

TABLE 6-1 Dry Matter Intake Requirements
to Fulfill Nutrient Allowances for Maintenance,
Milk Production, and Normal Live Weight Gain
During Mid- and Late Lactation

Live Wt: (kg)	PV 400	PV 500	PV 600	PV 700	PV 800
FCM (4%) ^a (kg)	% Live Wt ^{b,c}				
10	2.7	2.4	2.2	2.0	1.9
15	3.2	2.8	2.6	2.3	2.2
20	3.6	3.2	2.9	2.6	2.4
25	4.0	3.5	3.2	2.9	2.7
30	4.4	3.9	3.5	3.2	2.9
35	5.0	4.2	3.7	3.4	3.1
40	5.5	4.6	4.0	3.6	3.3
45	—	5.0	4.3	3.8	3.5
50	—	5.4	4.7	4.1	3.7
55	—	—	5.0	4.4	4.0
60	—	—	5.4	4.8	4.3

NOTE: The following assumptions were made in calculating the DMI requirements shown in Table 6-1:

1. The basic or reference cow used for the calculations weighed 600 kg and produced milk with 4 percent milk fat. Other live weights in the table and corresponding fat percentages were 400 kg and 5 percent fat; 500 kg and 4.5 percent fat; and 700 and 800 kg and 3.5 percent fat.
2. The concentration of energy in the diet for the reference cow was 1.42 Mcal of NEL/kg of DM for milk yields equal to or less than 10 kg/day. It increased linearly to 1.72 Mcal of NEL/kg for milk yields equal to or greater than 40 kg/day.
3. The energy concentrations of the diets for all other cows were assumed to change linearly as their energy requirements for milk production, relative to maintenance, changed in a manner identical to that of the 600-kg cow as she increased in milk yield from 10 to 40 kg/day.
4. Enough DM to provide sufficient energy for cows to gain 0.055 percent of their body weight daily was also included in the total. If cows do not consume as much DM as they require, as calculated from Table 6-1, their energy intake will be less than their requirements. The result will be a loss of body weight, reduced milk yields, or both. If cows consume more DM than what is projected as required from Table 6-1, the energy concentration of their diet should be reduced or they may become overly fat.

$$^a 4\% \text{ Fat-corrected milk (kg)} = (0.4) (\text{kg of milk}) + (15) (\text{kg of milk fat}).$$

^bThe probable DMI may be up to 18 percent less in early lactation.

^cDMI as a percentage of live weight may be 0.02 percent less per 1 percent increase in diet moisture content above 50 percent if fermented feeds constitute a major portion of the diet.

TABLE 8-3 Daily Nutrient Requirements of Lactating and Pregnant Cows

Live Weight (kg)	Energy		DE (Mcal)	TDN (kg)	Total Crude Protein (g)	Minerals		Vitamins	
	NEL (Mcal)	ME (Mcal)				Ca (g)	P (g)	A (1,000 IU)	D (1,000 IU)
<i>Maintenance of Mature Lactating Cows^a</i>									
400	7.16	12.01	13.80	3.13	318	16	11	30	12
450	7.82	13.12	15.08	3.42	341	18	13	34	14
500	8.46	14.20	16.32	3.70	364	20	14	38	15
550	9.09	15.25	17.53	3.97	386	22	16	42	17
600	9.70	16.28	18.71	4.24	406	24	17	46	18
650	10.30	17.29	19.86	4.51	428	26	19	49	20
700	10.89	18.28	21.00	4.76	449	28	20	53	21
750	11.47	19.25	22.12	5.02	468	30	21	57	23
800	12.03	20.20	23.21	5.26	486	32	23	61	24
<i>Maintenance Plus Last 2 Months of Gestation of Mature Dry Cows^b</i>									
400	9.30	15.26	18.23	4.15	890	26	16	30	12
450	10.16	16.66	19.91	4.53	973	30	18	34	14
500	11.00	18.04	21.55	4.90	1,053	33	20	38	15
550	11.81	19.37	23.14	5.27	1,131	36	22	42	17
600	12.61	20.68	24.71	5.62	1,207	39	24	46	18
650	13.39	21.96	26.23	5.97	1,281	43	26	49	20
700	14.15	23.21	27.73	6.31	1,355	46	28	53	21
750	14.90	24.44	29.21	6.65	1,427	49	30	57	23
800	15.64	25.66	30.65	6.98	1,497	53	32	61	24
<i>Milk Production—Nutrients/kg of Milk of Different Fat Percentages</i>									
(Fat %)									
3.0	0.64	1.07	1.23	0.280	78	2.73	1.68	—	—
3.5	0.69	1.15	1.33	0.301	84	2.97	1.83	—	—
4.0 FCM	0.74	1.24	1.42	0.322	90	3.21	1.98	—	—
4.5	0.78	1.32	1.51	0.343	96	3.45	2.13	—	—
5.0	0.83	1.40	1.61	0.364	101	3.69	2.28	—	—
5.5	0.88	1.48	1.70	0.385	107	3.93	2.43	—	—
<i>Live Weight Change During Lactation—Nutrients/kg of Weight Change^c</i>									
Weight loss	-4.92	-8.25	-9.55	-2.17	-320	—	—	—	—
Weight gain	5.12	8.55	9.96	2.26	320	—	—	—	—

NOTE: The following abbreviations were used: NEL, net energy for lactation; ME, metabolizable energy; DE, digestible energy; TDN, total digestible nutrients.

^aTo allow for growth of young lactating cows, increase the maintenance allowances for all nutrients except vitamins A and D by 20 percent during first lactation and 10 percent during the second lactation.

^bValues for calcium assume that the cow is in calcium balance at the beginning of the last 2 months of gestation. If the cow is not in balance, then calcium requirement can be increased from 25 to 33 percent.

^cNo allowance is made for mobilized calcium and phosphorus associated with live weight loss or with live weight gain. The maximum daily nitrogen available from weight loss is assumed to be 30 g or 234 g of crude protein.

TABLE 6-5 Recommended Nutrient Content of Diets for Dairy Cattle

Cow	Vt	Fat (kg/d)	Milk Yield (kg/d)	Lactating Cow Diets		Dry, Pregnant Cows	Calf Starter Milk	Growing Heifers and Bulls ^a	Mature Bulls	Maximum Tolerable Levels ^{b,c}
				3-6 Mos	> 12 Mos					
400	5.0	0.230	7	13	20	50	50	3-6 Mos	13	1.15
500	4.5	0.275	8	17	24	60	60	3-6 Mos	19	2.00
600	4.0	0.330	10	20	27	67	67	3-6 Mos	25	2.43
700	3.5	0.385	12	24	31	73	73	3-6 Mos	3	—
800	3.0	0.440	13	27	35	79	79	3-6 Mos	3	—

Energy, Mcal/kg	NEL, Mcal/kg	NEM, Mcal/kg	NEC, Mcal/kg	ME, Mcal/kg	DE, Mcal/kg	TDN, % of DM	Protein equivalent	Crude protein, %	UIP, %	DIP, %	Fiber content (min.) ^d	Crude fiber, %	Acid detergent fiber, %	Neutral detergent fiber, %	Ether extract (min.), %	Minerals	Calcium, %	Phosphorus, %	Magnesium, %	Potassium, %	Sodium, %	Chlorine, %	Sulfur, %	Iron, ppm	Cobalt, ppm	Copper, ppm	Manganese, ppm	Zinc, ppm	Iodine, ppm	Selenium, ppm	Vitamins		A, IU/kg	D, IU/kg	E, IU/kg
																															15	15			
1.42	1.52	1.62	1.72	1.72	1.89	75	18	15	4.4	7.8	17	17	21	25	3	0.51	0.33	0.20	0.90	0.13	0.25	0.30	50	0.10	40	40	40	40	0.60	0.30	3,200	1,000	15		
1.67	1.72	1.89	2.04	2.80	3.31	73	19	15	5.9	10.4	17	19	21	25	3	0.48	0.41	0.25	1.00	0.18	0.25	0.20	50	0.10	40	40	40	40	0.60	0.30	4,000	1,000	15		
1.25	1.40	1.53	1.70	2.40	3.11	80	18	13	8.2	9.7	17	21	27	35	3	0.70	0.60	0.16	1.00	0.10	0.20	0.20	50	0.10	40	40	40	40	0.60	0.30	2,200	600	40		
—	1.90	1.20	1.08	3.11	3.53	69	16	13	4.4	—	—	—	—	—	—	0.60	0.40	0.07	1.00	0.10	0.20	0.20	50	0.10	40	40	40	40	0.60	0.30	2,200	300	25		
—	1.58	0.98	0.98	2.47	2.89	66	12	12	7.2	—	—	—	—	—	—	0.52	0.30	0.16	0.65	0.10	0.20	0.20	50	0.10	40	40	40	40	0.60	0.30	2,200	300	25		
—	1.40	0.83	0.83	2.27	2.69	61	12	12	2.1	—	—	—	—	—	—	0.41	0.30	0.16	0.65	0.10	0.20	0.20	50	0.10	40	40	40	40	0.60	0.30	2,200	300	25		
—	1.15	—	—	2.00	2.43	55	10	10	—	—	—	—	—	—	—	0.30	0.19	0.16	0.65	0.10	0.20	0.20	50	0.10	40	40	40	40	0.60	0.30	3,200	300	25		
—	—	—	—	2.00	2.43	55	10	10	—	—	—	—	—	—	—	0.30	0.19	0.16	0.65	0.10	0.20	0.20	50	0.10	40	40	40	40	0.60	0.30	3,200	300	25		

NOTE: The values presented in this table are intended as guidelines for the use of professionals in diet formulation. Because of the many factors affecting such values, they are not intended and should not be used as a legal or regulatory base.

The approximate weight for growing heifers and bulls at 3-6 mos is 150 kg; at 6-12 mos, it is 250 kg; and at more than 12 mos, it is 400 kg. The approximate average daily gain is 700 g/day. The maximum safe levels for many of the mineral elements are not well defined and may be substantially affected by specific feeding conditions. Additional information is available in *Mineral Tolerance of Domestic Animals* (NRC, 1980).

Vitamin tolerances are discussed in detail in *Vitamin Tolerance of Animals* (NRC, 1987b). It is recommended that 75 percent of the NDF in lactating cow diets be provided as forage. If this recommendation is not followed, a depression in milk fat may occur. The value for calcium assumes that the cow is in calcium balance at the beginning of the dry period. If the cow is not in balance, then the dietary calcium requirement should be increased by 25 to 33 percent. Under conditions of heat stress, potassium should be increased to 1.2 percent (see text). Magnesium should be increased to 0.25 or 0.30 percent.

If the diet contains as much as 25 percent strongly goitrogenic feed on a dry basis, the iodine provided should be increased two times or more. Although cattle can tolerate this level of iodine, lower levels may be desirable to reduce the iodine content of milk. The cow's copper requirement is influenced by molybdenum and sulfur in the diet (see text).

The following minimum quantities of B-complex vitamins are suggested per unit of milk replacer: niacin, 2.6 ppm; pantothenic acid, 13 ppm; riboflavin, 6.5 ppm; pyridoxine, 6.5 ppm; folic acid, 0.5 ppm; biotin, 0.1 ppm; vitamin B₁₂, 0.07 ppm; thiamin, 6.5 ppm; and choline, 0.26 percent. It appears that adequate amounts of these vitamins are furnished when calves have functional rumens (usually at 6 weeks of age) by a combination of rumen synthesis and natural feedstuffs.