

**AFRICAN
STANDARD**

**DARS
1833**

First Edition 2024

Compounded pig feed — Specification



Reference No. DARS 1833: 2024(E)
ICS 65.120

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Foreword

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This African Standard was prepared by ARSO/TC 17, *Animal feeding, feeds and feeding stuffs*.

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Compounded pig feed — Specification

1 Scope

This Committee Draft African Standard specifies the requirements, sampling and test methods for compounded pig feeds.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

FDARS 2139, Code of practice on good animal feeding

FDARS 1828, *Animal feeds — Code of practice for production, processing, storage, transport, and distribution*

ISO 5510, *Animal feeding stuffs — Determination of available lysine*

ISO 5983-1, *Animal feeding stuffs — Determination of nitrogen content and calculation of crude protein content — Part 1: Kjeldahl method*

ISO 5985, *Animal feeding stuffs — Determination of ash insoluble in hydrochloric acid*

ISO 6490-1, *Animal feeding stuffs — Determination of calcium content — Part 1: Titrimetric method*

ISO 6491, *Animal feeding stuffs — Determination of phosphorus content — Spectrometric method*

ISO 6492, *Animal feeding stuffs — Determination of fat content*

ISO 6495, *Animal feeding stuffs — Determination of water-soluble chlorides content*

ISO 6496, *Animal feeding stuffs — Determination of moisture and other volatile matter content*

ISO 6497, *Animal feeding stuffs — Sampling*

ISO 6865, *Animal feeding stuffs — Determination of crude fibre content — Method with intermediate filtration*

ISO 9831, *Animal feeding stuffs, animal products, and faeces or urine — Determination of gross calorific value — Bomb calorimeter method*

ISO 13903, *Animal feeding stuffs — Determination of amino acids content*

ISO 17375, *Animal feeding stuffs — Determination of aflatoxin B1*

ISO 16050, *Foodstuffs — Determination of aflatoxin B1, and the total content of aflatoxins B1, B2, G1 and G2 in cereals, nuts and derived products — High-performance liquid chromatographic method*

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ISO 27085, *Animal feeding stuff — Determination of calcium, sodium, phosphorous, magnesium, potassium, iron, zinc, copper, manganese, cobalt, molybdenum, arsenic, lead and cadmium by ICP-AES*

3 Terms and definitions

For the purposes of this African Standard, the following terms and definitions apply.

3.1

pig starter/creep feed

feed suitable for growing pigs up to 20 kg live body weight from 1 to 10 weeks

3.2

pig grower feed

feed suitable for growing pigs up to 55 kg live body weight from age of 11 to 15 weeks

3.3

pig finishing feed

feed suitable for fattening pigs weighing over 55 kg live body weight

3.4

lactating sow feed

feed suitable for lactating sows

4 Requirements

4.1 General requirements

4.1.1 All ingredients and raw materials shall not be deteriorated and shall comply with the relevant African standards. The common feed stuffs described in Annex A and their nutrient composition provided in Annex B may be used for purposes of formulating compounded pig feed.

4.1.2 Where soybean meal is used, it shall have been subjected to adequate heat treatment to reduce the activity of trypsin inhibitor.

4.1.3 Compounded pig feed shall be dry and in the form of mash crumbs or pellets

4.1.4 Compounded pig feeds shall be free from:

- a) metallic and glass objects;
- b) adulterants;
- c) physical moulds;
- d) pathogens or insect infestation;
- e) mustiness;
- f) rancidity;
- g) any objectionable odours.

4.2 Specific requirements

4.2.1 The level of free fatty acids in compounded pig feeds should not exceed 15 % of the crude fat content at the time of manufacture when tested in accordance with the requirements of ISO/TS 17764-2.

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4.2.2 Compounded pig feed shall conform to the specific requirements stated in Table 1 when tested in accordance with test methods specified therein. Annex E provides further information on the feed requirements for pig feed.

Table 1 — Specific requirements for compounded pig feed

Parameter	Creep feed	Starter feed	Grower feed	Finishing feed	Bred (gilt sow) adult boars	Lactating gilts and Sows	Test method
Moisture, %	13						ISO 6496
Metabolizable energy, Kcal/kg ^a min.	3 220	3 000	2 500	2 200	2 500	3 000	ISO 9831
Crude protein, %, min	23	20	18	15	15	16	ISO 5983-1
Crude fat, max%	5	5	5	6	6	5	ISO 6492
Crude fibre, max. %	5	5	7	7	7	7	ISO 6865
Acid insoluble ash, max.%	4	4	4	4	0.5	4	ISO 5985
Sodium chloride, max. %	0.5	0.5	0.5	0.5	0.5	0.5	ISO 6495
Calcium, min. %	1	1	0.8	0.75	0.75	0.75	ISO 6490-1
Available phosphorus ^b , min. %	0.5	0.5	0.4	0.3	0.6	0.6	ISO 6491
Lysine, min. %	1.3	0,96	0.6	0.6	0.7	0.7	ISO 5510
Cysteine ^c + Methionine, min. %	0.7	0.55	0.36	0,35	0.5	0.5	ISO 13903
Methionine, min. %	0.6	0.45	0.25	0.25	0.3	0.3	ISO 13903

^a DE=GE*0.85, ME=DE*factor (f).

For feed with < 3 % fat ME = DE*1.01 – 0.45,

For feed with ≥ 3 % fat ME = (DE*1.01 – 0.45) + (0.0046*EE % -3)

EE is ether extracts (fat)

^b Not more than 70 % of the total phosphorus content may be derived from plant origin.

^c Not more than 50 % of the cystine and methionine requirement may be in the form of cystine.

5 Feed additive

5.1 Additives in the following categories may be used in pig feeds and if used, they shall comply with the requirements given in Annex D.

- a) antioxidants;
- b) colourants;
- c) emulsifiers;
- d) stabilisers;
- e) thickeners and gelling agents;
- f) binders;
- g) anti-caking agents and coagulants;

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- h) aromatic and appetising substances;
- i) enzymes; and
- j) preservatives.
- k) Probiotics
- l) Prebiotics

NOTE Material intended for mixing with animal feed as additives for use as feeding stuff should specify the kind of and, if appropriate the age group of the animal for which the feed is intended. In addition the quantity in grams per kilogram (or percentage by weight) of the complete feed which conform to the provisions of this standard should be stated in the label.

5.2 No antibiotic substance or drug may be added to or included in a feed

5.3 Where a consignment or a batch of feed or concentrate is prepared specifically for a consumer or group of consumers, substances may be added upon the express written instructions of the consumers provided that:

- a) such additions are made in accordance with the provisions of the competent authority and/or World Organization for Animal Health (WOAH), and
- b) the nature and quantities of such additions are clearly stated upon each and every container of the feed or concentrate.

5.2 Anti-nutritive factors

Compounded pig feeds shall not contain anti-nutritive factors beyond the limits as prescribed by the competent authority and/or World Organization for Animal Health (WOAH).

6 Contaminants

6.1 Aflatoxins

Compounded pig feed shall comply with the maximum aflatoxin limits given in Table 2 when tested in accordance with the methods specified therein.

Table 2 — Maximum limits for aflatoxin in compounded pig feed

S/N	Aflatoxin	Maximum limit, µg/kg	Test method
i.	Total aflatoxin	20	ISO 16050
ii.	Aflatoxin B1	10	ISO 17375

6.2 Pesticide residues

Compounded pig feeds shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for the ingredient used in pig feed.

6.3 Heavy metals

Pig feeds shall comply with the limits of heavy metals as specified in the Table 3 when tested in accordance with the methods specified therein.

Table 3 — Limits for heavy metals in compounded pig feed

S/N	Heavy metal	Maximum limit mg/kg	Test method
i.	Arsenic	2,0	ISO 27085
ii.	Lead	5,0	
iii.	Cadmium	1,0	
iv.	Mercury	0,1	

7 Hygiene, storage and transportation

7.1 Compounded pig feed shall be processed and handled in accordance with the requirements of FDARS 2139

7.2 Compounded pig feed shall be produced, transported, received and stored in accordance with the procedure described in the appropriate sections of FDARS 1828.

8 Packaging

Compounded pig feeds for sale shall be packaged in suitable containers that are of sufficient strength, and sufficiently sealed so as to withstand reasonable handling without tearing, bursting or falling open. The containers shall be clean and not previously used.

9 Labelling

Each package of pig feed shall be legibly and indelibly labelled with the following:

- a) name and type of the pig feed
- b) name and address or contact information of manufacturer;
- c)
- d) nutrient composition: CP, CF, ME, Ca and P
- e) weight in SI units;
- f) batch or Code number;
- g) directions and precautions for use, with the basal ingredient;
- h) date of manufacture;
- i) best before date; and

9 Sampling

Sampling shall be done in accordance with the requirements of ISO 6497.

Annex A
(informative)

Description of common feedstuffs

S/N	Product	Description	Main nutritional constituent
1.	Alfalfa meal	Alfalfa as grown, dried and processed, and to which no other matter has been added	Crude protein, crude fibre
2.	Barley meal	The meal obtained by grinding barley, as grown, which shall be the whole grain together only with such other substances as may reasonably be expected to have become associated with the grain in the field.	Crude protein, crude fibre
3.	Bean meal	The meal obtained by grinding commercially pure leguminous beans (other than soya bean).	Crude protein, crude fibre
4.	Bewery and distillery grains	The product obtained by drying the residue from distillery mash-tube, and to which no other matter has been added	Crude protein, crude fibre
5.	Cassava, dried	The dried root of the species <i>Manihot esculenta</i>	starch
6.	Clover meal	Clover as grown, dried and processed and to which no other matter has been added	Crude protein, crude fibre
7.	Coconut cake	The residue resulting after part removal of oil and of cortex from commercially pure coconut kernels	Crude protein, crude fibre
8.	Cotton seed cake	The residue resulting after part removal of oil and of cortex from commercially pure cotton seed	Crude protein, crude fibre
9.	Sorghum meal	The meal obtained by grinding sorghum as grown which shall be the whole grain together only with such substances as may reasonably be expected to have become associated with the grain in the field.	Crude protein, crude fibre, starch
1.	Fish meal	A product, which may contain an added antioxidant but to which no other matter has been added, obtained by drying and grinding or otherwise treating fish or fish waste.	Crude protein, oil, total ash
2.	Grass, meal	Any product which, (i) is obtained by artificially drying any of the following: grass, clover, lucerne, green cereal, or any mixture consisting of any of them, and (ii) is otherwise as grown (that is to say including any growths harvested there with but with no other substance added thereto), and contains not less than 13 % crude protein calculated on the assumption that it contain 10 % moisture.	Crude protein, crude fibre
3.	Groundnut cake	The residue resulting after part removal of oil and part of non-removal of cortex from commercially pure groundnuts	Crude protein, oil, crude fibre
4.	Maize	Maize kernel or crushed maize kernel as grown for commercial purposes	Crude protein, starch
5.	Maize germ meal	Consisting mainly of embryo of kernel not less than 10 % oil, and not more than 5 % ash	Crude protein, starch

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6.	Maize and cob meal	Ground maize on the cob	Crude protein, oil, crude fibre
7.	Maize meal	Milled whole maize	Crude protein, oil, starch
8.	Maize gluten meal	A by-product resulting from removal of a bran starch and germ from maize	Crude protein, oil
9.	Meat and bone meal	A product, which may contain an added antioxidant but to which no other matter has been added, containing not less than 65 % protein, obtained by drying and grinding animal carcasses of portions thereof but excluding hair, have been preliminarily treated for the removal of fat	Crude protein, oil
10.	Milk powder	Dried milk from which a substantial amount of fat has been removed and to which no other substance is added	Crude protein
11.	Millet	Finger millet of the species <i>Eleusine coracana</i>	Crude protein, crude fibre, starch
12.	Mineral mixture	Mixture of substances used whether in the form powder or licks and purporting to be essential for livestock	Percent of the mineral and trace elements
13.	Molasses	A concentrated syrup product obtained in the manufacture of sugar from sugar cane to which no other matter has been added	Sugar as sucrose
14.	Oats, ground	The product obtained by grinding commercially pure oats	Crude protein, crude fibre
15.	Pea meal	The meal obtained by grinding or crushing commercially pure peas including pods	Crude protein, crude fibre
16.	Rice bran	The outside husk or rice kernel to which no other matter has been added	Crude protein, crude fibre, oil, starch
17.	Rice meal	The product obtained by grinding commercially pure rice after the removal of hulls and to which no other substance is added	Crude fibre, crude protein, oil, starch
18.	Rice polishings	The product obtained when polishing kernels after the removal of hulls and bran	Crude protein, oil, crude fibre, starch
19.	Sesame cake	The residue resulting after the part removal of oil from commercially pure simsim kernels	Crude protein, oil, crude fibre
20.	Soya bean meal	The residue resulting after the part removal of oil from commercially pure soya bean seeds	Crude protein, oil, crude fibre
21.	Sweet potatoes	The dried tubers of the species <i>Ipomea batatas</i>	Crude protein, crude fibre, starch
22.	Wheat meal	The meal obtained by grinding commercially pure wheat as grown and to which no other substance has been added	Crude protein, crude fibre, starch
23.	Wheat bran	Outside husk of what kernel to which no other matter was added	Crude protein, crude fibre, starch
24.	Wheat pollard	A by-product of wheat separated during production of flour not mentioned otherwise in this schedule containing not more than 4 % of other than wheat vegetable substances	Crude protein, crude fibre, starch
25.	Yeast dried	The product obtained by drying of yeast or yeast residues, and to which no other matter has been added.	Crude protein

Annex B
(informative)

Nutrient composition of common feed ingredients

Ingredients	DM %	CP %	CF %	Ca %	P %	ME Kcal/kg	Lysine	Methionine %
Maize	88	8	12	0.17	0.55	3000	0.53	0.29
Maize bran	88	9.4	13	0.04	1.03	2200	0.18	0.21
Maize/cob meal	88	7	8	-	0.30	-	-	-
Rice bran	88	13.5	8.5	0.06	1.43	3000	0.5	0.22
Cassava meal	88	2.8	4.0	0.3	0.05	3000	-	-
Molasses	75	3.0	-	0.75	0.08	2300	-	-
Millet	88	10.5	-	0.05	0.40	1392	0.2	0.27
Sorghum	88	9.0	-	0.03	0.28	3250	0.2	0.12
Fish meal	88	60.0	-	4.37	2.53	2310	4.08	1.70
Blood meal	92	72.9	-	0.28	0.22	1177	7.0	0.9
Cotton seed cake	88	40.0	-	0.20	1.20	968	1.6	0.52
Soya bean meal	88	43.0	-	0.53	0.64	2800	2.84	0.65
Limestone	98	-	-	38.0	-	-	-	-
Oyster shells	98	-	-	35.0	-	-	-	-
Wheat pollard	98	15.0	-	-	-	-	0.60	0.35
Wheat bran	91.4	15.0	12.5	-	1.20	-	0.60	0.35
Sunflower cake	92	35.0	26.7	-	-	-	1.80	1.20
Groundnut cake	93	40.0	7.3	-	-	-	2.00	1.80
Rice polishings	92.5	12.0	4.2	-	-	-	4.0	0.40
Bone meal	94	24	15	-	-	-	-	-
Dicalcium phosphate	-	-	-	24	18	-	-	-
Tricalium phosphate	-	-	-	38	19	-	-	-
Meat meal	-	60.0	-	-	-	-	0.50	1.0
Alfalfa hay	87.5	18.9	33.1	-	-	-	-	-
Sugarcane bagasse	90.5	1.7	50.3	-	-	-	-	-
Sesame cake	93	36.1	6.7	-	-	-	-	-
Sugarcane tops	33.5	6.2	29.5	-	-	-	-	-
Whey	90	13.0	1.3	0.97	0.76	3100	-	0.2

Annex C
(normative)

Micronutrients requirements for pig feeds

Parameter	Pig starter feed		Grower feed		Finishing feed		Lactating sow feed	
	Min	Max	Min	Max	Min	Max	Min	Max
Selenium, mg/kg	0.20	5	0.20	5	0.20	5	0.20	5
Manganese, mg/kg	20	-	20	-	20	-	20	-
Iodine, mg/kg	1.00	-	1.00	-	0.50	-	1.00	-
Zinc, mg/kg	50	-	100	-	100	-	100	-
Iron, mg/kg	100	120	80	-	125	-	80	-
Copper, mg/kg	200	400	20	-	20	180	20	-
Cobalt, mg/kg	5	-	0.3	0.6	0.3	0.6	0.3	0.6
Riboflavin, mg/kg	15	-	5	-	5	-	5	-
Pantothenic acid, mg/kg	10	-	10	-	10	-	10	-
Niacin, mg/kg	15	-	15	-	15	-	15	-
Biotin, mg/kg	0.50	-	0.05	-	0.50	-	0.05	-
Folic acid, mg/kg	0.15	-	0.15	-	0.15	-	0.15	-
Vitamin B ₁₂ , mg/kg	0.01	-	0.015	-	0.01	-	0.015	-
Vitamin A, IU/kg	10 000	-	12 000	-	8000	-	12000	-
Vitamin D ₂ , IU/kg	2 000	-	2 400	-	1600	-	2400	-
Vitamin E, IU/kg	5	-	5	-	5	-	5	-
Vitamin K, IU/kg	2	-	3	-	1	-	3	-
Tryptophan %	1.20	-	1.25	-	1.25	-	1.25	-

Commented [IU1]: Annexes C and E should be explicitly referred to within the text (ISO/IEC Directives, part 2, 2021, p.47), just the way A,B and D were. Example: "Annex B provides further information...";
 "Use the methods described in Annex C";
 "See Figure A.6";
 "Clause A.2 describes...";
 "...as specified in C.2.5."

Commented [SK2R1]: Annex C Should be deleted from the document. It has already been captured in the Pig feed premises

Commented [SK3R1]: Annex E has been referred to in clause 4.2.2

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Annex D (normative)

Recommended additives used in pig feeds

D.1 Requirements for antioxidants in pig feeds

Pig feeds shall contain no added antioxidant other than an antioxidant of a name or description specified in the first column of Table D.1 or any other antioxidant as shall be approved by OIE. Where an antioxidant is added should not exceed the maximum content, if any, specified in the second column of the Table D.1.

Table D.1 — Requirements for antioxidants in pig feeds

Name or description	Maximum content in complete feed stuff mg/kg
L-Ascorbic acid Sodium L-ascorbate Calcium di (L-ascorbate) 5,6-Diacetyl-L-ascorbic acid 6-Palmitoyl-L-ascorbic acid Tocopherol-rich extracts of a natural origin Synthetic alpha-tocopherol Synthetic gamma-tocopherol Synthetic delta-tocopherol	According to the recommendation of GMPs
Propyl gallate Octyl gallate Dodecyl gallate	100, singly or in combination
Butylated hydroxyanisole (BHA)	150

D.2 Requirements for colourants in pig feed

Pig feed shall contain no colorant other than a colorant named or described in Table 11 in accordance with the maximum content specified.

Egg yolk colouring or flavourings designed to improve the palatability of the feed may be included at the manufacturer's discretion.

TableD.2 — Requirements for colorants in pig feeds

Name or description	Maximum content in complete feed, mg/kg
Patent Blue V Acid brilliant green BS	According to the recommendation of GMPs

D.3 Requirements for emulsifiers, stabilisers, thickeners and gelling agents

D.3.1 General

Pig feeds shall contain no added emulsifier, stabiliser, thickener or gelling agent other than an emulsifier, stabiliser, thickener or gelling agent of a name or description, specified in D.3.2 and D.3.3 any other emulsifier, stabiliser, thickener or gelling agent as shall be approved by OIE.

D.3.2 Name or description

Lecithins; Alginic acid; Sodium alginate; Potassium alginate; Ammonium alginate Calcium alginate; Propylene glycol alginate (propane- 1,1-diol alginate) Agar; Carrageenan; Furcellaran; Locust bean gum (carob gum); Tamarind seed flour Guar gum (gua flour); Tragacanth; Acacia (gum Arabic); Zanthan gum; Dglucitol (sorbitol); mannitol; Glycerol; Pectins; microcrystalline cellulose; Methylcellulose; Ethylcellulose; Hydroxypropyl cellulose;Hydroxypropylmethylcellulose; Ethylmethylcellulose; Carboxymethylcellulose;sodium salt; Sodium, potassium and calcium salts or edible fatty acids alone or in mixtures, derived from edible fat or distilled fatty acids Monoacyl and diacylglycerols esterified with the following acids: (a) acetic (b) lactic (c) citric (d) tartaric (e) monoacetyltartaric and (f) diacetyltartaric.

D.3.3 Sucrose esters or fatty acids

D.3.3.1 The following sucrose esters fatty acids may be added to pig feeds:

- a) mixture of sucrose esters of monoacyl and diacylglycerols (sucroglycerides, polyglycerides);
- b) polyglycerol esters of non-polymerised edible fatty acids;
- c) propylene glycol esters of fatty acids (propane-1,2-diol esters of fatty acids);
- d) stearyl-2-lactylic acid; sodium stearyl-1,2-lactylate; calcium stearyl-1,2-lactylate;
- e) stearyl-1-tartrate; glycerol poly (ethylene glycol) ricinolate; dextrans; sorbitan monostearate;
- f) sorbitan tristearate; sorbitan monolaurate; sorbitan mono-oleate; sorbitan monopalmitate;
- g) partial polyglycerol esters of polycondensed fatty acids of castor oil (polyglycerol polyricinoleate) polyoxyethylene (20) sorbitan monolaurate;
- h) polyoxyethylene (20) sorbitan monopalmitate, polyoxyethylene (20) sorbitan monostearate;
- i) polyoxyethylene (20) sorbitan tristearate, polyoxyethylene (20) sorbitan monocleate;
- j) polyoxyethylene (20) sorbitan tricleate, polyoxyethylene (8) sorbitan stearate; and
- k) polyoxyethylene (40) stearate.

D.3.3.2 The emulsifiers, stabilisers, thickeners and gelling agents listed in Table D.2 shall conform to the requirement therein.

Table D.3 — Requirements for emulsifiers, stabilisers, thickeners and gelling agents in pig feeds

Name or description	Maximum content in complete feed, mg/kg
Poly (ethylene glycol) (M.W 6 000)	300
Polyoxypropylene-polyoxyethelene polymers (M.W 6 800-9 000)	50
Propane-1,2-diol	12000
	36 000

D.4 Requirements for binders, anti-caking agents and coagulants

D.4.1 General

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Pig feeds shall contain no added binder, anti-caking agent or coagulant other than a binder, anti-caking agent or coagulant of a name or description specified in D.4.2.

D.4.2 Name or description

Lignosulphonates; Colloidal silica; Silicic acid, precipitate and dried; Sodium aluminosilicate, Sodium, potassium and calcium stearate; Kaolin and Kaslinitic clays free of asbestos- natural accruing mixtures of minerals containing at least 65 % complex hydrated aluminium silicates whose main constituent in Kasolinite; Bentonite and other montmerillonitee clays; Vermiculite-hydrated silicate of magnesium, aluminium and iron; Citric acid; Kieselguhr (diatomaceous earth, purified); Calcium silicate (synthetic); Natural mixtures of steatite and chlorite free of asbestos.

D.5 Requirements for aromatic and appetising substances

Pig feeds shall contain no added aromatic or appetising substance other than an aromatic or appetising substance of a name or description specified in Table D.3 and taking account of any such substance which is naturally present, without exceeding the maximum content specified.

Table D.3 — Requirements for aromatic and appetising substances

Name or description	Maximum content in complete feed, mg/kg
Saccharin	According to the recommendation of GMPs
All natural products and corresponding synthetic products	

D.6 Permitted preservatives

Pig feed shall contain no added preservatives other than a preservative of a name or description specified hereunder.

- a) sorbic acid, sodium sorbate, potassium sorbate, calcium sorbate;
- b) folic acid;
- c) ammonium formate, sodium formate, calcium formate;
- d) acetic acid, potassium acetate, sodium diacetate;
- e) lactic acid, sodium lactate, potassium lactate, ammonium lactate, calcium lactate;
- f) propionic acid, sodium propionate, potassium propionate;
- g) L-tartaric acid;
- h) citric acid, sodium citrates, calcium citrates;
- i) orthophosphoric acid;
- j) fumaric acid;
- k) DL-Malic acid; and
- l) hydrochloric acid or sulphuric acid for use in silage only.

Formaldehyde may be used in pig feeds up to six months at a maximum level of 600mg/kg/

D.7 Undesirable substances

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The presence in pig feed and feed ingredients of undesirable substances such as industrial and environmental contaminants, pesticides, radionuclides, persistent organic pollutants, pathogenic agents and toxins such as mycotoxins shall be identified, controlled and minimised.

Control measures applied to reduce unacceptable level of undesirable substances shall be assessed in terms of their impact on food safety.

Annex E
(informative)

Additional requirements for pig feed

Table E.1— Dietary nutrient requirements of growing pigs allowed ad lib feed (90 % dry matter)^a

	Body weight (kg)					
	3-5	5-10	10-20	20-50	50-80	80-120
Energy and protein						
DE content of diet (kcal/kg)	3.400	3.400	3.400	3.400	3.400	3.400
ME content of diet (kcal/kg) ^b	3.265	3.265	3.265	3.265	3.265	3.25
Estimated DE intake (kcal/day)	855	1.690	3.400	6.305	8.760	10.450
Estimated ME intake (kcal/day) ^t	820	1.620	3.265	6.050	8.410	10.030
Estimated feed intake (g/day)	250	500	1.000	1.855	2,575	3.075
Crude protein (%) ^c	26.0	23.7	20.9	18.0	15.5	13.2
Linoleic acid (%)	0.10	0.10	0.10	0.10	0.10	0.10
Amino acids, total (%)^d						
Arginine	0.59	0.54	0.46	0.37	0.27	0.19
Histidine	0.48	0.43	0.36	0.30	0.24	0.19
Isoleucine	0.83	0.73	0.63	0.51	0.42	0.33
Leucine	1.50	1.32	1.12	0.90	0.71	0.54
Lysine	1.50	1.35	1.15	0.95	0.75	0.60
Methionine	0.40	0.35	0.30	0.25	0.20	0.16
Methionine + cystine	0.86	0.76	0.65	0.54	0.44	0.35
Phenylalanine	0.90	0.80	0.68	0.55	0.44	0.34
Phenylalanine + tyrosine	1.41	1.25	1.06	0.87	0.70	0.55
Threonine	0.98	0.86	0.74	0.61	0.51	0.41
Tryptophan	0.27	0.24	0.21	0.17	0.14	0.11
Valine	1.04	0.92	0.79	0.64	0.52	0.40
Minerals						
Calcium (%) ^e	0.90	0.80	0.70	0.60	0.50	0.45
Phosphorus, total (%) ^f	0.70	0.65	0.60	0.50	0.45	0.40
Phosphorus, available (%) ^f	0.55	0.40	0.32	0.23	0.19	0.15
Sodium (%)	0.25	0.20	0.15	0.10	0.10	0.10
Chlorine (%)	0.25	0.20	0.15	0.08	0.08	0.08
Magnesium (%)	0.04	0.04	0.04	0.04	0.04	0.04
Potassium (%)	0.30	0.28	0.26	0.23	0.19	0.17
Copper (mg)	6.00	6.00	5.00	4.00	3.50	3.00
Iodine (mg)	0.14	0.14	0.14	0.14	0.14	0.14
Iron (mg)	100	100	80	60	50	40
Manganese (mg)	4.00	4.00	3.00	2.00	2.00	2.00
Selenium (mg)	0.30	0.30	0.25	0.15	0.15	0.15
Zinc (mg)	100	100	80	60	50	50
Vitamins and fatty acids						
Vitamin A (IU) ^f	2.200	2.200	1.750	1.300	1.300	1.300
Vitamin D ₃ (IU) ^f	220	220	200	150	150	150
Vitamin E (IU) ^f	16	16	11	11	11	11
Vitamin K (menadione, mg)	0.50	0.50	0.50	0.50	0.50	0.50
Biotin (mg)	0.08	0.05	0.05	0.05	0.05	0.05
Choline (g)	0.60	0.50	0.40	0.30	0.30	0.30
Folacin (mg)	0.30	0.30	0.30	0.30	0.30	0.30
Niacin, available (mg) ^g	20.00	15.00	12.50	10.00	7.00	7.00
Pantothenic acid (mg)	12.00	10.00	9.00	8.00	7.00	7.00
Riboflavin (mg)	4.00	3.50	3.00	2.50	2.00	2.00
Thiamine (mg)	1.50	1.00	1.00	1.00	1.00	1.00
Vitamin B ₆ (mg)	2.00	1.50	1.50	1.00	1.00	1.00
Vitamin B ₁₂ (µg)	20.00	17.50	15.00	10.00	5.00	5.00

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^a Estimates are for the midpoint of the weight range as determined by the NRC growth model for pigs of mixed gender (1:1 ratio of barrows and gilts) with high-medium lean growth rate (325 g/day of fat-free carcass lean) from 20-120 kg body wt. DE = digestible energy, ME = metabolizable energy.

^b ME is assumed to be 96 % of DE. In corn-soybean meal diets of these crude protein levels, ME is 94-96 % of DE.

^c Crude protein levels apply to corn-soybean meal diets. In 3- to 10-kg pigs fed diets with dried plasma and/or dried milk products, protein levels will be 2-3 % less than shown.

^d Total amino acid requirements are based on the following types of diets: 3- to 5-kg pigs, corn-soybean meal diet that includes 5-25 % dried milk products; 10- to 120-kg pigs, corn-soybean meal diet.

^e The percentages of calcium, phosphorus, and available phosphorus should be increased by 0.05-0.10 percentage points for developing boars and replacement gilts from 50-120 kg body wt.

^f Conversions: 1 IU vitamin A = 0.344 mg retinyl acetate; 1 IU vitamin D₃ = 0.025 mg cholecalciferol; 1 IU vitamin E = 0.67 mg of d-a-tocopherol or 1 mg of dl-a-tocopherol acetate.

^g The niacin in corn, grain sorghum, wheat, and barley is unavailable. Similarly, the niacin in byproducts made from these cereal grains is poorly available unless the byproducts have undergone a fermentation or wet-milling process.

Table E.2 — Dietary amino acid requirements of growing pigs with different lean growth rates (Ad Lib; 90 % DM)^a

Body weight range	Body weight 50 kg -80 kg						Body weight 80 kg - 120 kg					
	300	300	325	325	350	350	300	300	325	325	350	350
Lean gain (g/day):	300	300	325	325	350	350	300	300	325	325	350	350
Gender:	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt
Average weight in range (kg)	65	65	65	65	65	65	100	100	100	100	100	100
DE content of diet (kcal/kg)	3.400	3.400	3.400	3.400	3.400	3.400	3.400	3.400	3.400	3.400	3.400	3.400
ME content of diet (kcal/kg) ^b	3.265	3.265	3.265	3.265	3.265	3.265	3.265	3.265	3.265	3.265	3.265	3.265
Estimated DE intake (kcal/day)	9.360	8.165	9.360	8.165	9.360	8.165	11.150	9.750	11.150	9.750	11.150	9.750
Estimated ME intake (kcal/day) ^b	8.985	7.840	8.985	7.840	8.985	7.840	10.705	9.360	10.705	9.360	10.705	9.360
Estimated feed intake (g/day)	2.750	2.400	2.755	2.400	2.755	2.400	3.280	2.865	3.280	2.865	3.280	2.865
Crude protein (%) ^c	14.2	15.5	14.9	16.3	15.6	17.1	12.2	13.2	12.7	13.8	13.2	14.4
Amino acid requirements:												
True ileal digestible basis (%)												
Arginine	0.20	0.23	0.22	0.26	0.25	0.28	0.13	0.15	0.15	0.17	0.16	0.19
Histidine	0.18	0.21	0.20	0.23	0.21	0.24	0.14	0.16	0.15	0.18	0.17	0.19
Isoleucine	0.32	0.36	0.34	0.39	0.37	0.42	0.25	0.29	0.27	0.31	0.29	0.33
Leucine	0.58	0.66	0.62	0.72	0.67	0.77	0.45	0.51	0.48	0.55	0.52	0.59
Lysine	0.58	0.66	0.62	0.71	0.67	0.76	0.45	0.51	0.48	0.55	0.52	0.59
Methionine	0.16	0.18	0.17	0.19	0.18	0.21	0.12	0.14	0.13	0.15	0.14	0.16
Methionine + cystine	0.34	0.39	0.36	0.42	0.39	0.44	0.27	0.31	0.29	0.33	0.31	0.35
Phenylalanine	0.34	0.39	0.37	0.42	0.40	0.46	0.27	0.30	0.29	0.33	0.31	0.35
Phenylalanine + tyrosine	0.54	0.62	0.59	0.67	0.63	0.72	0.43	0.49	0.46	0.52	0.49	0.56
Threonine	0.37	0.43	0.40	0.46	0.43	0.49	0.30	0.34	0.32	0.37	0.34	0.39
Tryptophan	0.11	0.12	0.11	0.13	0.12	0.14	0.08	0.10	0.09	0.10	0.10	0.11
Valine	0.39	0.45	0.42	0.48	0.45	0.52	0.30	0.35	0.33	0.38	0.35	0.40
Apparent ileal digestible basis (%)												
Arginine	0.19	0.21	0.21	0.24	0.23	0.26	0.12	0.13	0.13	0.15	0.15	0.17
Histidine	0.17	0.20	0.19	0.21	0.20	0.23	0.14	0.15	0.15	0.17	0.16	0.18
Isoleucine	0.29	0.34	0.31	0.36	0.34	0.39	0.23	0.26	0.24	0.28	0.26	0.30
Leucine	0.56	0.64	0.60	0.69	0.65	0.74	0.43	0.50	0.47	0.53	0.50	0.57
Lysine	0.53	0.61	0.57	0.66	0.61	0.71	0.41	0.47	0.44	0.51	0.47	0.54
Methionine	0.15	0.17	0.16	0.18	0.17	0.20	0.12	0.13	0.13	0.14	0.13	0.15
Methionine + cystine	0.31	0.36	0.34	0.39	0.36	0.41	0.25	0.29	0.27	0.31	0.29	0.33
Phenylalanine	0.32	0.36	0.34	0.39	0.37	0.42	0.24	0.28	0.26	0.30	0.28	0.32
Phenylalanine + tyrosine	0.50	0.58	0.54	0.62	0.58	0.67	0.39	0.45	0.42	0.49	0.45	0.52
Threonine	0.32	0.37	0.35	0.40	0.37	0.43	0.26	0.30	0.28	0.32	0.30	0.34
Tryptophan	0.09	0.10	0.10	0.11	0.10	0.12	0.07	0.08	0.07	0.09	0.08	0.09

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Valine	0.36	0.41	0.38	0.44	0.41	0.47	0.28	0.32	0.30	0.34	0.32	0.37
Total basis (%c)												
Arginine	0.24	0.27	0.26	0.29	0.28	0.32	0.16	0.18	0.18	0.20	0.19	0.22
Histidine	0.21	0.24	0.23	0.26	0.24	0.28	0.17	0.19	0.18	0.20	0.19	0.22
Isoleucine	0.36	0.41	0.39	0.45	0.42	0.48	0.29	0.33	0.31	0.35	0.33	0.37
Leucine	0.61	0.71	0.67	0.77	0.72	0.83	0.46	0.54	0.50	0.58	0.54	0.63
Lysine	0.67	0.76	0.72	0.82	0.77	0.88	0.53	0.60	0.57	0.64	0.60	0.69
Methionine	0.17	0.20	0.19	0.21	0.20	0.23	0.14	0.15	0.15	0.17	0.16	0.18
Methionine + cystine	0.38	0.44	0.41	0.47	0.44	0.50	0.31	0.35	0.33	0.38	0.35	0.40
Phenylalanine	0.38	0.44	0.41	0.47	0.44	0.51	0.29	0.34	0.32	0.36	0.34	0.39
Phenylalanine + tyrosine	0.61	0.70	0.65	0.75	0.70	0.80	0.48	0.54	0.51	0.59	0.55	0.63
Threonine	0.44	0.50	0.47	0.54	0.51	0.58	0.36	0.41	0.38	0.44	0.41	0.46
Tryptophan	0.12	0.14	0.13	0.15	0.14	0.16	0.10	0.11	0.10	0.12	0.11	0.13
Valine	0.45	0.51	0.48	0.55	0.52	0.59	0.35	0.40	0.38	0.43	0.40	0.46

^a Average lean growth rates of 300, 325, and 350 g/day of carcass fat-free lean represent pigs with medium, high-medium, and high lean growth rates from 20 to 120 kg body weight.

^b Assumes that ME is 96% of DE.

^c Crude protein and total amino acid requirements are based on a corn-soybean meal diet.

^d Estimated from the growth model.

Table E.3 — Dietary requirements of gestating and lactating sows (90 % DM)^a

	Gestation ^b	Lactation ^b
DE content of diet (kcal/kg)	3.400	3.400
ME content of diet (kcal/kg) ^c	3.265	3.265
Estimated DE intake (kcal/day)	6.405	18.205
Estimated ME intake (kcal/day) ^c	6.150	17.475
Estimated feed intake (kg/day)	1.88	5.35
Crude protein (%) ^d	12.4	17.5
Linoleic acid (%)	0.10	0.10
Amino acids, total (%)^e		
Arginine	0.00	0.48
Histidine	0.17	0.36
Isoleucine	0.31	0.50
Leucine	0.46	0.97
Lysine	0.54	0.91
Methionine	0.14	0.23
Methionine + cystine	0.37	0.44
Phenylalanine	0.30	0.48
Phenylalanine + tyrosine	0.51	1.00
Threonine	0.44	0.58
Tryptophan	0.11	0.16
Valine	0.36	0.76
Minerals		
Calcium (%)	0.75	0.75
Phosphorus, total (%)	0.60	0.60
Phosphorus, available (%)	0.35	0.35
Sodium (%)	0.15	0.20
Chlorine (%)	0.12	0.16
Magnesium (%)	0.04	0.04
Potassium (%)	0.20	0.20
Copper (mg)	5.00	5.00
Iodine (mg)	0.14	0.14
Iron (mg)	80	80
Manganese (mg)	20	20
Selenium (mg)	0.15	0.15
Zinc (mg)	50	50
Vitamins		
Vitamin A (IU) ^f	4,000	2,000
Vitamin D ₃ (IU) ^g	200	200
Vitamin E (IU) ^g	44	44
Vitamin K (menadione, mg)	0.50	0.50
Biotin (mg)	0.20	0.20
Choline (g)	1.25	1.00
Folacin (mg)	1.30	1.30
Niacin, available (mg) ^h	10	10
Pantothenic acid (mg)	12	12
Riboflavin (mg)	3.75	3.75

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Thiamine (mg)	1.00	1.00
Vitamin B ₆ (mg)	1.00	1.00
Vitamin B ₁₂ (µg)	15	15
<p>^a Estimates for gestation are for a sow weighing 175 kg breeding and gaining 40 kg body wt during gestation (includes maternal tissue and products of conception) with an anticipated litter size of 12 piglets.</p> <p>^b Estimates for lactation are for a sow weighing 175 kg post-farrowing and losing no weight during a 21-day lactation while nursing 10 piglets that each gain 200 g/day.</p> <p>^c ME is assumed to be 96% of DE.</p> <p>^d Crude protein levels are based on corn-soybean meal diets.</p> <p>^e Total amino acid requirements are based on corn-soybean meal diets.</p> <p>^f Conversions: 1 IU vitamin A = 0.344 mg retinyl acetate; 1 IU vitamin D₃ = 0.025 mg cholecalciferol; 1 IU vitamin E = 0.67 mg of d-a-tocopherol or 1 mg of dl-a-tocopherol acetate.</p> <p>^g The niacin in corn, grain sorghum, wheat, and barley is unavailable. Similarly, the niacin in byproducts made from these cereal grains is poorly available unless the byproducts have undergone a fermentation or wet-milling process.</p>		

* The requirements are based on the daily consumption of 1.85 and 5.25 kg of feed, respectively. If lower amounts of feed are consumed, the dietary percentage may need to be increased. DE = digestible energy; ME = metabolizable energy.

Table E.4 — Dietary mineral, vitamin, and fatty acid requirements of growing pigs (Ad Lib; 90% DM)^a

	Body weight					
	kg					
	3-5	5-10	10-20	20-50	50-80	80-120
Average weight in range (kg)	4	7.5	15	35	65	100
DE content of diet (kcal/kg)	3.400	3.400	3.400	3.400	3.400	3.400
ME content of diet (kcal/kg) ^b	3.265	3.265	3.265	3.265	3.265	3.265
Estimated DE intake (kcal/day)	855	1.690	3.400	6.305	8.760	10.450
Estimated ME intake (kcal/day) ^b	820	1.620	3.265	6.050	8.410	10.030
Estimated feed intake (g/day)	250	500	1.000	1.855	2.575	3.075
Linoleic acid (%)	0.10	0.10	0.10	0.10	0.10	0.10
Requirements (% or amount/kg of diet):						
Mineral elements						
Calcium (%) ^c	0.90	0.80	0.70	0.60	0.50	0.45
Phosphorus, total (%) ^c	0.70	0.65	0.60	0.50	0.45	0.40
Phosphorus, available (%) ^c	0.55	0.40	0.32	0.23	0.19	0.15
Sodium (%)	0.25	0.20	0.15	0.10	0.10	0.10
Chlorine (%)	0.25	0.20	0.15	0.08	0.08	0.08
Magnesium (%)	0.04	0.04	0.04	0.04	0.04	0.04
Potassium (%)	0.30	0.28	0.26	0.23	0.19	0.17
Copper (mg)	6.00	6.00	5.00	4.00	3.50	3.00
Iodine (mg)	0.14	0.14	0.14	0.14	0.14	0.14
Iron (mg)	100	100	80	60	50	40
Manganese (mg)	4.00	4.00	3.00	2.00	2.00	2.00
Selenium (mg)	0.30	0.30	0.25	0.15	0.15	0.15
Zinc (mg)	100	100	80	60	50	50
Vitamins						
Vitamin A (IU) ^d	2.200	2.200	1.750	1.300	1.300	1.300
Vitamin D ₃ (IU) ^d	220	220	200	150	150	150
Vitamin E (IU) ^d	16	16	11	11	11	11
Vitamin K (menadione) (mg)	0.50	0.50	0.50	0.50	0.50	0.50
Biotin (mg)	0.08	0.05	0.05	0.05	0.05	0.05
Choline (g)	0.60	0.50	0.40	0.30	0.30	0.30
Folic acid (mg)	0.30	0.30	0.30	0.30	0.30	0.30
Niacin, available (mg) ^e	20.00	15.00	12.50	10.00	7.00	7.00
Pantothenic acid (mg)	12.00	10.00	9.00	8.00	7.00	7.00

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Riboflavin (mg)	4.00	3.50	3.00	2.50	2.00	2.00
Thiamin (mg)	1.50	1.00	1.00	1.00	1.00	1.00
Vitamin B6 (mg)	2.00	1.50	1.50	1.00	1.00	1.00
Vitamin B12 (µg)	20.00	17.50	15.00	10.00	5.00	5.00

^a Pigs of mixed gender (1:1 ratio of barrows to gilts). The requirements of certain minerals and vitamins may be slightly higher for pigs having high lean growth rates (>325 g/day of carcass fat-free lean), but no distinction is made.

^b Assumes that ME is 96 % of DE. In corn-soybean meal diets, ME is 94-96 % of DE, depending on crude protein level of the diet.

^c The percentages of calcium, phosphorus, and available phosphorus should be increased by 0.05 to 0.1 percentage points for developing boars and replacement gilts from 50 to 120 kg body weight.

^d Conversions: 1 IU vitamin A = 0.344 µg (g retinyl acetate); 1 IU vitamin D₃ = 0.025 µg cholecalciferol; 1 IU vitamin E = 0.67 mg of D-α-tocopherol or 1 mg of DL-α-tocopheryl acetate.

^e The niacin in corn, grain sorghum, wheat, and barley is unavailable. Similarly, the niacin in by-products made from these cereal grains is poorly available unless the by-products have undergone a fermentation or wet-milling process.

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Table E.5 — Daily amino acid requirements of gestating sows (90 % DM)^a

	Body weight at breeding kg					
	125	150	175	200	200	200
	Gestation weight gain					
	55	45	40	35	30	35
	Anticipated pigs in litter					
	11	12	12	12	12	14
DE content of diet (kcal/kg)	3.400	3.400	3.400	3.400	3.400	3.400
ME content of diet (kcal/kg) ^c	3.265	3.265	3.265	3.265	3.265	3.265
Estimated DE intake (kcal/day)	6.660	6.265	6.405	6.535	6.115	6.275
Estimated ME intake (kcal/day) ^c	6.395	6.015	6.150	6.275	5.870	6.025
Estimated feed intake (kg/day)	1.96	1.84	1.88	1.92	1.80	1.85
Crude protein (%) ^d	12.9	12.8	12.4	12.0	12.1	12.4
Amino acid requirements:						
True ileal digestible basis (g/day)						
Arginine	0.8	0.1	0.0	0.0	0.0	0.0
Histidine	3.1	2.9	2.8	2.7	2.5	2.7
Isoleucine	5.6	5.2	5.1	5.0	4.7	5.0
Leucine	9.4	8.7	8.3	7.9	7.4	8.1
Lysine	9.7	9.0	8.7	8.4	7.9	8.5
Methionine	2.7	2.5	2.4	2.3	2.2	2.3
Methionine + cystine	6.4	6.1	6.1	6.0	5.7	6.1
Phenylalanine	5.7	5.2	5.0	4.8	4.6	4.9
Phenylalanine + tyrosine	9.5	8.9	8.6	8.4	7.9	8.5
Threonine	7.3	7.0	6.9	6.9	6.6	7.0
Tryptophan	1.9	1.8	1.7	1.7	1.6	1.7
Valine	6.6	6.1	5.9	5.7	5.4	5.8
Apparent ileal digestible basis (g/day)						
Arginine	0.6	0.0	0.0	0.0	0.0	0.0
Histidine	2.9	2.7	2.6	2.5	2.4	2.6
Isoleucine	5.1	4.8	4.7	4.5	4.3	4.6
Leucine	9.2	8.4	8.1	7.7	7.3	7.9
Lysine	8.9	8.2	7.9	7.6	7.2	7.7
Methionine	2.5	2.4	2.3	2.2	2.1	2.2
Methionine + cystine	6.0	5.7	5.7	5.6	5.3	5.7
Phenylalanine	5.2	4.8	4.6	4.4	4.2	4.5
Phenylalanine + tyrosine	8.8	8.2	8.0	7.7	7.3	7.9
Threonine	6.3	6.0	6.0	6.0	5.7	6.1
Tryptophan	1.6	1.5	1.4	1.4	1.3	1.4
Valine	6.0	5.6	5.4	5.2	4.9	5.3
Total basis (g/day)						
Arginine	1.3	0.5	0.0	0.0	0.0	0.0
Histidine	3.6	3.4	3.3	3.2	3.0	3.2
Isoleucine	6.4	6.0	5.9	5.7	5.4	5.8
Leucine	9.9	9.0	8.6	8.2	7.7	8.3
Lysine	11.4	10.6	10.3	9.9	9.4	10.0
Methionine	2.9	2.7	2.6	2.6	2.4	2.6
Methionine + cystine	7.3	7.0	6.9	6.8	6.5	6.9
Phenylalanine	6.3	5.8	5.6	5.4	5.0	5.4
Phenylalanine + tyrosine	10.6	9.9	9.6	9.4	8.9	9.5
Threonine	8.6	8.3	8.3	8.2	7.8	8.3
Tryptophan	2.2	2.0	2.0	1.9	1.8	2.0
Valine	7.6	7.0	6.8	6.6	6.2	6.7

^a Daily intakes of DE and feed and the amino acid requirements are estimated by the gestation model.

^b Weight gain includes maternal tissue and products of conception.

^c Assumes that ME is 96% of DE.

^d Crude protein and total amino acid requirements are based on a corn-soybean meal diet.

Table E.6 — Daily amino acid requirements of lactating sows (90% DM)^a

	Sow postfarrowing weight kg					
	175	175	175	175	175	175
	Anticipated Lactational Weight Change (kg) ^b					
	0	0	0	-10	-10	-10

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	Daily Weight Gain of Pigs (g) ^b					
	150	200	250	150	200	250
DE content of diet (kcal/kg)	3.400	3.400	3.400	3.400	3.400	3.400
ME content of diet (kcal/kg) ^c	3.265	3.265	3.265	3.265	3.265	3.265
Estimated DE intake (kcal/day)	14.645	18.205	21.765	12.120	15.680	19.240
Estimated ME intake (kcal/day) ^c	14.060	17.475	20.895	11.635	15.055	18.470
Estimated feed intake (kg/day)	4.31	5.35	6.40	3.56	4.61	5.66
Crude protein (%) ^d	16.3	17.5	18.4	17.2	18.5	19.2
Amino acid requirements:						
True ileal digestible basis (g/day)						
Arginine	15.6	23.4	31.1	12.5	20.3	28.0
Histidine	12.2	17.0	21.7	10.9	15.6	20.3
Isoleucine	17.2	23.6	30.1	15.6	22.1	28.5
Leucine	34.4	48.0	61.5	31.0	44.5	58.1
Lysine	30.7	42.5	54.3	27.6	39.4	51.2
Methionine	8.0	11.0	14.1	7.2	10.2	13.2
Methionine + cystine	15.3	20.6	26.0	13.9	19.2	24.5
Phenylalanine	16.8	23.3	29.7	14.9	21.4	27.9
Phenylalanine + tyrosine	34.6	47.9	61.1	31.4	44.6	57.8
Threonine	19.5	26.4	33.3	17.7	24.6	31.5
Tryptophan	5.5	7.6	9.7	5.2	7.3	9.4
Valine	25.8	35.8	45.8	23.6	33.6	43.6
Apparent ileal digestible basis (g/day)						
Arginine	14.6	22.0	29.3	11.7	19.1	26.4
Histidine	11.5	16.0	20.5	10.2	14.7	19.2
Isoleucine	15.9	21.9	27.9	14.5	20.5	26.5
Leucine	33.0	45.9	58.7	29.7	42.6	55.4
Lysine	28.4	39.4	50.4	25.5	36.5	47.5
Methionine	7.6	10.5	13.4	6.8	9.7	12.6
Methionine + cystine	14.2	19.2	24.1	12.9	17.8	22.8
Phenylalanine	15.5	21.6	27.6	13.8	19.9	25.9
Phenylalanine + tyrosine	32.3	44.7	57.1	29.3	41.7	54.1
Threonine	17.1	23.1	29.2	15.5	21.6	27.7
Tryptophan	4.7	6.6	8.4	4.5	6.3	8.1
Valine	23.6	32.8	42.0	21.6	30.8	40.0
Total basis (g/day)						
Arginine	17.4	25.8	34.3	14.0	22.4	30.8
Histidine	13.8	19.1	24.4	12.2	17.5	22.8
Isoleucine	19.5	26.8	34.1	17.7	25.0	32.3
Leucine	37.2	52.1	67.0	33.7	48.6	63.5
Lysine	35.3	48.6	61.9	31.6	44.9	58.2
Methionine	8.8	12.2	15.6	7.9	11.3	14.6
Methionine + cystine	17.3	23.4	29.4	15.7	21.7	27.8
Phenylalanine	18.7	25.9	33.2	16.6	23.9	31.1
Phenylalanine + tyrosine	38.7	53.4	68.2	35.1	49.8	64.6
Threonine	23.0	31.1	39.1	20.8	28.8	36.9
Tryptophan	6.3	8.6	11.0	5.9	8.2	10.6
Valine	29.5	40.9	52.3	26.9	38.4	49.8
^a Daily intakes of DE and feed and the amino acid requirements are estimated by the lactation model.						
^b Assumes 10 pigs per litter and a 21-day lactation period.						
^c Assumes that ME is 96% of DE. In corn-soybean meal diets of these crude protein levels, ME is 95-96% of DE.						
^d Crude protein and total amino acid requirements are based on a corn-soybean meal diet.						

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Table E.7 — Dietary and daily amino acid, mineral, vitamin, and fatty acid requirements of sexually active boars (90% DM)^a

DE content of diet (kcal/kg)	3.400		3.400	
ME content of diet (kcal/kg)	3.265		3.265	
DE intake (kcal/day)	6.800		6.800	
ME intake (kcal/day)	6.530		6.530	
Feed intake (kg/day)	2.00		2.00	
Linoleic acid	0.1 %		2.0 g	
Crude protein (%)	13.0		13.0	
	% or Amount/kg of diet		Amount/day	
Amino acids (total basis) ^b				
Arginine	—		—	
Histidine	0.19	%	3.8	g
Isoleucine	0.35	%	7.0	g
Leucine	0.51	%	10.2	g
Lysine	0.60	%	12.0	g
Methionine	0.16	%	3.2	g
Methionine + cystine	0.42	%	8.4	g
Phenylalanine	0.33	%	6.6	g
Phenylalanine + tyrosine	0.57	%	11.4	g
Threonine	0.50	%	10.0	g
Tryptophan	0.12	%	2.4	g
Valine	0.40	%	8.0	g
Mineral elements				
Calcium	0.75	%	15.0	g
Phosphorus, total	0.60	%	12.0	g
Phosphorus, available	0.35	%	7.0	g
Sodium	0.15	%	3.0	g
Chlorine	0.12	%	2.4	g
Magnesium	0.04	%	0.8	g
Potassium	0.20	%	4.0	g
Copper	5	mg	10	mg
Iodine	0.14	mg	0.28	mg
Iron	80	mg	160	mg
Manganese	20	mg	40	mg
Selenium	0.15	mg	0.3	mg
Zinc	50	mg	100	mg
Vitamins				
Vitamin A ^c	4,000	IU	8,000	IU
Vitamin D3 ^c	200	IU	400	IU
Vitamin E ^c	44	IU	88	IU
Vitamin K (menadione)	0.50	mg	1.0	mg
Biotin	0.20	mg	0.4	mg
Choline	1.25	g	2.5	g
Folacin	1.30	mg	2.6	mg
Niacin, available ^d	10	mg	20	mg
Pantothenic acid	12	mg	24	mg
Riboflavin	3.75	mg	7.5	mg
Thiamin	1.0	mg	2.0	mg
Vitamin B ₆	1.0	mg	2.0	mg
Vitamin B ₁₂	15	µg	30	µg
^a The requirements are based on the daily consumption of 2.0 kg of feed. Feed intake may need to be adjusted, depending on the weight of the boar and the amount of weight gain desired.				
^b Assumes a corn-soybean meal diet. The lysine requirement was set as 0.60 % (12.0 g/day). Other amino acids were calculated using ratios (total basis) similar to those for gestating sows.				
^c Conversions: 1 IU vitamin A = 0.344 µg retinyl acetate; 1 IU vitamin D ₃ = 0.025 µg cholecalciferol; 1 IU vitamin E = 0.67 mg of D-α-tocopherol or 1 mg of DL-α-tocopheryl acetate.				
^d The niacin in corn, grain sorghum, wheat, and barley is unavailable. Similarly, the niacin in by-products made from these cereal grains is poorly available unless the by-products have undergone a fermentation or wet-milling process.				

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