pelleting and(or) expanding decreases Vitamin stability by 10-12% and 15-20% respectively. Consult Vitamin manufacturer to verify the extent by vitamin so additional fortification can be made as required.

[c] Organic forms of Zinc, Manganese, Copper and Selenium is suggested starting with the replacement gilt diets, gestation, lactation and boar stud diets.

Alternative Ingredients

With the price increase in corn and soybean meal, many producers are looking at using increased levels of alternative ingredients like corn dried distiller's grains, bakery by-products, glycerin and fractioned corn. Remember that these products are by-products and users must be careful when using them. Some alternative ingredients are not well studied and should be used with extreme caution. For example, glycerin is still being studied as an energy source for swine and therefore its use should be limited (max of 6%) because of the lack of nutritional knowledge behind the product and feed flowability issues at high inclusion levels. These products tend to be very variable in nutrient content and could possibly contain high levels of mycotoxins. Ingredient samples must be taken and analyzed to determine their nutrient levels. Consistency is very important so try and source from one or two plants where the products have been well characterized when receiving alternative ingredients. When dealing with alternative ingredients, producers must keep in mind feed mill space, feed flowability, and carcass traits.

There are two feeding strategies for DDGS. They are 1) Step up program and 2) High inclusion. The idea of a step up program is to slowly let the pigs get used to the taste and smell of DDGS and not adding a high level of DDGS suddenly. The second concept is to have a high level of DDGS in the starter diets so the pigs will get use to DDGS early and use DDGS sooner. New research from Gaines et al. (2007), indicates decreased carcass yield with high levels of DDGS due to increased intestine weight. Other ingredients that may decrease yield if used at high of levels are soybean meal, wheat midds and soy hulls (ingredients that contain fiber).

Some packers are now testing for iodine value (IV) which is a measure of the level of unsaturation or softness of fat tissue. Benz et al. (2007a,c) has proven that IV will increase with inclusion of vegetable oils with high levels of unsaturated fatty acids like corn oil from DDGS. Other ingredients that will increase IV are extruded expelled soybean meal (Benz et al., 2007b) and high oil corn. Below is an example of the amount (%) of DDGS that can be added to nursery and finishing diets that will minimize the yield decline and keep the IV within acceptable range (Table 21). It is also recommended that when new ingredients are used, incremental increases should be limited to only 5%. Stepping up faster with DDGS or other by-products can result in lower feed intakes. Other ingredients in the diet can also affect IV so consultant with your nutritionist and packer on IV specs. Breeding herd inclusions are shown in Table 22.

Table 21

Amount of DDGS in Diets for Market Pigs or Replacement Gilts								
DDGS	Unit	12 to 15	15 to 25	25 to 50	50 to 90	90 to 210	210 to Market	Paylean
Market	%	0.0	5.0	15.0	20.0	30.0	20.0	15.0
Multiplication	%	0.0	5.0	15.0	20.0	30.0	30.0	--

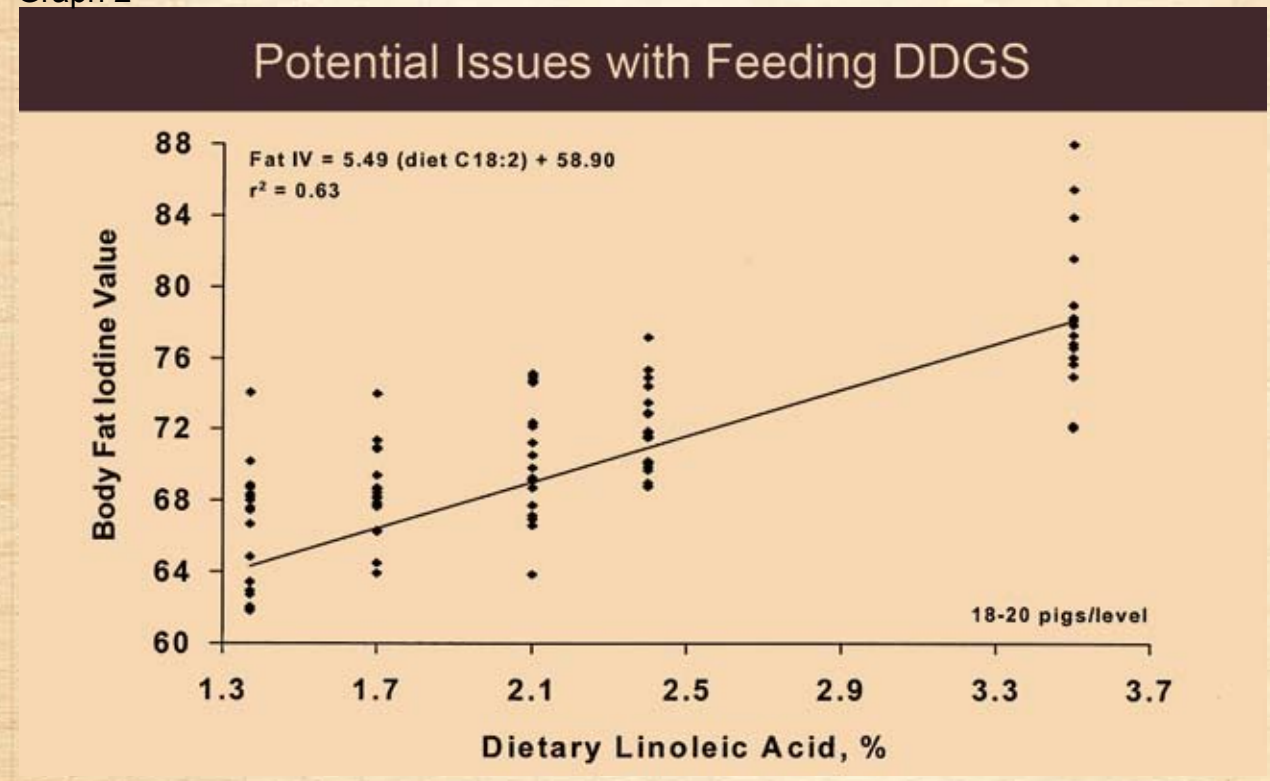
Table 22

Amount of DDGS in the Breeding Herd		
Diet	Unit	DDGS
Gestation	%	0 to 60
Lactation	%	0 to 30
Boar Stud	%	0

Research also has proved that when dietary linoleic acid is increased this will cause IV to increase.

Producers must work closely with their nutritionists to implement these ingredients in their diets.

Graph 2



PIC Technical Memo 153

Pork Quality

Below are pictures courtesy of Purdue University from bellies from pigs that were fed either 0%, 10%, 20%, or 30% DDGS. The pictures show the flop test and as higher levels of DDGS were fed the fat on the bellies became softer.

Picture 2

0%

10%

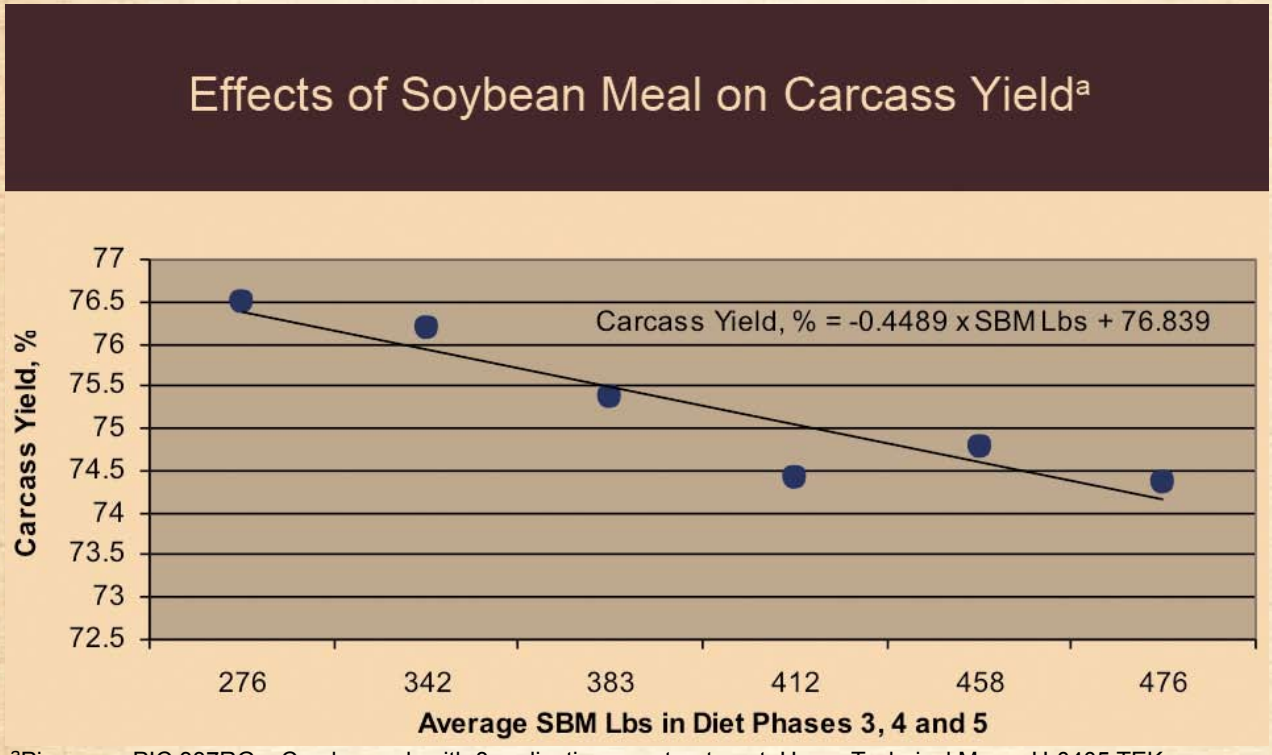
20%

30%

Effects of Nutrition on Yield

Recent research has demonstrated that ingredient type can affect the yield of PIC finishing pigs. As mentioned in the alternative ingredient section, high fiber ingredients have shown to decrease yield. Also in the Paylean® section references low soybean meal and high synthetic amino acid diets can increase yield. High levels of soybean meal throughout the finishing period can also cause low yields. Below is a trial conducted with high levels of soybean meal and low levels of synthetic amino acids (Graph 3 and Table 23).

Graph 3



[a]Pigs were PIC 337RG x Camborough with 8 replications per treatment. Hanor Technical Memo H-0405 TEK

Table 23

Effect of Low vs. High Synthetic Amino Acid Diets for PIC Gilts fed Paylean® (6.5 g/ton) for 21 days[a]

Item	L-Lysine, lbs/ton		SEM	*P*-Value
	1.5 lbs (556 lbs/ton SBM)	6 lbs (398 lbs/ton SBM)		
Growth				
Day 0 BW, lbs	229.7	230.8	1.30	0.57
Day 21 BW, lbs	278.0	278.1	1.50	0.96
ADG, lbs/d	2.30	2.25	0.03	0.33
ADFI, lbs/day	6.20	6.08	0.08	0.32
Feed/Gain	2.70	2.70	0.04	0.96
Carcass				
Carcass wt., lbs	207.1	211.4	1.07	0.03
Backfat, in.	0.64	0.66	0.02	0.63
Yield, %	76.4	77.6	0.38	0.05
Lean, %	56.0	55.8	0.29	0.69

[a] Data represents the means of 8 replicate pens (21 pigs/pen). Diets were formulated to a 0.95% SID lysine (2.78 g SID lysine/Mcal ME) and fed for 21 days. Trial was conducted at PorkTech, LLC (Moberly, MO). Gaines et al., 2007.

Feed Manufacturing

Guidelines for feed manufacturing for PIC pigs.

Meal feed:

Roller mill
600 microns with a standard deviation of < 2.3
Mixing CV of less than 10%

- < 30 % over 1 mm
- < 20 % under 300 microns
- < 2.5 % under 150 microns

Pellets:

Hammer mill
400 microns with a standard deviation of < 2.5
PDI > 90
Percent of fines should be < 20%

Feed Form:

With increased feed prices, feed efficiency has become increasingly important. PIC has done a number of large scale trials comparing feed form of meal and pellets on feed efficiency. Below are a few trials comparing sire lines and meal versus pellets on growth performance (Table 24, 25 and 26). The trial results demonstrate that feeding pellets will improve (6% to 10%) feed efficiency in all sire lines however full value pigs may be higher (1% to 3%) in meal diets for some lines. All pigs were not vaccinated for PCV2 and not fed Paylean®.

Table 24

Impact of Feed Form on PIC280 Sired Pigs [a]			
	Sire Line x Feed Form		
Item	PIC280 Meal	PIC280 Pellet	*P* <
On test weight, lb	62.9	64.3	0.53
Off test weight, lb	255.1	264.8	0.016
ADG, lb	2.03	2.12	0.0011
F/G	2.74	2.48	0.0001
Age at 275 lb, d	174.4	172.1	0.0001
Survival Rate, %	97.2	98.2	0.27
Yield, %	74.5	74.6	0.19
Lean, %	54.7	54.5	0.23

[a] A total of 1,044 pigs (PIC280 x Camborough) were used with 41 replications for meal and 43 replications for pellets.

Table 25

Impact of Feed Form on PIC337RG Sired Pigs [a]			
	Sire Line x Feed Form		
Item	PIC337RG Meal	PIC337RG Pellet	*P* <
On test weight, lb	53.3	53.2	0.97
Off test weight, lb	265.3	269.3	0.01
ADG, lb	2.08	2.12	0.01
F/G	2.52	2.36	0.0001
Age at 275 lb, d	171.0	168.9	0.0003
Deads, %	2.1	3.1	0.18
Culls, %	3.5	4.1	0.52
Lean, %	56.1	55.6	0.0004

[a] A total of 1,730 pigs (PIC337RG x Camborough) were used with 75 replications for meal and 73 replications for pellets.

Table 26

Impact of Feed Form on PIC380 Sired Pigs [a]			
	Sire Line x Feed Form		
Item	PIC380 Meal	PIC380 Pellet	*P* <
On test weight, lb	55.7	54.5	030
Off test weight, lb	268.2	270.3	0.22
ADG, lb	2.11	2.15	0.003
F/G	2.49	2.36	0.0001
Age at 275 lb, d	168.8	166.8	0.0001
Deads, %	1.5	3.4	0.01
Culls, %	1.5	2.9	0.06
Backfat, in.	0.68	0.71	0.0001
Loin depth, in.	2.31	2.36	0.0001
Lean, %	55.4	55.1	0.009

[a] A total of 1,699 pigs (PIC380 x Camborough) were used with 76 replications for meal and 74 replications for pellets.

Feeder Space

Guidelines for feeder space for PIC pigs depending on feeder type and trial results.

Feeder Requirements:

Wet or Dry Feeders:

- Maximum of 12 pigs per feeder space on high energy diets
- Maximum of 10 pigs per feeder space on lower energy diets (no added fat)
- Minimum of 14 inches per head space (280 lb market weight)
- Minimum of 16 inches per head space (320 lb market weight)

Tube Feeders:

- Maximum of 10 pigs per tube
- Minimum of 2 inches trough space per pig

Appendix 1: Diets Used in High vs Low Energy Diet Trial

Diet Formulations for High Energy Diets

	High Energy			
Ingredient	**Grower 1**	**Grower 2**	**Finisher 1**	**Finisher 2**
Corn, %	57.90	61.54	69.66	71.24
Soybean meal, (dehulled), %	28.15	25.45	17.5	16.1
Corn – DDGS, %	6.0	6.0	6.0	6.0
Choice white grease, %	4.95	4.5	4.5	4.5
Wheat midds, %	.0	.0	.0	.0
Limestone, %	1.125	1.095	1.07	1.06
Mono-Calcium phosphate, %	.395	.315	.265	.245
Salt, %	.4	.4	.4	.4
L-Lysine, %	.325	.3	.275	.175
DL-Methionine, %	.092	.062	.003	.0
L-Threonine, %	.085	.088	.076	.0275
Trace mineral premix, %	.075	.075	.075	.075
Vitamin premix, %	.025	.025	.025	.025
Potassium chloride, %	.1	.1	.1	.1
Copper sulfate, %	.049	.0	.0	.0
Selenium premix, %	.05	.05	.05	.05
Antibiotic premix, %	.278	.0	.0	.0

Nutrient Specifications for High Energy Diets

	High Energy			
Specification	**Grower 1**	**Grower 2**	**Finisher 1**	**Finisher 2**
Lysine total, %	1.28	1.20	.96	.85
Lysine available, %	1.13	1.04	.84	.725
Metabolizable energy[a], Kcal / kg	3,408	3,419	3,443	3,454
Calcium, %	.76	.74	.70	.675
Phosphorus available, %	.30	.29	.27	.266
Total fat	7.93	7.53	7.71	7.75

Appendix 2: Growth Curves

Table 1. PIC337RG Growth Curves by Age and Energy Level

(Average of Barrows and Gilts)

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion
70 / 10	64.1				62.0			
77 / 11	76.4	1.76	21.92	1.78	73.8	1.69	21.73	1.84
84 / 12	89.4	1.86	24.97	1.92	86.4	1.80	24.94	1.98
91 / 13	103.2	1.97	27.86	2.02	99.7	1.90	28.02	2.11
98 / 14	117.5	2.04	30.51	2.13	113.5	1.97	30.93	2.24
105 / 15	132.2	2.10	32.90	2.24	127.7	2.03	33.59	2.37
112 / 16	147.2	2.14	35.00	2.33	142.3	2.09	36.00	2.47
119 / 17	162.5	2.19	36.82	2.41	157.0	2.10	38.14	2.59
126 / 18	177.8	2.19	38.38	2.51	171.9	2.13	40.02	2.69
133 / 19	193.2	2.20	39.69	2.58	186.8	2.13	41.64	2.79
140 / 20	208.5	2.19	40.79	2.67	201.6	2.11	43.04	2.91
147 / 21	223.7	2.17	41.72	2.74	216.4	2.11	44.24	2.99
154 / 22	238.7	2.14	42.49	2.83	230.9	2.07	45.26	3.12
161 / 23	253.5	2.11	43.14	2.91	245.3	2.06	46.13	3.20
168 / 24	268.0	2.07	43.69	3.01	259.3	2.00	46.87	3.35
175 / 25	282.1	2.01	44.15	3.13	273.0	1.96	47.50	3.47
182 / 26	295.9	1.97	44.54	3.23	286.4	1.91	48.04	3.59
189 / 27	309.3	1.91	44.87	3.35	299.4	1.86	48.51	3.73
196 / 28	322.3	1.86	45.16	3.47	312.1	1.81	48.90	3.85

Table 2. PIC337RG Cumulative Performance by Age and Energy Level

(Average of Barrows and Gilts)

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion
70 / 10	64.1				62.0			
77 / 11	76.4	1.76	21.92	1.78	73.8	1.69	21.73	1.84
84 / 12	89.4	1.81	46.89	1.85	86.4	1.74	46.67	1.91
91 / 13	103.2	1.86	74.75	1.91	99.7	1.80	74.69	1.98
98 / 14	117.5	1.91	105.26	1.97	113.5	1.84	105.62	2.05
105 / 15	132.2	1.95	138.16	2.03	127.7	1.88	139.21	2.12
112 / 16	147.2	1.98	173.16	2.08	142.3	1.91	175.21	2.18
119 / 17	162.5	2.01	209.98	2.13	157.0	1.94	213.35	2.25
126 / 18	177.8	2.03	248.36	2.18	171.9	1.96	253.37	2.31
133 / 19	193.2	2.05	288.05	2.23	186.8	1.98	295.01	2.36
140 / 20	208.5	2.06	328.84	2.28	201.6	1.99	338.05	2.42
147 / 21	223.7	2.07	370.56	2.32	216.4	2.01	382.29	2.48
154 / 22	238.7	2.08	413.05	2.37	230.9	2.01	427.55	2.53
161 / 23	253.5	2.08	456.19	2.41	245.3	2.01	473.68	2.58
168 / 24	268.0	2.08	499.88	2.45	259.3	2.01	520.55	2.64
175 / 25	282.1	2.08	544.03	2.50	273.0	2.01	568.05	2.69
182 / 26	295.9	2.07	588.57	2.54	286.4	2.00	616.09	2.75
189 / 27	309.3	2.06	633.44	2.58	299.4	1.99	664.60	2.80
196 / 28	322.3	2.05	678.60	2.63	312.1	1.98	713.50	2.85

Table 3. Growth Curves by Age and Energy Level for PIC337RG Barrows

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion
70 / 10	64.3				61.6			
77 / 11	77.1	1.83	21.94	1.71	73.7	1.73	21.54	1.78
84 / 12	90.7	1.94	25.70	1.89	86.7	1.86	25.37	1.95
91 / 13	105.0	2.04	29.27	2.05	100.4	1.96	29.07	2.12
98 / 14	119.9	2.13	32.52	2.18	114.7	2.04	32.55	2.28
105 / 15	135.3	2.20	35.40	2.30	129.4	2.10	35.72	2.43
112 / 16	151.0	2.24	37.87	2.41	144.4	2.14	38.53	2.57
119 / 17	167.0	2.29	39.93	2.50	159.7	2.19	40.97	2.68
126 / 18	183.1	2.30	41.61	2.58	175.1	2.20	43.05	2.80
133 / 19	199.1	2.29	42.96	2.69	190.5	2.20	44.79	2.91
140 / 20	215.1	2.29	44.02	2.75	205.9	2.20	46.22	3.00
147 / 21	231.0	2.27	44.85	2.82	221.0	2.16	47.39	3.14
154 / 22	246.6	2.23	45.48	2.92	236.0	2.14	48.33	3.22
161 / 23	261.9	2.19	45.97	3.00	250.7	2.10	49.08	3.34
168 / 24	276.8	2.13	46.33	3.11	265.0	2.04	49.68	3.47
175 / 25	291.4	2.09	46.61	3.19	279.0	2.00	50.15	3.58
182 / 26	305.5	2.01	46.81	3.32	292.6	1.94	50.53	3.72
189 / 27	319.3	1.97	46.97	3.40	305.8	1.89	50.83	3.85
196 / 28	332.5	1.89	47.09	3.57	318.5	1.81	51.06	4.02

Table 4. Cumulative Means by Age and Energy Level for PIC337RG Barrows

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion
70 / 10	64.3				61.6			
77 / 11	77.1	1.83	21.94	1.71	73.7	1.73	21.54	1.78
84 / 12	90.7	1.89	47.64	1.80	86.7	1.79	46.91	1.87
91 / 13	105.0	1.94	76.91	1.89	100.4	1.85	75.98	1.96
98 / 14	119.9	1.99	109.43	1.97	114.7	1.90	108.53	2.04
105 / 15	135.3	2.03	144.83	2.04	129.4	1.94	144.25	2.13
112 / 16	151.0	2.06	182.70	2.11	144.4	1.97	182.78	2.21
119 / 17	167.0	2.10	222.63	2.17	159.7	2.00	223.75	2.28
126 / 18	183.1	2.12	264.24	2.22	175.1	2.03	266.80	2.35
133 / 19	199.1	2.14	307.20	2.28	190.5	2.05	311.59	2.42
140 / 20	215.1	2.15	351.22	2.33	205.9	2.06	357.81	2.48
147 / 21	231.0	2.16	396.07	2.38	221.0	2.07	405.20	2.54
154 / 22	246.6	2.17	441.55	2.42	236.0	2.08	453.53	2.60
161 / 23	261.9	2.17	487.52	2.47	250.7	2.08	502.61	2.66
168 / 24	276.8	2.17	533.85	2.51	265.0	2.08	552.29	2.72
175 / 25	291.4	2.16	580.46	2.56	279.0	2.07	602.44	2.77
182 / 26	305.5	2.15	627.27	2.60	292.6	2.06	652.97	2.83
189 / 27	319.3	2.14	674.24	2.64	305.8	2.05	703.80	2.88
196 / 28	332.5	2.13	721.33	2.69	318.5	2.04	754.88	2.94

Table 5. Growth Curves by Age and Energy Level for PIC337RG Gilts

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion
70 / 10	63.9				62.3			
77 / 11	75.7	1.69	21.89	1.86	73.9	1.66	21.93	1.89
84 / 12	88.2	1.79	24.24	1.94	86.1	1.74	24.51	2.01
91 / 13	101.4	1.89	26.45	2.00	99.0	1.84	26.97	2.09
98 / 14	115.0	1.94	28.50	2.10	112.3	1.90	29.30	2.20
105 / 15	129.1	2.01	30.40	2.16	126.1	1.97	31.47	2.28
112 / 16	143.4	2.04	32.14	2.25	140.1	2.00	33.47	2.39
119 / 17	157.9	2.07	33.71	2.32	154.3	2.03	35.31	2.49
126 / 18	172.6	2.10	35.14	2.39	168.7	2.06	36.98	2.57
133 / 19	187.3	2.10	36.42	2.48	183.1	2.06	38.50	2.67
140 / 20	202.0	2.10	37.57	2.56	197.4	2.04	39.87	2.79
147 / 21	216.5	2.07	38.59	2.66	211.7	2.04	41.10	2.87
154 / 22	230.9	2.06	39.51	2.74	225.9	2.03	42.20	2.97
161 / 23	245.2	2.04	40.32	2.82	239.8	1.99	43.19	3.11
168 / 24	259.1	1.99	41.04	2.95	253.6	1.97	44.07	3.19
175 / 25	272.8	1.96	41.69	3.04	267.0	1.91	44.86	3.35
182 / 26	286.2	1.91	42.26	3.15	280.2	1.89	45.58	3.45
189 / 27	299.3	1.87	42.77	3.26	293.1	1.84	46.19	3.58
196 / 28	312.0	1.81	43.23	3.40	305.6	1.79	46.75	3.74

Table 6. Cumulative Means by Age and Energy Level for PIC337RG Gilts

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion
70 / 10	63.9				62.3			
77 / 11	75.7	1.69	21.89	1.86	73.9	1.66	21.93	1.89
84 / 12	88.2	1.74	46.13	1.90	86.1	1.70	46.44	1.95
91 / 13	101.4	1.79	72.58	1.94	99.0	1.75	73.41	2.00
98 / 14	115.0	1.83	101.08	1.98	112.3	1.79	102.71	2.05
105 / 15	129.1	1.86	131.48	2.02	126.1	1.82	134.18	2.10
112 / 16	143.4	1.89	163.62	2.06	140.1	1.85	167.65	2.15
119 / 17	157.9	1.92	197.33	2.10	154.3	1.88	202.96	2.21
126 / 18	172.6	1.94	232.47	2.14	168.7	1.90	239.94	2.26
133 / 19	187.3	1.96	268.89	2.18	183.1	1.92	278.44	2.30
140 / 20	202.0	1.97	306.46	2.22	197.4	1.93	318.31	2.36
147 / 21	216.5	1.98	345.05	2.26	211.7	1.94	359.41	2.41
154 / 22	230.9	1.99	384.56	2.30	225.9	1.95	401.61	2.45
161 / 23	245.2	1.99	424.88	2.34	239.8	1.95	444.80	2.51
168 / 24	259.1	1.99	465.92	2.39	253.6	1.95	488.87	2.56
175 / 25	272.8	1.99	507.61	2.43	267.0	1.95	533.73	2.61
182 / 26	286.2	1.98	549.87	2.47	280.2	1.95	579.29	2.66
189 / 27	299.3	1.98	592.64	2.52	293.1	1.94	625.48	2.71
196 / 28	312.0	1.97	635.87	2.56	305.6	1.93	672.23	2.76

Table 7. PIC327L Growth Curves by Age and Energy Level

(Average of Barrows and Gilts)

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion
70 / 10	64.5				63.6			
77 / 11	76.7	1.74	22.03	1.81	75.7	1.73	22.33	1.85
84 / 12	89.8	1.87	25.05	1.91	88.4	1.81	25.53	2.01
91 / 13	103.4	1.94	27.90	2.05	101.8	1.91	28.60	2.13
98 / 14	117.6	2.03	30.51	2.15	115.6	1.97	31.47	2.28
105 / 15	132.2	2.09	32.87	2.25	129.8	2.03	34.10	2.40
112 / 16	147.1	2.13	34.94	2.34	144.3	2.07	36.47	2.52
119 / 17	162.2	2.16	36.74	2.43	159.0	2.10	38.58	2.62
126 / 18	177.4	2.17	38.29	2.52	173.7	2.10	40.43	2.75
133 / 19	192.5	2.16	39.60	2.62	188.4	2.10	42.03	2.86
140 / 20	207.6	2.16	40.71	2.70	203.1	2.10	43.42	2.95
147 / 21	222.5	2.13	41.64	2.79	217.5	2.06	44.61	3.10
154 / 22	237.3	2.11	42.43	2.87	231.8	2.04	45.63	3.19
161 / 23	251.7	2.06	43.09	2.99	245.7	1.99	46.50	3.35
168 / 24	265.9	2.03	43.65	3.07	259.4	1.96	47.24	3.45
175 / 25	279.7	1.97	44.13	3.20	272.7	1.90	47.88	3.60
182 / 26	293.2	1.93	44.54	3.30	285.7	1.86	48.42	3.72
189 / 27	306.2	1.86	44.89	3.45	298.3	1.80	48.89	3.88
196 / 28	318.9	1.81	45.19	3.56	310.5	1.74	49.30	4.04

Table 8. PIC327L Cumulative Means by Age and Energy Level

(Average of Barrows and Gilts)

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion
70 / 10	64.5				63.6			
77 / 11	76.7	1.74	22.03	1.81	75.7	1.73	22.33	1.85
84 / 12	89.8	1.81	47.08	1.86	88.4	1.77	47.86	1.93
91 / 13	103.4	1.85	74.98	1.93	101.8	1.82	76.46	2.00
98 / 14	117.6	1.90	105.49	1.99	115.6	1.86	107.93	2.08
105 / 15	132.2	1.93	138.36	2.04	129.8	1.89	142.03	2.15
112 / 16	147.1	1.97	173.30	2.10	144.3	1.92	178.50	2.21
119 / 17	162.2	1.99	210.04	2.15	159.0	1.95	217.08	2.28
126 / 18	177.4	2.02	248.33	2.20	173.7	1.97	257.51	2.34
133 / 19	192.5	2.03	287.93	2.25	188.4	1.98	299.54	2.40
140 / 20	207.6	2.04	328.64	2.30	203.1	1.99	342.96	2.46
147 / 21	222.5	2.05	370.28	2.34	217.5	2.00	387.57	2.52
154 / 22	237.3	2.06	412.71	2.39	231.8	2.00	433.20	2.58
161 / 23	251.7	2.06	455.80	2.43	245.7	2.00	479.70	2.63
168 / 24	265.9	2.06	499.45	2.48	259.4	2.00	526.94	2.69
175 / 25	279.7	2.05	543.58	2.53	272.7	1.99	574.82	2.75
182 / 26	293.2	2.04	588.12	2.57	285.7	1.98	623.24	2.81
189 / 27	306.2	2.03	633.01	2.62	298.3	1.97	672.13	2.86
196 / 28	318.9	2.02	678.20	2.67	310.5	1.96	721.43	2.92

Table 9. Growth Curves by Age and Energy Level for PIC327L Barrows

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion
70 / 10	65.4				64.5			
77 / 11	78.2	1.83	22.26	1.74	77.0	1.79	22.65	1.81
84 / 12	91.9	1.96	25.99	1.90	90.4	1.91	26.53	1.98
91 / 13	106.2	2.04	29.51	2.06	104.4	2.00	30.27	2.16
98 / 14	121.1	2.13	32.72	2.20	119.1	2.10	33.75	2.30
105 / 15	136.5	2.20	35.55	2.31	134.1	2.14	36.92	2.46
112 / 16	152.2	2.24	37.97	2.42	149.4	2.19	39.72	2.60
119 / 17	168.0	2.26	40.01	2.53	164.9	2.21	42.15	2.72
126 / 18	183.9	2.27	41.67	2.62	180.4	2.21	44.23	2.85
133 / 19	199.9	2.29	43.01	2.69	195.9	2.21	45.97	2.97
140 / 20	215.7	2.26	44.07	2.79	211.3	2.20	47.40	3.08
147 / 21	231.3	2.23	44.90	2.88	226.5	2.17	48.58	3.20
154 / 22	246.6	2.19	45.54	2.98	241.4	2.13	49.54	3.32
161 / 23	261.7	2.16	46.03	3.05	256.1	2.10	50.31	3.42
168 / 24	276.3	2.09	46.41	3.18	270.3	2.03	50.93	3.59
175 / 25	290.6	2.04	46.70	3.27	284.2	1.99	51.43	3.70
182 / 26	304.5	1.99	46.92	3.38	297.6	1.91	51.83	3.87
189 / 27	317.9	1.91	47.08	3.51	310.6	1.86	52.15	4.01
196 / 28	330.8	1.84	47.21	3.66	323.1	1.79	52.40	4.19

Table 10. Cumulative Means by Age and Energy Level for PIC327L Barrows

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion
70 / 10	65.4				64.5			
77 / 11	78.2	1.83	22.26	1.74	77.0	1.79	22.65	1.81
84 / 12	91.9	1.89	48.25	1.82	90.4	1.85	49.18	1.90
91 / 13	106.2	1.94	77.76	1.91	104.4	1.90	79.45	1.99
98 / 14	121.1	1.99	110.48	1.98	119.1	1.95	113.20	2.07
105 / 15	136.5	2.03	146.03	2.05	134.1	1.99	150.12	2.16
112 / 16	152.2	2.07	184.00	2.12	149.4	2.02	189.84	2.24
119 / 17	168.0	2.09	224.01	2.18	164.9	2.05	231.99	2.31
126 / 18	183.9	2.12	265.68	2.24	180.4	2.07	276.22	2.38
133 / 19	199.9	2.13	308.69	2.30	195.9	2.09	322.19	2.45
140 / 20	215.7	2.15	352.76	2.35	211.3	2.10	369.59	2.52
147 / 21	231.3	2.15	397.66	2.40	226.5	2.10	418.17	2.58
154 / 22	246.6	2.16	443.20	2.45	241.4	2.11	467.71	2.64
161 / 23	261.7	2.16	489.23	2.49	256.1	2.11	518.02	2.70
168 / 24	276.3	2.15	535.64	2.54	270.3	2.10	568.95	2.76
175 / 25	290.6	2.14	582.34	2.59	284.2	2.09	620.38	2.82
182 / 26	304.5	2.13	629.26	2.63	297.6	2.08	672.21	2.88
189 / 27	317.9	2.12	676.34	2.68	310.6	2.07	724.36	2.94
196 / 28	330.8	2.11	723.55	2.73	323.1	2.05	776.76	3.00

Table 11. Growth Curves by Age and Energy Level for PIC327L Gilts

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion
70 / 10	63.5				62.8			
77 / 11	75.3	1.69	21.80	1.85	74.3	1.64	22.02	1.91
84 / 12	87.7	1.77	24.11	1.94	86.4	1.73	24.53	2.03
91 / 13	100.7	1.86	26.28	2.02	99.0	1.80	26.93	2.14
98 / 14	114.1	1.91	28.31	2.11	112.1	1.87	29.19	2.23
105 / 15	128.0	1.99	30.19	2.17	125.6	1.93	31.29	2.32
112 / 16	142.1	2.01	31.91	2.26	139.3	1.96	33.23	2.43
119 / 17	156.4	2.04	33.48	2.34	153.1	1.97	35.01	2.54
126 / 18	170.8	2.06	34.90	2.42	167.0	1.99	36.63	2.64
133 / 19	185.2	2.06	36.19	2.51	180.9	1.99	38.10	2.74
140 / 20	199.6	2.06	37.35	2.59	194.8	1.99	39.43	2.84
147 / 21	213.8	2.03	38.39	2.70	208.5	1.96	40.63	2.97
154 / 22	227.9	2.01	39.32	2.79	222.1	1.94	41.71	3.07
161 / 23	241.8	1.99	40.15	2.89	235.4	1.90	42.68	3.21
168 / 24	255.5	1.96	40.90	2.99	248.5	1.87	43.55	3.32
175 / 25	268.8	1.90	41.57	3.13	261.3	1.83	44.32	3.46
182 / 26	281.9	1.87	42.16	3.22	273.8	1.79	45.02	3.60
189 / 27	294.6	1.81	42.70	3.36	286.0	1.74	45.64	3.74
196 / 28	307.0	1.77	43.18	3.48	297.8	1.69	46.20	3.92

Table 12. Cumulative Means by Age and Energy Level for PIC327L Gilts

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion
70 / 10	63.5				62.8			
77 / 11	75.3	1.69	21.80	1.85	74.3	1.64	22.02	1.91
84 / 12	87.7	1.73	45.91	1.90	86.4	1.69	46.55	1.97
91 / 13	100.7	1.77	72.19	1.94	99.0	1.72	73.48	2.03
98 / 14	114.1	1.81	100.50	1.99	112.1	1.76	102.67	2.08
105 / 15	128.0	1.84	130.69	2.03	125.6	1.79	133.96	2.13
112 / 16	142.1	1.87	162.60	2.07	139.3	1.82	167.19	2.19
119 / 17	156.4	1.90	196.08	2.11	153.1	1.84	202.20	2.24
126 / 18	170.8	1.92	230.98	2.15	167.0	1.86	238.83	2.29
133 / 19	185.2	1.93	267.17	2.20	180.9	1.87	276.93	2.34
140 / 20	199.6	1.94	304.52	2.24	194.8	1.89	316.36	2.40
147 / 21	213.8	1.95	342.91	2.28	208.5	1.89	356.99	2.45
154 / 22	227.9	1.96	382.23	2.33	222.1	1.90	398.70	2.50
161 / 23	241.8	1.96	422.38	2.37	235.4	1.90	441.38	2.56
168 / 24	255.5	1.96	463.28	2.41	248.5	1.89	484.93	2.61
175 / 25	268.8	1.96	504.85	2.46	261.3	1.89	529.25	2.67
182 / 26	281.9	1.95	547.01	2.50	273.8	1.88	574.27	2.72
189 / 27	294.6	1.94	589.71	2.55	286.0	1.88	619.91	2.78
196 / 28	307.0	1.93	632.89	2.60	297.8	1.87	666.11	2.83

Table 13. PIC280M Growth Curves by Age and Energy Level

(Average of Barrows and Gilts)

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion
70 / 10	67.9				66.0			
77 / 11	80.7	1.83	22.94	1.79	78.4	1.77	23.21	1.87
84 / 12	94.3	1.94	26.12	1.92	91.6	1.89	26.60	2.02
91 / 13	108.5	2.03	29.12	2.05	105.4	1.97	29.87	2.16
98 / 14	123.2	2.10	31.86	2.17	119.7	2.04	32.93	2.30
105 / 15	138.3	2.16	34.32	2.27	134.3	2.09	35.75	2.45
112 / 16	153.7	2.20	36.48	2.37	149.3	2.14	38.29	2.55
119 / 17	169.2	2.21	38.35	2.47	164.3	2.14	40.57	2.70
126 / 18	184.8	2.23	39.96	2.56	179.4	2.16	42.57	2.82
133 / 19	200.3	2.21	41.31	2.67	194.5	2.16	44.31	2.93
140 / 20	215.7	2.20	42.45	2.76	209.4	2.13	45.83	3.08
147 / 21	230.9	2.17	43.41	2.86	224.2	2.11	47.13	3.18
154 / 22	245.9	2.14	44.22	2.95	238.7	2.07	48.25	3.33
161 / 23	260.5	2.09	44.89	3.07	252.9	2.03	49.22	3.47
168 / 24	274.9	2.06	45.46	3.16	266.8	1.99	50.04	3.60
175 / 25	288.8	1.99	45.94	3.31	280.3	1.93	50.75	3.76
182 / 26	302.3	1.93	46.35	3.43	293.5	1.89	51.36	3.89
189 / 27	315.4	1.87	46.70	3.56	306.2	1.81	51.88	4.09
196 / 28	328.1	1.81	47.00	3.70	318.6	1.77	52.34	4.22

Table 14. PIC280M Cumulative Means by Age and Energy Level

(Average of Barrows and Gilts)

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion
70 / 10	67.9				66.0			
77 / 11	80.7	1.83	22.94	1.79	78.4	1.77	23.21	1.87
84 / 12	94.3	1.89	49.06	1.86	91.6	1.83	49.81	1.95
91 / 13	108.5	1.93	78.18	1.93	105.4	1.88	79.68	2.02
98 / 14	123.2	1.98	110.04	1.99	119.7	1.92	112.61	2.10
105 / 15	138.3	2.01	144.36	2.05	134.3	1.95	148.36	2.17
112 / 16	153.7	2.04	180.84	2.11	149.3	1.98	186.65	2.24
119 / 17	169.2	2.07	219.19	2.16	164.3	2.01	227.22	2.31
126 / 18	184.8	2.09	259.15	2.22	179.4	2.03	269.79	2.38
133 / 19	200.3	2.10	300.46	2.27	194.5	2.04	314.10	2.44
140 / 20	215.7	2.11	342.91	2.32	209.4	2.05	359.93	2.51
147 / 21	230.9	2.12	386.32	2.37	224.2	2.05	407.06	2.57
154 / 22	245.9	2.12	430.54	2.42	238.7	2.06	455.31	2.64
161 / 23	260.5	2.12	475.43	2.47	252.9	2.05	504.53	2.70
168 / 24	274.9	2.11	520.89	2.52	266.8	2.05	554.57	2.76
175 / 25	288.8	2.10	566.83	2.57	280.3	2.04	605.32	2.82
182 / 26	302.3	2.09	613.18	2.62	293.5	2.03	656.68	2.89
189 / 27	315.4	2.08	659.88	2.67	306.2	2.02	708.56	2.95
196 / 28	328.1	2.07	706.88	2.72	318.6	2.00	760.90	3.01

Table 15. Growth Curves by Age and Energy Level for PIC280M Barrows

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion
70 / 10	67.9				66.3			
77 / 11	81.2	1.90	23.45	1.76	79.1	1.83	23.43	1.83
84 / 12	95.3	2.01	27.34	1.94	92.8	1.96	27.41	2.00
91 / 13	110.1	2.11	31.01	2.10	107.1	2.04	31.24	2.18
98 / 14	125.4	2.19	34.34	2.24	121.9	2.11	34.82	2.35
105 / 15	141.2	2.26	37.27	2.36	137.1	2.17	38.08	2.51
112 / 16	157.3	2.30	39.78	2.47	152.6	2.21	40.98	2.64
119 / 17	173.5	2.31	41.88	2.59	168.3	2.24	43.51	2.77
126 / 18	189.8	2.33	43.61	2.68	183.9	2.23	45.67	2.93
133 / 19	206.0	2.31	44.99	2.78	199.5	2.23	47.50	3.04
140 / 20	222.1	2.30	46.09	2.86	214.9	2.20	49.03	3.18
147 / 21	238.0	2.27	46.95	2.95	230.1	2.17	50.29	3.31
154 / 22	253.5	2.21	47.62	3.07	245.1	2.14	51.33	3.42
161 / 23	268.7	2.17	48.13	3.17	259.6	2.07	52.18	3.60
168 / 24	283.6	2.13	48.53	3.26	273.8	2.03	52.86	3.72
175 / 25	298.0	2.06	48.83	3.39	287.6	1.97	53.42	3.87
182 / 26	312.0	2.00	49.06	3.50	300.9	1.90	53.87	4.05
189 / 27	325.4	1.91	49.24	3.67	313.8	1.84	54.24	4.20
196 / 28	338.5	1.87	49.38	3.77	326.2	1.77	54.53	4.40

Table 16. Cumulative Means by Age and Energy Level for PIC280M Barrows

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion
70 / 10	67.9				66.3			
77 / 11	81.2	1.90	23.45	1.76	79.1	1.83	23.43	1.83
84 / 12	95.3	1.96	50.79	1.85	92.8	1.89	50.84	1.92
91 / 13	110.1	2.01	81.80	1.94	107.1	1.94	82.08	2.01
98 / 14	125.4	2.05	116.14	2.02	121.9	1.99	116.90	2.10
105 / 15	141.2	2.09	153.41	2.09	137.1	2.02	154.98	2.19
112 / 16	157.3	2.13	193.19	2.16	152.6	2.05	195.96	2.27
119 / 17	173.5	2.16	235.07	2.23	168.3	2.08	239.47	2.35
126 / 18	189.8	2.18	278.68	2.29	183.9	2.10	285.14	2.42
133 / 19	206.0	2.19	323.67	2.34	199.5	2.11	332.64	2.50
140 / 20	222.1	2.20	369.76	2.40	214.9	2.12	381.67	2.57
147 / 21	238.0	2.21	416.71	2.45	230.1	2.13	431.96	2.64
154 / 22	253.5	2.21	464.33	2.50	245.1	2.13	483.29	2.70
161 / 23	268.7	2.21	512.46	2.55	259.6	2.12	535.47	2.77
168 / 24	283.6	2.20	560.99	2.60	273.8	2.12	588.33	2.84
175 / 25	298.0	2.19	609.82	2.65	287.6	2.11	641.75	2.90
182 / 26	312.0	2.18	658.88	2.70	300.9	2.09	695.62	2.97
189 / 27	325.4	2.16	708.12	2.75	313.8	2.08	749.86	3.03
196 / 28	338.5	2.15	757.50	2.80	326.2	2.06	804.39	3.09

Table 17. Growth Curves by Age and Energy Level for PIC280M Gilts

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb. / week	Feed Conversion
70 / 10	67.8				65.7			
77 / 11	80.2	1.77	22.44	1.81	77.8	1.73	22.98	1.90
84 / 12	93.3	1.87	24.90	1.90	90.5	1.81	25.80	2.03
91 / 13	106.9	1.94	27.22	2.00	103.7	1.89	28.49	2.16
98 / 14	121.0	2.01	29.38	2.08	117.5	1.97	31.04	2.25
105 / 15	135.5	2.07	31.37	2.16	131.6	2.01	33.41	2.37
112 / 16	150.2	2.10	33.18	2.26	145.9	2.04	35.61	2.49
119 / 17	165.0	2.11	34.82	2.35	160.4	2.07	37.63	2.60
126 / 18	179.8	2.11	36.31	2.45	174.9	2.07	39.46	2.72
133 / 19	194.7	2.13	37.63	2.53	189.4	2.07	41.12	2.84
140 / 20	209.4	2.10	38.82	2.64	203.9	2.07	42.62	2.94
147 / 21	223.9	2.07	39.88	2.75	218.2	2.04	43.97	3.07
154 / 22	238.3	2.06	40.82	2.83	232.3	2.01	45.18	3.20
161 / 23	252.4	2.01	41.65	2.95	246.2	1.99	46.26	3.33
168 / 24	266.1	1.96	42.39	3.09	259.8	1.94	47.22	3.47
175 / 25	279.6	1.93	43.05	3.19	273.1	1.90	48.08	3.62
182 / 26	292.7	1.87	43.64	3.33	286.1	1.86	48.85	3.76
189 / 27	305.4	1.81	44.16	3.48	298.7	1.80	49.53	3.93
196 / 28	317.7	1.76	44.62	3.63	310.9	1.74	50.15	4.11

Table 18. Cumulative Means by Age and Energy Level for PIC280M Gilts

	High Energy				Low Energy			
Days of Age / Weeks of Age	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion	Wt., lb.	ADG, lb. / day	Feed Intake, lb.	Feed Conversion
70 / 10	67.8				65.7			
77 / 11	80.2	1.77	22.44	1.81	77.8	1.73	22.98	1.90
84 / 12	93.3	1.82	47.34	1.86	90.5	1.77	48.78	1.97
91 / 13	106.9	1.86	74.56	1.91	103.7	1.81	77.27	2.03
98 / 14	121.0	1.90	103.94	1.95	117.5	1.85	108.31	2.09
105 / 15	135.5	1.93	135.31	2.00	131.6	1.88	141.72	2.15
112 / 16	150.2	1.96	168.49	2.04	145.9	1.91	177.33	2.21
119 / 17	165.0	1.98	203.31	2.09	160.4	1.93	214.96	2.27
126 / 18	179.8	2.00	239.62	2.14	174.9	1.95	254.42	2.33
133 / 19	194.7	2.01	277.25	2.18	189.4	1.96	295.54	2.39
140 / 20	209.4	2.02	316.07	2.23	203.9	1.97	338.18	2.45
147 / 21	223.9	2.03	355.95	2.28	218.2	1.98	382.13	2.51
154 / 22	238.3	2.03	396.77	2.33	232.3	1.98	427.31	2.56
161 / 23	252.4	2.03	438.42	2.37	246.2	1.98	473.57	2.62
168 / 24	266.1	2.02	480.81	2.42	259.8	1.98	520.79	2.68
175 / 25	279.6	2.02	523.86	2.47	273.1	1.98	568.87	2.74
182 / 26	292.7	2.01	567.50	2.52	286.1	1.97	617.72	2.80
189 / 27	305.4	2.00	611.66	2.57	298.7	1.96	667.25	2.86
196 / 28	317.7	1.98	656.28	2.63	310.9	1.95	717.40	2.93

Appendix 3: Gender Response

	High Energy		Low Energy	
Trait	**Barrows**	**Gilts**	**Barrows**	**Gilts**
Entry Wt., lb.	64.3	63.9	61.6	62.3
Market Wt., lb.	290.4	290.0	289.7	290.3
Ave. Daily Gain, lb. / day	2.16	1.98	2.06	1.94
Daily Feed Intake, lb. / day	5.62	4.98	5.91	5.32
Feed Conversion	2.60	2.52	2.87	2.74
Metabolizable Energy, Kcals / day	8,888	7,691	8,778	7,713
Energy Conversion, Kcals / lb. gain	4,115	3,884	4,261	3,975

Appendix 4: Feed Manufacturing

With the current ingredient costs continuing to increase the cost of production to feed a pig represents 60% to 70% of the total cost of raising a pig. Therefore, producers need to focus on the nutrition and feed manufacturing to improve efficiencies. One often overlooked area to help improve feed efficiency is the feed manufacturing process. This is a big opportunity to focus on to not only make sure diets are being manufactured correctly, but are delivered to the right barn, right bin and right pigs.

With the help of Kansas State University Grain Science and Animal Science departments, PIC has developed a one page feed mill audit for producers to use at their own feed mill or toll mill. This audit doesn't completely cover every single aspect of a feed mill; however this one page audit can be used by a producer to make sure the major areas of feed manufacturing are being done correctly so your pig's performance will be more predictable. More extensive large scale audits from top to bottom should be done by a feed mill expert if needed.

Below are the major areas of the feed mill audit and discussion on why this is important for performance of your pigs.

Quality Control/Assurance of incoming ingredients.

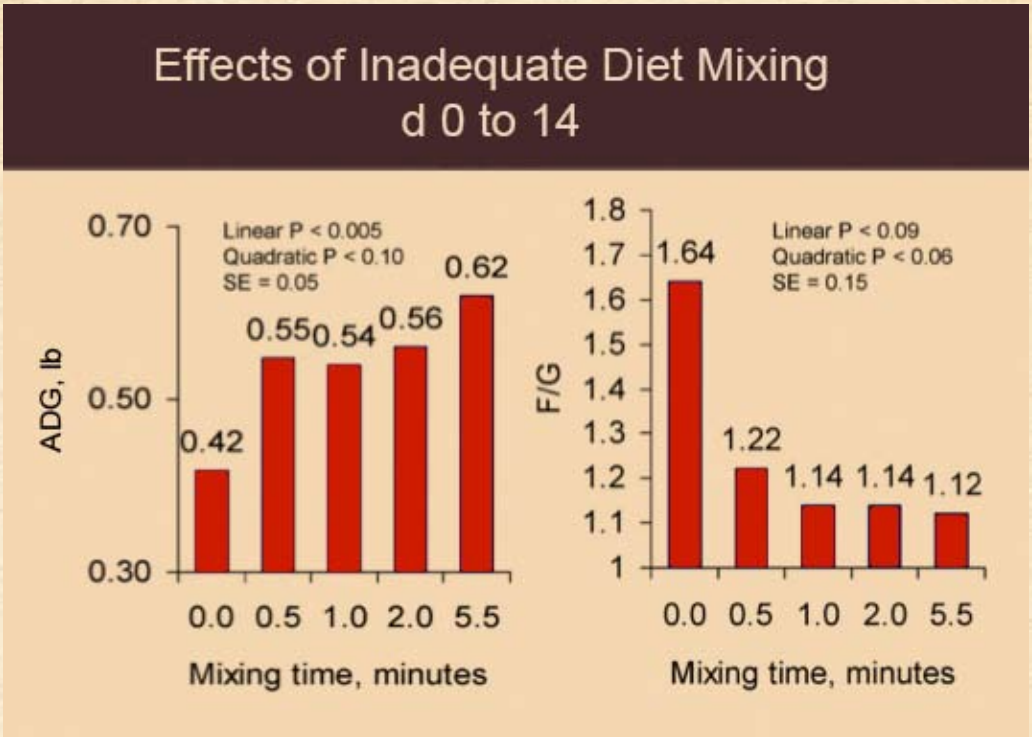
The ingredient moisture percentage should be monitored to make sure the producer is not purchasing excess moisture or water. Also if corn moisture is too high this will affect the particle size because grinding higher moisture corn will result in larger particles. Ingredients should also be tested for mycotoxins to prevent any type of off or deduced feed intake or abortions. Checking manufacture dates on vitamins, trace minerals, feed additives is important to make sure stock is being rotated and managed as "first in first out." This will help keep ingredients fresh and maintain the guarantee level of nutrients for each ingredient. To help keep ingredients fresh the bags should be stored on a pallet and away from walls to prevent heat or moisture damage. If feed additives are placed in a storage container make sure each container is properly labeled and has its own scoop. This will help prevent any cross contamination of ingredients.

Grinding, batching, mixing and scales.

One of the largest impacts on feed efficiency is the particle size of the grain you are feeding. This is why doing a feed mill audit is extremely important to understand how the grain is being ground and making sure the feed mill is recording the size and consistently achieves the particle size target. For meal diets a good goal for particle size is 500 to 600 microns and for pellets is 300 to 400 microns. Standard deviation should also be recorded and a goal for this is < 2.3. If there is a wide standard deviation this can cause flow ability problems with finished feed not flowing out of the feed bins or feeders and could cause out of feed events.

Photo: Kansas State University

Batch sheets should be reconciled with actual usage everyday to ensure no overages or underage occurred.
A mixing efficiency test should be done twice a year to ensure all ingredients are being mixed correctly to make a uniform final complete feed. If the mixer is not mixing correctly this can cause growth and feed efficiency problems. Below is a trial from Kansas State University that evaluated mixing times in the nursery. When mix time was not long enough the growth performance was reduced and feed efficiency was poorer.



Groesbeck et. al, 2006

Proper mixer coefficient of variation is < 10% as shown below. When the CV is above 10% means ingredients are not getting mixed well enough and attention is needed to fix this. Below is a table on ideas of what to do if the CV is greater than 10%.

Ingredient Mixing		
CV	**Rating**	**Corrective Action**
<10%	Excellent	None
10-15%	Good	Increase mixing time by 25-30%
15-20%	Fair	Increase mixing time by 50%, look for worn equipment, overfilling, or sequence of ingredient addition
20% +	Poor	Possible combination of all the above. Consult extension personnel or feed equipment manufacturer

All scales should be checked and validated every 6 months to ensure ingredients are added at the correct amount. This also includes liquid ingredient scales or pumps. If the calibration is not correct the feed mill maybe adding too much or not enough of any liquid ingredients (fat, amino acids, etc.) to each batch of feed.

Proper Labeling of Ingredient Bins, Finished Feed Bins, and Pest Control

These areas are important to ensure that ingredient delivered to the mill and complete feed delivered to the farm is correctly placed. Additionally, rodent plan is very important for bio-security and mill longevity reasons.

Pelleting

This area is only form mills manufacturing pelleted feeds. Pigs fed high quality pellets will have improved in feed efficiency. However, if the pellet quality is poor, meaning greater than 25% fines at the feeder pan, feed efficiency will not improve and feeding meal would result in similar results. The diet formulation has a major impact on pellet quality but checking the pellet mill temperature, cooled pellet temperature and checking the pellet durability is all important in producing a good quality pellet.

Recommendations for Quality Finished Feed

Audit Date: _____ **Mill Name:** _____

Yes	No	N/A	Frequency	Description
			Load	Corn moisture analyzed: _____ % (<15%)
			Load	Aflatoxin level analyzed: _____ ppb
			Load	Vomitoxin level analyzed: ppm
			Load	Zearalenone level analyzed: ppm
			Load	DDGS moisture analyzed: _____ % (<12%)
			Week	DDGS fat analyzed: _____ %
			Load	Wheat midd moisture analyzed: _____% (<15%)
			Load	Fat MIU analyzed: _____% (<1% moisture, <0.05% impurities, <1% unsaponifiable materials)
			Load	Feed additives stored in original, labeled containers
			Load	Feed additives stored off floor and away from walls
			Load	Ingredient lot change procedures verified
			Load	Feed additives used within 6 months of manufacture date
			Day	Drug inventory reconsiled with formulas and batch sheets
			Day	Hand-add scale cleaned and verified with check weight: ____ lb
			Shift	Corn particle size analyzed: _____ microns, _____ SD
			Day	Batch sheet reconsiled with actual usage
			Month	Liquid meters checked
			6 Months	Scale certification program in place: _____ company
			Year	Flushing sequence verified
			Year	Mixer uniformity analyzed: _____ % CV
			Year	Bulk bins labeled
			Year	Delivery bins labeled
			Year	Truck sequencing/sanitation verified
			Year	Valid mill license: _____ license number
			-	Incoming bulk records retained 18 months
			-	Feed order records retained 18 months
			-	Bulk ingredient samples (except corn)retained 6 months
			-	Finished feed samples retained 12 months
			-	Pest control program in place: _____ license number
			-	Customer complaints and response files maintained
			-	Product recall file maintained
			-	Emergency feed order file maintained
			-	Master formulas updated and maintained
			-	Delivery ticket with bin confirmation maintained
			Shift	Roller bearing grease checked
			Week	Oil temperature checked: _____ °F (Log daily, >65 degrees C or 5 degree change, inspect and clean air/oil cooler
			Month	Steam valves checked
			Week	Steam quality checked
			Day	Conditioning temperature checked: _____ °F (160-185)
			Shift	Die seals checked
			Shift	Cooled pellet temperature checked: _____ °F (<80, 12-14% MC)
			Shift	Pellet durability analyzed: _____% (> 85%)
			Total	

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DISCLAIMER.

Performance data shown in Nutrient specification tables were obtained in Commercial settings and under conditions of high health, thermo-neutral temperature and good management. They are not guaranteed levels of performance. A competent Nutritionist should adapt suggested Nutrient levels to specific conditions. These concepts are discussed in greater detail in Nutrition Technical Updates for Sows, Nursery pigs and Grow-Finish pigs.