AFRICAN STANDARD

DARS 1827

First Edition 2024

Compounded cattle feed — Specification

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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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Introduction

To achieve efficient cattle production, all nutrients should be provided in amounts necessary to meet the animal's requirements. The formulation of balanced diets that provide the correct amounts and proportions of these nutrients are essential to support the requirements for maintenance and production. Nutrient requirements become defined accurately through research trials so as to formulate diets more precisely. The standards presented in this document give the restrictions required for the prevention of poor animal performance.

To effectively achieve and increase animal production capacity, all nutrients must be provided in sufficient amounts formulated to meet maintenance and production needs. This standard contains the technical requirements on safety and quality of compounded cattle feeds.

Compounded cattle feed — Specification

1 Scope

This Draft African Standard specifies the requirements, sampling, and test methods for compounded cattle feeds. This standard applies to feeds for dairy and beef cattle.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 good practice on animal feeding*

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

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

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

ISO 5984, *Animal feeding stuffs — determination of crude ash*

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 6495, *Animal feeding stuffs — determination of water-soluble chlorides content — part 1: titrimetric method*

ISO 6497 *Animal feeding stuffs — Sampling*

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

ISO 17375, *Animal feeding stuffs — Determination of aflatoxin B_1*

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

ISO 17375, Animal feeding stuffs — Determination of aflatoxin B1

ISO 16472: Animal feeding stuffs — Determination of amylase-treated neutral detergent fibre content (aNDF)

ISO 2591-1, *Test sieving — Part 1: Methods using test sieves of woven wire cloth and perforated metal plate*

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

ISO 6654, *Animal feeding stuffs — Determination of urea content*

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

ISO 6866, *Animal feeding stuffs — Determination of free and total gossypol*

ISO 6867, *Animal feeding stuffs — Determination of vitamin E content — Method using high-performance liquid chromatography*

ISO 6869, *Animal feeding stuffs — Determination of the contents of calcium, copper, iron, magnesium, manganese, potassium, sodium and zinc — Method using atomic absorption spectrometry*

ISO 14565, *Animal feeding stuffs — Determination of vitamin A content — Method using high-performance liquid chromatography*

ISO 14718, *Animal feeding stuffs — Determination of aflatoxin B_1 content of mixed feeding stuffs — Method using high-performance liquid chromatography*

ISO 16634-1, *Food products — Determination of the total nitrogen content by combustion according to the Dumas principle and calculation of the crude protein content — Part 1: Oilseeds and animal feeding stuffs*

ISO 7937, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of Clostridium perfringens — Colony-count technique*

EN 13207 - Thermoplastic silage films and tubes for use in agriculture

EN 14932 - Thermoplastic stretch fils for wrapping silage bales

3 Terms and definitions

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

3.1
feed ingredients
component part or constituent of any combination of mixture making up cattle feed, whether or not it has a nutritional value in the cattle's diet, including feed additives

3.2
NPN free concentrate
feed suitable for cattle, not containing non protein nitrogen sources and designed to be fed in conjunction with such quantity of roughage as may be necessary for the class of cattle

3.3
calf feed (starter)
concentrate feed for young calf from birth to 6 months of age

3.4
concentrate feed mixture
CFM
compounded mixture which when mixed with maize meal, maize/cob meal, or maize bran of nominal composition, in proportions stated by the manufacturer, produces a resultant feed equal in all respects to the feed of relevant designation specified in these standards

3.5
total mixed ration
TMR
homogenous mixture of all ration ingredients (e.g., forages, grains, feed supplements) that is supplied to cattle

3.6
complete dry feed
homogenous mixture of all ration ingredients (e.g., dry forages, dry roughage, grains, feed supplements) that contain all animal nutrients allowance

3.7
feed additives
substance intentionally added to cattle feed and/or water, not consumed as feed by itself, whether or not it has a nutritional value, that affects the characteristics of feed including organoleptic properties, animal products, animal production or performance or welfare, or the environment

3.8
antioxidant
substance prolonging the storage life of cattle feed and cattle feed ingredients by protecting them against deterioration caused by oxidation

3.9
crude fat
ether extract
EE
total fat content of cattle feed determined by a laboratory test

3.10
crude fibre
residue obtained after acid and alkaline digestion of a cattle feed sample that contains cellulose, hemicellulose and lignin

3.11
crude protein
CP
total protein content of cattle feed which is determined by analysing the nitrogen content of feed and multiplying the result by a factor

3.12
metabolizable energy
ME
amount of the useful energy in cattle feed that represents that portion of the feed gross energy not lost in feaces, urine and gaseous products of fermentation (calculated from chemical composition)

3.13
minerals
measure of the content of individual minerals in a feed

3.14
moisture content
mass fraction of substances lost on drying the sample by using the accredited procedure

3.15
total digestible nutrients
TDN
sum of the digestible fibre, protein, crude fat and nitrogen free extracts content of cattle feed, which expresses the energy value of feed as calculated using formulae and not reported as measured values

3.16
total ash
inorganic part of cattle feed consisting of mineral elements determined in a laboratory by incineration at a high temperature and weighing the residue

3.17
undesirable substances
contaminants and other substances, which are present in cattle feed, feed ingredients and which constitute a risk to the health of consumer, including food safety related animal health issues

3.18
dietary cation-anion difference
DCAD
simple calculation of adding together the milliequivalents of dietary cations (sodium + potassium) and subtracting the sum of the milliequivalents of dietary anions (chloride + sulfur)

3.19
degradable protein
portion of dietary protein that can be degraded in the rumen

3.20
undegradable protein
portion of dietary protein that escapes degradation by ruminal microorganisms and is passed into the small intestine for digestion and absorption

3.21
metabolizable protein
total amount of amino acids absorbed in small intestine of ruminants, which is supplied by both rumen-undegradable protein (by-pass protein) and rumen-microbial protein

3.22
dairy calves
young dairy cattle up to 3 months of age

3.23
dairy cows
female cattle especially bred and kept for milk production, and have calved at least once

3.24
heifers
female cattle from 8 months up to the point of 1st calving

3.25
dairy feed
feed suitable for lactating dairy cows and designed to provide the nutritional requirements for milk production

3.26
weaners
young cattle between age 3 - 8 months

3.27
dry cow
dairy cow that is in a stage of their lactation cycle where there is no milk production, and typically last between 40 - 65 days

3.28
transitional period
three weeks before calving and the three weeks following calving

3.29
growing calf stage 1
calf aged from 3 - 6 months

3.30
growing calf stage 2
calf aged from 6 -12 months

3.31
high lactating cows
lactating cow that is producing above the herd average in its previous lactation

2.32
low lactating cows
lactating cow that is producing lower than the herd average in its previous lactation

3.33
fattening stages
fattening stage 1 and stage 2

3.34
protected fat
fat sources specifically designed to resist biohydrogenation by ruminal microbes

4 Requirements

4.1 General requirements

4.1.1 Compounded cattle feed shall be palatable.
4.1.2 Compounded cattle feed shall be in the form of a meal, cubes, pellets or bales
4.1.3 Where the feed is in the form of mash, the particle size of less than 1 mm shall not be more than 35 % of the total mash. Annex G provides further information on the sizing of feed.
4.1.4 Compounded cattle feed shall be free from harmful constituents such as

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

4.1.6 Non – protein nitrogen (NPN) sources may be used in compounded feed for all types of matured cattle and shall not exceed 1.5 % on DM basis.

Note 1 Where NPN has been added, the compounded cattle feed shall contain not less than 10 % by mass of easily digestible carbohydrates like molasses, cereal grains, potato starch, tapioca starch, etc.

Note 2 Inorganic sulphur source should be added to the rations of dairy cattle and other ruminants when NPN furnishes part of the nitrogen so that the elements provide a ratio of approximately 15 parts of nitrogen to 1 part of sulphur.

4.1.7 Vitamins preparations added to feed shall be in stabilised form.

4.1.8 Compounded cattle feed shall not contain more than 10 % of fish meal

4.2 Ingredients

All ingredients shall not be deteriorated and shall comply with relevant African standards. Annex B and C provides further information on the nutrient composition of common feed ingredients and a description of common feedstuffs

4.3 Specific requirements

Nutrient and quality requirements of compounded cattle feeds shall conform to the specifications in Tables 1 - 4 when tested in accordance with the methods specified therein.

4.3.1 Requirement for calf starter feed

Calf starter feed shall:

a) be highly nutritive and palatable;
b) be free from NPN sources;
c) contain not more than 5 % of fish meal;
d) have calcium/phosphorus ratio maintained between 1:3 and 1:5;
e) be free from whole or ground corticated cottonseed;
f) be free from whole rice husks;
g) contain no more than 0.02 % of gossypol;
h) be free from ground raw soybean seed or soybean meal which has not been subjected to adequate heat treatment; and
i) conform to the calf nutrient requirements in Table 1.

Table 1 — Nutrient requirements for calf starter

Item	Calf starter	Test method
Moisture, %, max	14	ISO 6496
ME, kcal/kg, DM	2480 - 3370	Annex A
Crude protein (CP),% DM	16 - 22	ISO 5983-1
Crude fibre (CF), % DM, max.	8	ISO 5498
Neutral Detergent Fibre (NDF), %, DM	13 - 25	ISO 16472
Total ash , %, DM	7 – 9,1	ISO 5984
Calcium,%, DM, min.	0.7	ISO 6490-1
Total phosphorus,%, DM. min	0.5	ISO 6491
Sodium chloride, % max.	0.5	ISO 6495

4.3.2 Requirements for wet total mixed ration

Wet total mixed ration shall conform to the requirements specified in Table (2) when tested in accordance with the methods specified therein . Compounded cattle feed may meet the requirements for rumen degradable and undegradable protein, DCAD, minerals and supplement as listed in annex D, W and F and E).

Table 2 — Requirements for wet total mixed ration for growing calves, heifers and lactating cattle

Items	Growing calf stage 1	Growing calf stage 2	Heifers under service	Dry cows	Low lactating cows	high lactating cows	Test methods
Moisture, %, max.	50	50	50	50	50	50	ISO 6496
ME, kcal/kg, DM min.	1 900	1 900	2 120	1 890	2 390	2 600	Annex A
Crude protein, % DM	12,0 - 15	11,5 – 12,6	12,7	11,9	16 - 17	17 - 18	ISO 5983-1
Crude fat %, DM, max.	8	8	8	8	8	8	ISO 11058
Total Neutral Detergent Fibre (TNDF), %, DM	25 - 33	25 - 33	25 - 33	25 - 33	25 - 33	25 - 33	ISO 16472
Calcium, %, DM	0,4 – 0,6	0,37 – 0,44	0,39	0,31 – 0,37	0,57	0,57	ISO 6490-1
Total phosphorus, %, DM	0,2 – 0,26	0,18- 0,21	0,19	0,19 – 0,21	0,35	0,35	ISO 6491
Sodium chloride, %	0,25 – 0,5	0,25 – 0,5	0,25 – 0,5	0,25 – 0,5	0,25 – 0,5	0,25 – 0,5	ISO 6495
Note 1 Fat percent may be higher than 8% where the fat used is in the form of protected fat. Note 2 The forage neutral detergent fibre may be between 19 – 25 %, DM for the total mixed ration							

4.3.3 Requirements for concentrate feed mixture (CFM)

Concentrate feed mixture shall be used in compounded cattle feed. Where used, it shall comply to the requirements specified in Table 3 when tested with the methods specified therein.

Table 3 — Requirements of concentrate feed mixture for different stages of dairy and beef cattle

Items	Concentrate feed mixture (CFM)								Test methods
	Growing calf stage 1	Growing calf stage 2	Heifers under service	Dry cow	low lactating cows	High lactating cows	Fattening stage 1	Fattening stage 2	
Moisture, %, max.	14	14	14	14	14	14	14	14	ISO 6496
ME, kcal/kg,, DM, min.	2 350	2 450	2 350	2 200	2 700	2 800	2 400	2 600	Annex A
Crude protein, % DM, min.	16,00	15,00	14,00	12,00	16,00	17,00	14,00	12,00	ISO 5983-1
Crude fat %, DM, max*.	8	8	8	8	8	8	8	8	ISO 11058
Crude Fibre, %, DM, max.	10	13	15	15	15	15	13	10	ISO 5498
Total Ash , %, DM	12	12	12	14	14	14	12	12	ISO 5984
Calcium, %, DM	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	ISO 6490-1
Total phosphorus, %, DM	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	ISO 6491
Sodium chloride, %	0,5 - 1	0,5 - 1	0,5 - 1	0,5 - 1	0,5 - 1	0,5 - 1	0,5 - 1	0,5 - 1	ISO 6495

* Fat percent may be higher than 8% where the fat used is in the form of protected fat.

4.3.4 Requirements for complete dry feed

Complete dry feed shall comply with the requirements specified in Table 4 when tested with the test methods specified therein.

Table 4 — Requirements for complete dry feed for dairy and beef cattle

Item	Complete dry feed			Test methods
	Lactating	Fattening stage 1	Fattening stage 2	
Moisture, %, max	14			ISO 6496
ME, kcal/kg DM, min.	2 000	2 000	2 200	Annex A
Crude protein, %, DM, min.	13.00	12.00	10.00	ISO 5983-1
Crude fat %, DM, max.*	8			ISO 11058
Crude Fiber, %, DM, max.	24	22	20	ISO 5498
Total Ash , % ,DM, max.	11	12	11	ISO 5984
Calcium, %, DM	1,9 – 2,5			ISO 6490-1
Total Phosphorus, %, DM, min.	0,57			ISO 6491
Sodium Chloride, %	0,5 - 1			ISO 6495

*Fat percent may be higher than 8% if the fat used is in the form of protected fat.

5 Feed additives

5.1 Additives in the following categories may be used in cattle feed:

i. antioxidants;
ii. colourants;
iii. emulsifiers;
iv. stabilisers,
v. thickeners and gelling agents;
vi. binders;
vii. anti-caking agents and coagulants;
viii. aromatic and appetising substances; and
ix. preservatives.

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

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

5.4 Annex H provides further information on the feed additives.

6 Contaminants

6.1 Aflatoxins

Compounded cattle feed shall comply with the maximum limits for aflatoxin specified in Table 5 when tested with the methods therein.

Table 5 — Aflatoxin limits for compounded cattle feed

S/N	Aflatoxin	Maximum limits µg/kg	Test methods
i.	Total aflatoxin	20	ISO 16050
ii.	Aflatoxin B1	10	ISO 17375

6.2 Heavy metals

Compounded cattle feed shall comply with the maximum limits of heavy metals specified in Table 6 when tested with the methods therein.

Table 6 — Heavy metals limit for compounded cattle feed

S/N	Heavy metals	Maximum limits mg/kg	Test methods
i	Arsenic	4.0	ISO 27085
ii	Lead	3.0	
iii	Cadmium	1.0	

iv	Mercury	0.1	

6.3 Pesticide residues

Compounded cattle feed shall not exceed the limits of pesticide residues established in the Codex Alimentarius Commission on Contaminants

8 Hygiene, Storage and transportation

Compounded cattle feed shall be produced, transported, received and stored in accordance with the procedure described in the appropriate sections of FDARS 1828 and FDARS 2139.

9 Packaging and Labelling

9.1.1 Packaging

Compounded cattle feed for sale shall be packaged in 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.

9.1.2 Wet total mixed ration shall be firmly packed to minimize the oxygen content to prevent spoilage. The thermoplastic used in packaging TMR bale shall conform to the specifications in EN 13207 - Thermoplastic silage films and tubes for use in agriculture and EN 14932 - Thermoplastic stretch films for wrapping silage bales

9.2 Labelling

Each package of compounded cattle feed shall be legibly and indelibly marked with the following information:

a) name and type of the feed;
b) name, physical address or contact information of manufacturer/producer/importer/exporter/packer;
c) nutrient composition;
d) net weight in SI units;
e) batch or code number;
f) date of manufacture;
g) best before / Expiry date; and
h) instruction for use, storage and handling.

10 Sampling

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

Annex A
(normative)

Method for calculating metabolizable energy (ME)

GE kcal = (4.2 * carbohydrate %) + (5.2 * CP %) + (9*fat %) (NRC, 2001)

DE (kcal) = GE (kcal) * 0.76

ME (kcal) = DE (kcal) * 0.82 (NASEM, 2016)

Where:

GE – gross energy
DE – Digestible energy
ME - Metabolizable energy

Annex B
(informative)
Nutrient composition of common feed ingredients

Ingredients[a]	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	6.5	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	2330	-	-
Millet	88	10.5	2.0	0.05	0.40	1392	0.2	0.27
Sorghum	88	9.0	2.1	0.03	0.28	3250	0.2	0.12
Fish meal	88	60.0	1.0	4.37	2.53	2310	4.08	1.70
Cotton seed cake	88	40.0	14	0.20	1.20	968	1.6	0.52
Soya bean meal	88	43.0	6	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 polishing	92.5	12.0	4.2				4.0	0.40
Dicalcium phosphate				24	18			
Tricalcium 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

DM – Dry Matter, CP – Crude Protein, CF – Crude Fat, ME – Metabolisable Energy

[a] Feed stuff used in animal feed is not limited to those listed in this table

The complete dry feed should be fed without any quantity of roughage.

Annex C
(informative)
Description of common feedstuffs

S/N	Product	Description	Main nutritional constituent
i.	Alfalfa meal	Alfalfa as grown, dried and processed, and to which no other matter has been added	Crude protein, Crude fibre
ii.	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
iii.	Bean meal	The meal obtained by grinding commercially pure leguminous beans (other than soya bean).	Crude protein, Crude fibre
iv.	Blood meal	The meal has been dried out to which no other matter has been added	Crude protein, Dry matter
v.	Bone meal	Commercially pure steamed bone, raw or degreased, which has been ground or crushed and which contains phosphorus not less than 4.5% phosphorus.	Crude protein, Phosphorus, Calcium
vi.	Brewery and distillery grains	The product obtained by drying the residue from distillery mash-tube, and to which no other matter has been added	Crude fibre, Crude protein
vii.	Cassava, dried	The dried root of the species *Manhot esculanta*	Crude fibre, Crude protein
viii.	Clover meal	Clover as grown, dried and processed and to which no other matter has been added	Crude protein, Crude fibre
ix.	Coconut cake	The residue resulting after part removal of oil and of cortex from commercially pure coconut kernels	Crude protein Crude fibre
x.	Cotton seed cake	The residue resulting after part removal of oil and of cortex from commercially pure cotton seed	Crude protein, Crude fibre
xi.	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
xii.	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.
xiii.	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
xiv.	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
xv.	Maize	Maize kernel or crushed maize kernel as grown for commercial purposes	Crude protein
xvi.	Maize germ meal	Consisting mainly of embryo of kernel not less than 10 % oil, and not more than 5 % ash	? Crude protein, starch
xvii.	Maize and cob meal	Ground maize on the cob	Crude protein, Oil, crude fibre
xviii.	Maize meal	Milled whole maize	Crude protein, Oil, crude fibre

S/N	Product	Description	Main nutritional constituent
xix.	Maize gluten meal	A by-product resulting from removal of a bran starch and germ from maize	Crude protein, Oil, crude fibre
xx.	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, crude fibre
xxi.	Milk powder	Dried milk from which a substantial amount of fat has been removed and to which no other substance is added	Crude protein
xxii.	Millet	Finger millet of the species *Eleusine coracana*	Crude protein, Crude fibre
xxiii.	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
xxiv.	Molasses	A concentrated syrup product obtained in the manufacture of sugar from sugar cane to which no other matter has been added	Dry matter, sugar as sucrose
xxv.	Oats, ground	The product obtained by grinding commercially pure oats	Crude protein, Crude fibre
xxvi.	Pea meal	The meal obtained by grinding or crushing commercially pure peas including pods	Crude protein, Crude fibre
xxvii.	Rice bran	The outside husk or rice kernel to which no other matter has been added	Crude protein, Crude fibre, oil
xxviii.	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
xxix.	Rice polishings	The product obtained when polishing kernels after the removal of hulls and bran	Crude protein, oil, Crude fibre
xxx.	Sesame cake	The residue resulting after the part removal of oil from commercially pure simsim kernels	Crude protein, oil, Crude fibre
xxxi.	Soya bean meal	The residue resulting after the part removal of oil from commercially pure soya bean seeds	Crude protein, oil, Crude fibre
xxxii.	Sweet potatoes	The dried tubers of the species *Ipomea batatas*	Crude protein, Crude fibre
xxxiii.	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
xxxiv.	Wheat bran	Outside husk of what kernel to which no other matter was added	Crude protein, Crude fibre
xxxv.	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
xxxvi.	Yeast dried	The product obtained by drying of yeast or yeast residues, and to which no other matter has been added.	Crude protein

Annex D
(informative)

Guide for macro and micronutrient requirements for wet total mixed ration growing calves and heifers for both dairy and beef cattle at different age, weight and growth rate.

Age, days	30	100	225	350	475	600
Body weight, kg	65	120	230	330	420	530
Growth rate,kg/day	0.7	0.7	0.9	0.8	0.7	0.9
ME, Mcal/kg DM	3.68	2.26	2.09	1.95	1.92	2.12
NEL, Mcal/kg DM						
Rumen-degradable protein, %		10.0	10.0	10.0	10.0	10.0
Rumen-undegradable protein, %		6.6	4.4	2.6	1.7	2.7
Crude protein, %	21.0	16.6	14.4	12.6	11.7	12.7
Metabolizable protein, %	16.5	9.5	8.1	6.8	6.1	6.6
Net protein, %	10.7	5.1	4.4	3.9	3.6	4.1
NDF, %	-	25-33				
Forage NDF, minimum %		19-25				
Starch maximum %		15-20				
Macromineral, %						
Ca	0.59	0.78	0.58	0.44	0.37	0.39
P	0.45	0.32	0.26	0.21	0.18	0.19
Mg	0.15	0.14	0.12	0.12	0.12	0.1
K	1	0.51	0.52	0.54	0.56	0.6
Na	0.35	0.17	0.16	0.16	0.15	0.16
Cl	0.28	0.14	0.14	0.13	0.13	0.13
S	-	0.2	0.2	0.2	0.2	0.2
DCAD-S, mEq/kg minimum	-	39	42	45	50	60
Trace mineral , mg/kg DM						
Cu	5	16	16	15	15	17
Co	-	0.2	0.2	0.2	0.2	0.2
I	0.78	0.69	0.58	0.54	0.53	0.54
Fe	90	61	46	32	24	28
Mn	50	49	44	40	38	43
Se	0.3	0.3	0.3	0.3	0.3	0.3
Zn	70	47	41	36	34	35
Vitamins. IU/kg						
Vitamin A	2218	3390	3829	4265	4698	5288
Vitamin D	1518	924	1044		1281	1442
Vitamin E	86	49	56	62	68	77

Annex E
(informative)

Guide for macro and micro nutrient requirements for wet total mixed ration for dairy cattle (dry cows) during transitional period (<21 day to calving)

days to calving	**60-21**	**<21**
Body weight, kg	740	740
Growth rate,kg/day	0.0	0.0
ME, Mcal/kg DM	1.93	1.89
NEL, Mcal/kg DM	1.28	1.28
Rumen-degradable protein, %	10	10
Rumen-undegradable protein, %	1.9	3.6
Crude protein, %	11.9	13.6
Metabolizable protein, %	5.2	6.2
Net protein, %	3.6	4.2
NDF, %	25-33	
Forage NDF, minimum %	19-25	
Starch maximum %	15-20	
Macromineral, %		
Ca	0.31	0.37
P	0.19	0.21
Mg	0.13	0.13
K	0.62	0.65
Na	0.16	0.16
Cl	0.13	0.13
S	0.2	0.2
DCAD-S, mEq/kg minimum	66	-100
Trace mineral , mg/kg DM		
Cu	18	19
Co	0.2	0.2
I	0.51	0.54
Fe	13	14
Mn	38	41
Se	0.3	0.3
Zn	30	30
Vitamins. IU/kg		
Vitamin A	5850	6272
Vitamin D	1595	1710
Vitamin E	85	171

Annex F
(informative)

Guide for macro and micronutrient requirements for wet total mixed ration for dairy cattle (lactating cows, by parity (boy weight) and Days in milk)

	first (570 kg)		mature (700 kg)		
days in milk	15	150	20	100	200
milk, kg	33	39	53	55	43
fat %	3.9	3.6	3.7	3.5	3.8
protein %	3.1	3	2.8	2.8	3.3
ME, Mcal/kg DM	2.39	2.61	2.58	2.73	2.6
NEL, Mcal/kg DM	1.51	1.72	1.61	1.8	1.73
Rumen-degradable protein, %	10	10	10	10	10
Rumen-undegradable protein, %	6.2	7	7.5	7.4	7.5
Crude protein, %	16.2	17	17.5	17.4	17.5
Metabolizable protein, %	9.9	9.8	10.8	10.7	10.8
Net protein, %	6.7	6.7	7.3	7.3	7.3
NDF, %	25-33				
Forage NDF, minimum %	19-25				
Starch maximum %	22-30				
Macromineral, %					
Ca	0.57	0.57	0.57	0.57	0.57
P	0.35	0.35	0.35	0.35	0.35
Mg	0.17	0.17	0.17	0.17	0.17
K	1.03	0.97	0.97	0.97	0.97
Na	0.21	0.21	0.21	0.21	0.21
Cl	0.29	0.3	0.3	0.3	0.3
S	0.2	0.2	0.2	0.2	0.2
DCAD-S, mEq/kg minimum	148	130	130	130	130
Trace mineral, mg/kg DM					
Cu	9	8	10	8	10
Co	0.2	0.2	0.2	0.2	0.2
I	0.46	0.42	0.47	0.42	0.41
Fe	16	16	21	19	16
Mn	28	26	31	28	27
Se	0.3	0.3	0.3	0.3	0.3
Zn	57	58	66	62	61
Vitamins. IU/kg					
Vitamin A	3021	2796	3687	3303	3103
Vitamin D	1099	954	1085	952	1021
Vitamin E	22	19	22	19	20

Annex G
Informative

Sizing of form of feed

Where the feed is in the form of pellets, the pellet diameter should not exceed 15 mm.

Where the feed is in the form of cubes, the size of the cubes should not exceed 20 mm.

Annex H
(informative)

Feed additives and provisions related to their use

H.1 Requirements for antioxidants in cattle feed

Cattle feed shall contain no added antioxidant other than an antioxidant of a name or description specified in the first column of the table below, where an antioxidant if added should not exceed the maximum content, if any, specified in the second column of the Table H.1.

Table H.1 — Requirements for antioxidants in cattle 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

H.2 Requirements for colourants in cattle feed

Cattle feed shall contain no colorant other than a colorant named or described in Table H.2 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.

Table H.2 — Requirements for colorants in cattle feeds

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

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

H.3.1 General

Cattle feed 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 hereunder.

H.3.2 Name or description

Lecithins; Alginic acid; Sodium alginate; Potassium alginate; Ammonium alginate Calcium alginate; Prophylene glycol alginate (propane- 1,1-diol alginate) Agar; Carrageenan; Furcellaran; Locust bean gum (carob gum); Tamarind seed flour Gurar gum (gua flour); Tragacanth; Acacia (gum Arabic); Zanthan gum; D-glucitol (sorbitol); mannitol; Glycerol; Pectins; microcrystalline cellulose; Methylcellulose; Ethylcellulose; Hydroxylpropyl cellulose;Hydorxyprophylmethylcellulose; Ethylmethlcellulose; 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) monoacetylatartaric and (f) diacetyltartaric.

H.3.3 Sucrose esters or fatty acids

The following sucrose esters fatty acids may be added to cattle feeds:

a) mixture of sucrose esters of monocyl 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) stearoyl-2-lactylic acid; sodium stearoyl-1,2-lacylate; calcium stearoyl-1,2-lactylate;

e) stearoyl-1-tartrate; glycerol poly (ethylene glycol) ricinolcate; dextrans; sorbitan monostearate;

f) sorbitan tristearte; sorbitan monolaurate; sorbitan mono-eleate; 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.

The emulsifiers, stabilisers, thickeners and gelling agents listed in Table 5 shall conform to the requirement in Table H.3.

Table H 3 — Requirements for emulsifiers, stabilisers, thickeners and gelling agents in cattle feeds

S/N	Name or description	Maximum content In complete feed, mg/kg
i.	Poly (ethylene glycol) 6 000	300
ii.	Polyoxypropylene-Polyoxyethelene polymers (M.W 6 800-9 000)	50
iii.	Propane-1,2-diol	36 000

H.4 Requirements for binders, anticaking agents and coagulants

H.4.1 General

Cattle feed 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 A.4.2

A.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.

A.5 Requirements for aromatic and appetising substances

Cattle feed shall contain no added aromatic or appetising substance other than an aromatic or appetising substance of a name or description specified in Table C.4 and taking account of any such substance which is naturally present, without exceeding the maximum content specified.

Table A.4 — 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	According to the recommendation of GMPs

A.6 Permitted preservatives

Cattle 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) latic 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.

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