Updated energy and protein requirements of dairy youngstock

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Preface

The current CVB recommendations for growth and the requirements for net energy (VEM) and intestinal available protein (DVE) for dairy youngstock are based on CVB Documentation Report No. 19, *Energie- en eiwitnormen voor de voederbehoefte van vrouwelijk jongvee bestemd voor de melkveehouderij*, published in 1997. In 2022, the body weights and energy requirements of Holstein Friesian dairy cows were updated by CVB and documented in CVB Documentation Reports No. 78 and 79, respectively. Current growth recommendations and requirements for energy and protein of young are based on model calculations intended to reach a BW of 530 kg at an age of 24 months. In contrast, the updated bodyweights of Holstein Friesian cows, heifers reach a body weight of 572 kg at an age of 24 months - a difference of 42 kg. Additionally, the 2022 updated energy maintenance requirements for Holstein Friesian cows are substantially higher than those requirements previously published by CVB. This documentation report introduces two new growth schedules, a regular growth scheme for reaching a BW of 572 kg at an age of 24 months and a fast growth scheme for reaching a BW of 572 kg at 22 months. It also presents updated VEM2022 and DVE requirements necessary to support these growth targets.

This project was conducted under the guidance of the CVB Technical Committee and the Ad hoc group 'Actualisatie VEM2022-behoefte jongvee'.

Wageningen, January 2025 J.W. Spek

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Abbeviations

BW	Body weight (kg)
BWG	Body weight gain (kg/d)
Body_FAT	fat in EBW (kg)
Body_Protein	protein in FFM (kg)
СР	Crude protein
DM	Dry matter
DMI	Dry matter intake (kg/animal/d)
DVE	Darmverteerbaar eiwit (intestinal digestible protein)
EBW	Empty body weight (kg)
FFM	fat free mass of the body (kg)
HF	Holstein Friesian
ILVO	Instituut voor Landbouw-, Visserij- en voedingsonderzoek
K _e	efficiency of protein retention from DVE
kg	conversion efficiency of ME to RE
k _i	conversion efficiency of ME to milk energy
k _m	conversion efficiency of NE to ME for maintenance
ME	Metabolizable energy in feed
MEg	Metabolizable energy requirement for growth (kJ/d)
ME _m	Metabolizable energy requirement for maintenance (kJ/d)
ME _{preg}	Metabolizable energy requirement for pregnancy (kJ/d)
NE	Net energy
NE _m	Net energy requirement for maintenance (kJ/kg BW ^{0.75})
q	metabolizable energy in feed : gross energy in feed × 100
RE	Retained energy in the body (kJ/d)
VEM	Voedereenheid melk (old VEM-system)
VEM2022	Voedereenheid melk (recent VEM2022-system)

1. Introduction

In 2022 CVB has updated the body weights (BW; kg) and juvenile growth rates of lactating Holstein Friesian (HF) dairy cows for the various parities (CVB 2022a; Documentation Report No. 78). This update resulted in increased BW values for the various parities. For example, the average BW for a first parity cow in the first week of lactation was increased from 530 kg to 572 kg. This means that the current growth schedule and energy requirements for dairy youngstock (calves and heifers) need to be revised as well.

The first goal of this study therefore was to update the growth schedule for female HF youngstock in such a way that a BW of 572 kg is reached at 24 months of age. In this study we will name this updated growth schedule, a regular growth schedule.

The second goal was to establish a fast growth curve for youngstock in such a way that a BW of 572 kg is reached at 22 months of age (meaning that a BW of 572 kg is reached two months earlier compared to the regular growth schedule in the first goal). A reduced age of calving from 24 to 22 months is advantageous for dairy farmers with respect to feed costs and excretion of nitrogen and phosphate. In this study we will name this updated fast growth schedule, a fast growth schedule

To reach these two goals, data from the present CVB growth schedule and growth data from a recent ILVO youngstock project (ILVO, 2023) were used to model the two new growth schedules, also taking into account that growth rates should be feasible with respect to maximum feed intake levels and VEM2022 and DVE levels of diets used in practise.

The third goal of this study was to update the CVB energy requirements for growing HF heifers. In order to have an indication whether current CVB energy requirements for youngstock were still valid for modern HF youngstock, the current CVB energy requirement norms for youngstock were applied to data from the recent ILVO project (ILVO, 2023) in which the BW and energy intake of 60 HF heifers was monitored on the ILVO research farm during the entire rearing period of around 24 months. The measured energy intake of these 60 heifers was then compared to the calculated CVB energy requirements of the youngstock based on calculation rules from CVB (1997; Documentation Report No. 19). Furthermore, measured energy intake of the youngstock was compared to current CVB requirements for growth and maintenance and it was observed that replacing the old CVB energy requirements for maintenance (CVB, 2022b) largely removed the difference between observed energy intake and predicted energy intake. This resulted in the decision to apply the energy requirements for maintenance established on adult dairy cows (CVB, 2022b) also for growing youngstock.

2. Materials and Methods

2.1 Energy requirement calculation rules

In Table 1 the calculation rules for calculating energy requirements for maintenance and growth for youngstock according to CVB (1997) rules and energy requirements for maintenance and pregnancy are given according to CVB (2022b) rules.

Table 1. Calculation rules	for ca	lculating er	nergy re	equirements f	or maintei	nance and	growth
for youngstock from CVB (1997) and CVB ((2022b)). ^{a)}			

	CVB (1997)
EBW (kg)	exp(-0.7308 + 1.0958 × ln(BW))
Body_Fat (kg)	exp(-5.5207 + 1.3864 × ln(EBW) + 0.0447 × (ln(EBW)) ²
FFM (kg)	EBW – Body_Fat
Body_Protein (kg)	0.1436 × FFM ^{1.0723}
RE (kJ/d)	((500 + 6 × BW) × 4.184 × BWG) / (1 – BWG × 0.3)
NE _m (kJ/d)	1.15 × 330 × BW ^{0.75}
q	70 if BW ≤ 70; 60 if BW < 237 and > 70; 55 if BW > 237
k _m (ratio)	0.00287 × q + 0.554
k _g (ratio)	0.0078 × q + 0.006
ME _m (kJ/d)	NE _m / k _m
ME _g (kJ/d)	RE / kg
	CVB (2022b)
ME _m (kJ/d)	1.1 × 562 × BW ^{0.75}
ME _{preg} (kJ/d) ^{b)}	455 x EXP(0.01634 x days pregnant) x 0.90
k _l ^{c)}	(0.405 + 0.00418 × q)
Total VEM2022 reg. (VEM2022/d)	$(ME_m + ME_a + ME_{rreg}) * k_1 / 7.82$

^{a)} Abbreviations used in this table are: EBW = empty body weight (kg); BW = body weight (kg); BWG = body weight gain (kg/d); Body_Fat = kg fat in EBW; FFM = fat free mass of the body (kg);

Body_Protein = kg protein in FFM; RE = retained energy per day (kJ/d); NE = Net energy; NE_m = NE requirement for maintenance (kJ/d); q = metabolizable : gross energy × 100; k_m = conversion efficiency of NE to metabolizable energy (ME) for maintenance; k_l = conversion efficiency of ME to milk energy; ME_m = ME requirement for maintenance (kJ/d); k_g = conversion efficiency of ME to RE; $ME_g = ME$ -requirement for growth (kJ/d).

^{b)} In CVB (2022b) the formula for ME_{preg} (kJ/d) was based on multiparous cows. In order to account for the fact that calves of nulliparous cows are less heavy a factor of 0.90 was added to the ME_{preg} formula to correct for this.

^{c)} For the new regular growth schedule the value of q is 65 if age <= 2 months, 60 if age <= 4 months, 55 if age <= 23 months, and 60 for month 24. For the new fast growth schedule the value of q is 70 if age <= 2 months, 65 if age <= 3 months, 60 if age <= 4 months, 55 if age <= 21 months and 60 for month 22.

The calculation rules presented in Table 1 were used to calculate metabolizable energy (ME) requirements for youngstock. Depending on the BW and the level of growth a ME-requirement can then be calculated for any particular day in the growing period of youngstock. Besides requirements for energy also requirements for DVE need to be taken into account. In Table 2 the DVE-requirement calculation rules based on CVB (1997) are

presented that were used to calculate DVE-requirements for the regular and fast growing scheme.

	Calculation rule
DVE for maintenance (g/d)	(2.75 × BW ^{0.5} + 0.2 × BW ^{0.6}) / 0.67
K _e	0.7862 / (1 + exp(0.005286 × (BW – 417.7)))
DVE for growth (g/d)	Retained protein (g/d) / K _e
DVE for pregnancy (g/d)	$(34.375 \times \exp((8.5357 - 13.1201 \times \exp(-0.00262 \times d) - 0.00262 \times d)) / (0.50)$
	$10.00202 \times 011/0.00$

Table 2. Calculation rules used for calculating DVE requirements for maintenance, growth and pregnancy for youngstock from CVB (1997).^{a)}

^{a)} BW = body weight (kg); K_e = efficiency of protein retention from DVE; Retained protein on a given day n is calculated by determining the value of Body_Protein (kg) on days n+1 and n (see Table 1 for details on calculating Body_Protein), subtracting the value on day n from that on day n+1, and multiplying the result by 1000 to express the retained protein on day n in g/day; d = days pregnant and the DVE formula for pregnancy being applied to the pregnancy period 141 – 280 days in pregnancy.

Daily requirements for VEM2022 and DVE need to be converted into VEM2022 and DVE requirements per kg of DM in order to be translated into diet formulation. Therefore an estimate of possible dry matter intake (DMI; kg/d) is required. Dry matter intake capacity of youngstock was estimated based on the publication of Hoffman et al. (2008):

DMI (kg/d) = $15.36 \times (1 - EXP(-0.0022 \times BW))$ for the age range of 5 -21 months or BW range of 168 - 625 kg BW (uncorrected for foetal weight)

Additional support for using this prediction formula came from the ILVO project (ILVO, 2023) with youngstock which showed that the prediction formula of Hoffman et al. (2008) resulted in predicted DMI values that were close observed DMI as becomes clear from Fig. 1.

When extrapolating the Hoffman formula to the age period 2 - 4 months it appeared that predicted DMI was higher than observed DMI in the ILVO project. However, as it appeared that extrapolation of the Hoffman prediction formula to the age period 2 - 4 resulted in estimated DMI that are feasible according to scientific literature and as it resulted in calculated realistic dietary VEM2022-concentrations it was decided to also use the Hoffman prediction formula for the weight range of 2 - 4 months.



Figure 1. Relationship between observed DMI (kg/animal/d) of growing youngstock in the ILVO trial (ILVO, 2023) and DMI predicted by the formula from the study of Hoffman et al. (2008): DMI (kg/d) = $15.36 \times (1 - EXP(-0.0022 \times BW))$ for the age range of 5 -21 months or BW range of 168 - 625 kg BW (uncorrected for foetal weight).

3. Results and Discussion

3.1 Growth curves

The formula developed to calculate the <u>regular</u> growth curve to achieve a BW of 572 kg at 24 months has 3 phases and is as follows:

Phase 1 (day 1 to day 140 with a starting weight of 38 kg at day 1): Growth (g/d) = $313 + 7.97 \times age - 0.0280 \times age^2$

Phase 2 (day 141 to day 650: day 650 corresponds with an age of roughly 21.5 months): Growth (g/d) = 972 - 1.143 × age + $0.00423 \times age^2 - 0.00000536 \times age^3$

Phase 3 (day 651 to day 730: 730 corresponds with an age of 24.0 months): Growth (g/d) = $3592 - 4.70 \times age$

The formula developed to calculate the <u>fast</u> growth curve to achieve a BW of 572 kg at 22 months has 3 phases as well and is as follows:

Phase 1 (day 1 to day 130 with a starting weight of 38 kg at day 1): Growth (g/d) = $335 + 9.59 \times age - 0.0358 \times age^2$

Phase 2 (day 131 to day 590: day 590 corresponds with an age of 19.4 months): Growth (g/d) = $1032 - 0.855 \times age + 0.004085 \times age^2 - 0.000006717 \times age^3$

Phase 3 (day 591 to day 669; day 6669 corresponds with an age of 22.0 months): Growth (g/d) = $3557 - 5.06 \times age$

In the above formula age is expressed in days. The first and second phase of both the regular growth curve and the fast growth curve is chosen such as to allow a growth pattern that is in between the measured growth curve of the ILVO experiment (ILVO, 2023) and the current CVB growth curve as can be seen from the plotted curves in Fig. 2. Additionally, the growth curve is modelled such that calculated VEM2022 and DVE requirements expressed per kg of DM are feasible and follow a more or less smooth trajectory. In Fig. 2 the results of the new proposed growth curves (both regular and fast growth curve), the current CVB growth curve and the observed growth curve from the ILVO experiment are plotted. As both the current CVB growth curve and the measured ILVO growth curve show a strong decrease in growth at an age of roughly 640 days, this strong decrease in growth was modelled as the third phase of both the regular and fast growth curve with a linear decrease in growth of 4.99 g/d after 655 days of age (until 730 days of age) for the regular growth curve and with a linear decrease in growth of -5.06 g/d after 591 days of age (until 669 days of age) for the fast growth curve. This modelled strong decrease in growth in the third phase can be explained by the strong increase in energy requirements for pregnancy resulting in less energy available for growth. Furthermore, it was suggested by the Ad hoc group to have a

similar growth from the moment of insemination (day 450 and 389 for, respectively, the regular and fast growth curve) until the moment of calving for both the regular and fast growth curve. However, in order to achieve this it would be necessary to calculate with growth rates of around 1100 g/d in the period 111 - 389 days of the fast growth curve and it would furthermore require a steep decline in growth rate to reach a similar growth rate at day 389 of age as the growth level of the regular growth curve at day 450. As a growth rate of 1100 g/d was considered too high and also because a sharp decline in growth rate in the period before 389 days of age in the fast growth curve seems not logical from the point of feeding management on dairy farms, it was chosen to allow for a higher growth rate in the fast growth curve in the period after insemination (insemination at day 389) compared to the growth rate in the regular growth curve in the period after insemination (insemination at day 450). In Fig. 3 a visual overview is given of the proposed regular and fast growth curves expressed in kg BW together with the present CVB growth curve based on CVB (1997; Appendix 6) and the growth curve observed in the ILVO trial (ILVO, 2023) for the age period 1 - 730 days.



Figure 2. Regular and fast growth curves expressed in g/d together with the present CVB growth curve based on CVB (1997; Appendix 6) and the growth curve observed in the ILVO trial (ILVO, 2023) for the age period 1 - 730 days.



Figure 3. Regular and fast growth curves expressed in kg BW together with the present CVB growth curve based on CVB (1997; Appendix 6) and the growth curve observed in the ILVO trial (ILVO, 2023) for the age period 1 - 730 days.

3.2 Validation of updated VEM2022-requirements

The ILVO youngstock experiment (ILVO, 2023) was used to compare predicted ME-intake predicted by the CVB (1997) calculation rules with observed ME-intake of animals in the ILVO youngstock experiment. This was achieved by calculating the ME-coverage as follows:

ME-coverage (%) = observed ME-intake : predicted intake × 100.

A ME-coverage of 100% then means that predicted ME-intake is equal to observed MEintake whereas a ME-coverage higher than 100% means that the observed ME-intake is higher than the predicted ME-intake meaning that the calculation rules underpredict requirements.

In Fig. 4 the ME-coverage is shown for the ILVO data (ILVO, 2023) for both the entire growing period of 1 – 23 months and for the limited growing period of 5 – 20 months. The limited period excludes the first few months in which the calf is transitioning from a more or less monogastric type of digestion to a rumen fermentation type and also excluding the last 3 months of the pregnancy period in order to limit the change of errors with respect to correction of measured BW values for the weight of the foetus, amniotic fluid and placenta. The BW values of youngstock in the ILVO experiment was corrected for the weight of the foetus, amniotic fluid and placenta by calculating this weight using the formula shown in Fig. 6 in CVB (2022b) and then subtracting this weight from the measured BW to obtain a corrected BW.



Figure 4. ME-coverage (ME-intake observed : calculated CVB-ME-requirement × 100) for the ILVO experiment (ILVO, 2023) data for the complete growing period of 1 to 23 months (left panel) and a limited growth period of 5 to 20 months (right panel).

Results in Fig. 4 show that the energy calculation rules in CVB (1997) result in an underprediction of ME-intake. The average ME-coverage for months 5 - 20 was 108.1% meaning that the observed ME-intake was on average 8.1% higher than the CVB (1997) calculated ME-requirement.

In Fig. 5 the ME-coverage percentages are shown for the CVB (1997) energy evaluation system with the exception of implementing VEM2022- energy requirements for maintenance (kJ/d) of $1.1 \times 562 \text{ kJ/kg BW}^{0.75}$ per day and for pregnancy (kJ/d; 455 × EXP(0.01634 × days pregnant) × 0.90). ME-coverages are shown for both the complete growing period (1 – 23 months) and a limited period (5 – 20 months).



Figure 5. ME-coverage (ME-intake observed : calculated CVB-ME-requirement × 100) for the ILVO experiment (ILVO, 2023) data for the complete growing period of 1 to 23 months (left panel) and a limited growth period of 5 to 20 months (right panel). The ME-requirements according to CVB (1997) are used with the exception of implementing VEM2022 energy requirements for maintenance and for pregnancy.

Results from Fig. 5 show that replacing the current CVB (1997) calculation rules for ME_m with the ME_m calculation rule of the VEM2022 system results in on average correctly predicted ME-intake. The average ME-coverage for months 5 – 20 was 98.4% meaning that the observed ME-intake is on average 1.6% lower than the ME-requirement calculated by using the CVB (1997) calculation rules for growth and VEM2022 energy requirements for maintenance of 1.1 × 562 kJ/kg BW^{0.75} per day and pregnancy. Compared with the average ME-coverage of 108.1% (Fig.4) when using the CVB (1997) energy evaluation calculation rules, replacing the CVB (1997) calculation rules for ME_m with the VEM2022-calculation rules for ME_m resulted in a substantial improvement in predicting the observed ME-intake in the ILVO experiment (ILVO, 2023).

4. Proposal for CVB

It is proposed to adopt the suggestion of the Ad hoc group by maintaining the current CVB (1997) VEM and DVE calculation rules for youngstock with the exception of replacing the energy requirements for maintenance with the updated VEM2022 requirements for maintenance for adult dairy cows. The CVB (1997) energy requirement of 330 kJ NE_m per kg BW^{0.75} is based on the publication of van Es (1978) based on a ME_m requirement of 100 kcal ME per kg BW^{0.75} for steers and non-lactating cows in a tie-stall and assuming a 10% increase because youngstock is kept loose in groups. Then, assuming a q of 57, a k_m was calculated with a value of $(0.554 + 0.00287 \times 57) = 0.718$. Multiplying 110 kcal ME_m × BW^{0.75} with 0.718 results in a NE_m requirement of 78.93 kcal NE_m × BW^{0.75} and converting from kcal to kJ results in a NE_m of 78.93 × 4.184 = 330 kJ NE_m × BW^{0.75}. For some reason, in the CVB (1997) study the NE requirements for growth and maintenance were multiplied with a factor 1.15 in order to correct for the fact that the rules were applied to female youngstock instead of males. The background for this correction is unclear. The proposal is to adopt the CVB (2022b) maintenance requirement for adult cows and use it for growing heifers, calculated as $1.1^{1} \times 562 \text{ kJ} \times \text{BW}^{0.75} = 618 \text{ kJ} \times \text{BW}^{0.75}$. This value of 618 kJ × BW^{0.75} is 16.8% higher than the current ME_m requirement value of $110 \times 1.15 \times 4.184 = 529$ kJ × BW^{0.75}. Additionally it is proposed to adopt the VEM2022-requirement calculation rule for pregnancy of adult dairy cattle (CVB, 2022b) also for heifers but multiply the estimated value with a factor of 0.9 in order to correct for the lower BW of calves from nulliparous cows compared to calves from multiparous cows (a correction factor of 0.9 was also used in CVB (1997)). As well, it is proposed to adopt the VEM2022-requirements for grazing of 30% of the energy requirement for maintenance for a situation of day and night grazing. It is further proposed to adopt the fast and regular growth schemes for growing youngstock as presented in this report. As the Ad hoc group agreed on using the DMI prediction formula of Hoffman et al. (2008) for the growing period 5 - 24 months and as well to allow for extrapolation of this formula for predicting DMI for calves in the growing period 2 - 5 months, it is proposed to use the Hoffman formula for calculating DMI and to calculate VEM2022 and DVE requirements for the fast and regular growth schemes expressed per kg DM for the entire growth period of 2 -24 months. In Table 3 the DVE and VEM2022-requirements are presented for growing youngstock at various ages (months) based on the proposed regular growth scheme and calculation rules for VEM2022 and DVE. The values in Table 3 are valid for the ages at the end of the months presented in the first column (so values for an age of 2 months means that the values are based on an animal of 61 days). Calculated DVE requirements, based on current DVE requirement calculation rules presented in Table 2, result in calculated DVErequirements of 40 g/kg DM at an age of 23 months and 45 g/kg DM at an age of 24 months. However, scientific literature and experience from practise indicates that during the last month of pregnancy of heifers diets should contain at least 14% CP in DM and 60 g DVE per kg DM in order to maximise milk yield in the subsequent lactation. Therefore, an extra requirement of 10 g DVE/kg DM for the 23 month of age and 15 g DVE/kg DM for the 24

¹The factor 1.1 is a correction factor to account for the fact that the maintenance energy requirement value of 562 kJ per kg BW0.75 is based on tied animals whereas the energy requirements for maintenance of cows housed in non-tied stables is 10% higher.

month of age is advised above the calculated DVE requirements for maintenance, growth and pregnancy of 40 g/kg DM and 45 g/kg DM for months 23 and 24 of age, respectively. Table 3 is presented in the CVB Table Booklet Feeding of Ruminants 2025 as Table 1.4.

Table 3. Proposal for DVE and VEM2022 requirements for youngstock having a regular growth scheme.

Table 1.4	DVE and VEM2022-requirements for indoor-fed female dairy youngstock having a regular growth scheme ¹
	(as presented in the CVB Table Booklet Feeding of Ruminants 2025).

Age (months) ²⁾	BW (kg)	Growth (g/d)	DMI (kg/d)	DVE (g/d)	VEM2022 (/d)	DVE (g/kg DM)	VEM2022 (/kg DM)	Additional VEM2022 when grazing (/d) ³⁾
2	69	690	2.2	190	2260	90	1050	375
3	92	800	2.8	230	2730	80	975	450
4	118	870	3.5	260	3260	75	925	550
6	170	870	4.8	290	3770	60	775	700
8	224	870	6.0	310	4590	50	775	875
10	276	870	7.0	335	5370	50	775	1025
12	329	860	7.9	355	6110	45	775	1175
14	381	840	8.7	375	6760	45	775	1300
16	431	800	9.6	395	7340	40	775	1425
18	477	740	10.0	400	7770	40	775	1525
20	519	640	10.7	425	8130	40	775	1625
22	553	450	11.0	445	8200	40	775	1650
23 ⁴⁾	565	310	11.0	460	8820	40+10	800	1750
24 ⁴⁾	572	170	11.0	500	9910	45+15	900	1825

¹⁾ The requirements for VEM2022 and DVE are on a daily basis per animal. The growth scheme is developed in such a way that a BW of 572 kg is reached at an age of 24 months (based on BW data of first parity Holstein Friesian cows in the first week of lactation described in CVB Documentation report nr. 78: Body weight of Holstein Friesian cows). The BW and growth values in this Table exclude the weight and growth values related to pregnancy. The requirements for female youngstock have been described in CVB Documentation report nr. 19: "Energie en eiwitnormen voor de voederbehoefte van vrouwelijk jongvee bestemd voor de melkveehouderij (1997). The two deviations from these calculation rules are that 1) the energy requirements for maintenance and pregnancy are based on VEM2022 requirements for maintenance as described in CVB Documentation report nr. 79: Geactualiseerde energiebehoeftenormen voor Holstein Friesian melkkoeien.

²⁾ The values in this Table are valid for the ages at the end of the months presented in the first column (so values for an age of 2 months means that the values are based on an animal of 61 days).

³⁾ When grazing day and night, the VEM2022 requirements for maintenance are approximately 30% higher (based on CVB documentation report nr. 79: Geactualiseerde energiebehoeftenormen voor Holstein Friesian melkkoeien). The additional allowance for grazing is given in the last column.

⁴⁾ Scientific literature and experience from practise indicates that during the last month of pregnancy of heifers diets should contain at least 14% CP in DM and 60 g DVE per kg DM in order to maximise milk yield in the subsequent lactation. Therefore an extra requirement of 10 g DVE/kg DM for the 23 month of age and 15 g DVE/kg DM for the 24 month of age is advised above the calculated DVE requirements for maintenance, growth and pregnancy of 40 g/kg DM and 45 g/kg DM for months 23 and 24 of age, respectively.

In Table 4 the DVE and VEM2022-requirements are presented for growing youngstock at various ages (months) based on the proposed fast growth scheme and calculation rules for VEM2022 and DVE. The values in Table 4 are valid for the ages at the end of the months presented in the first column (so values for an age of 2 months means that the values are based on an animal of 61 days). Calculated DVE requirements, based on current DVE requirement calculation rules presented in Table 2, result in calculated DVE-requirements of 45 g/kg DM at an age of 21 months and 45 g/kg DM at an age of 24 months. However, scientific literature and experience from practise indicates that during the last month of pregnancy of heifers diets should contain at least 14% CP in DM and 60 g DVE per kg DM in

order to maximise milk yield in the subsequent lactation. Therefore, an extra requirement of 10 g DVE/kg DM for the 21 month of age and 15 g DVE/kg DM for the 22 month of age is advised above the calculated DVE requirements for maintenance, growth and pregnancy of 45 g/kg DM for months 21 and 22 of age. Table 4 is presented in the CVB Table Booklet Feeding of Ruminants 2025 as Table 1.5.

Table 4. Proposal for DVE and VEM2022 requirements for youngstock having a fast growth scheme.

Table 1.5
 Requirements for the nutrient requirements with indoor-feeding of youngstock destined for dairy cattle having a fast growth scheme¹⁾

Age (months) ²⁾	BW (kg)	Growth (g/d)	DMI (kg/d)	DVE (g/d)	VEM2022 (/d)	DVE (g/kg DM)	VEM2022 (/kg DM)	Additional VEM2022 when grazing (/d) ³⁾
2	73	780	2.3	215	2430	95	1075	400
3	99	910	3.0	260	2960	85	975	500
4	128	970	3.8	290	3410	80	900	600
6	187	970	5.2	320	4280	60	825	750
8	245	970	6.4	350	5220	55	825	950
10	304	960	7.5	375	6110	50	825	1100
12	362	940	8.4	400	6900	45	825	1250
14	418	890	9.2	420	7560	45	825	1400
16	470	810	10.0	425	8010	40	800	1525
18	516	690	10.6	445	8310	40	775	1625
20	553	480	11.0	460	8610	40	775	1725
21 ⁴⁾	565	330	11.0	470	8900	45+10	825	1750
22 ⁴⁾	572	180	11.0	510	9940	45+15	900	1825

¹⁷ The requirements for VEM2022 and DVE are on a daily basis per animal. The growth scheme is developed in such a way that a BW of 572 kg is reached at an age of 22 months. A BW of 572 kg at the moment of calving is based on BW data of first parity Holstein Friesian cows in the first week of lactation described in CVB Documentation report nr. 78: Body weight of Holstein Friesian cows. The BW and growth values in this Table exclude the weight and growth values related to pregnancy. The requirements for female youngstock have been described in CVB Documentation report nr. 19: "Energie en eiwithormen voor de voederbehoefte van vrouwelijk jongvee bestemd voor de melkveehouderij (1997). The two deviations from these calculation rules are that 1) the energy requirements for maintenance and pregnancy are based on VEM2022 requirements for maintenance as described in CVB Documentation report nr. 79: Geactualiseerde energiebehoeftenormen voor Holstein Friesian melkkoeien.

- ²⁾ The values in this Table are valid for the ages at the end of the months presented in the first column (so values for an age of 2 months means that the values are based on an animal of 61 days).
- ³⁾ When grazing day and night, the VEM2022 requirements for maintenance are approximately 30% higher (based on CVB documentation report nr. 79: Geactualiseerde energiebehoeftenormen voor Holstein Friesian melkkoeien. The additional allowance for grazing is given in the last column.
- ⁴⁾ Scientific literature and experience from practise indicates that during the last month of pregnancy of heifers diets should contain at least 14% CP in DM and 60 g DVE per kg DM in order to maximise milk yield in the subsequent lactation. Therefore an extra requirement of 10 g DVE/kg DM for the 21 month of age and 15 g DVE/kg DM for the 22 month of age is advised above the calculated DVE requirements for maintenance, growth and pregnancy of 45 g/kg DM for months 21 and 22 of age.

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