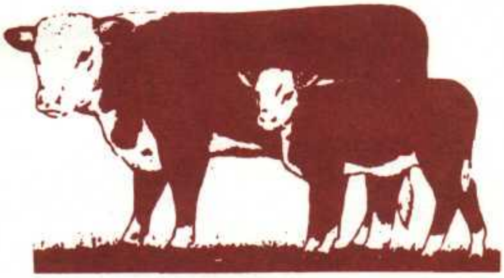
Net Energy Requirements of Growing and Finishing Cattle
Michigan State University Extension Service
Michigan Beef Production
John C. Waller, Dept. of Animal Science
Issued September 1982
4 pages

EXTENSION BULLETIN E-1653
SEPTEMBER 1982



MICHIGAN BEEF PRODUCTION

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

Net Energy Requirements of Growing and Finishing Cattle

By John C. Waller, Animal Science Dept.

The net energy requirements of growing cattle are related to body weight, stage of growth the animal is at for a given weight, rate of gain, sex, environmental conditions, age and previous nutritional history.

The net energy requirements for growth (NE_g) is the actual amount of energy that will be deposited as fat or muscle at a given weight and rate of gain. As cattle increase in weight the proportion of fat in the gain increases. As fat contains 2.25 times as much energy as a similar amount of protein in muscle tissue, more than twice as much energy is required to synthesize a pound of fat. In addition, more water is deposited with protein than with fat during growth. Therefore, daily net energy requirements for growth are related to the amount gained per day and the proportion of fat in the gain made at a given weight, which in turn is related to the eventual mature weight of the cattle. Heifers mature earlier than steers and therefore deposit more fat in the gain at a similar weight. Steers mature earlier than bulls, and thus deposit more fat at the same weight as bulls. Cattle with a relatively large mature size such as the Charolais, Chianina, Holstein and Simmental breeds will deposit less fat in the gain at the same weight as moderate sized cattle such as the Angus, Hereford, or Shorthorn breeds, and will have the same energy requirements for gain at a 100 to 300 lb. heavier weight.

The net energy requirements for maintenance (NE_m) are directly related to the actual weight of the cattle, and represent the amount of actual energy needed to support life (beating of the heart and functioning of the organs, maintaining body temperature and for muscular activity). Since they are related to the actual weight of the cattle they are likely similar at a given weight for various breeds of cattle, regardless of eventual mature size.

Factors such as extreme cold (wind and/or temperature) rain and mud and extreme abrupt changes in weather affect maintenance requirements, however.

Mud and cold rain can increase maintenance energy costs by 25 to 40%. Mud increases the energy requirements for activity and decreases feed intake as cattle often will not travel through mud to reach feed until they are excessively hungry. Also exposure to cold rain in the winter reduces the insulation barrier of the hair coat, resulting in excessive body heat losses. Often cattle will compensate for short periods of poor environmental conditions when followed by more suitable weather, but prolonged exposure to poor environmental conditions such as mud and cold rain can greatly increase total energy requirements.

Cold temperatures alone apparently do not necessarily greatly increase the proportion of feed consumed that is needed for maintenance, however, as cattle are able to utilize the large amount of heat increment normally available from the types of rations they are fed to maintain body temperature during cold weather. Calculations from Canadian studies show that the critical temperature (i.e., the temperature at which body tissue or energy normally available for gain is used to maintain body temperature) is 0°F. or below for cattle on an average intake of a ration that contains about .45 MCal. NE_g per lb. D.M. and as low as -20°F. on rations containing .60 MCal. NE_g per lb. D.M., without any wind.

The Canadian studies show that wind greatly increases energy requirements, however, and protection from wind is much more important than protection from cold. The critical temperature changes about 1°F. for each 1 M.P.H. of wind. Also, it appears that abrupt, severe weather changes affect cattle performance due to re-adaptation required and adjustments in feed intake that occur. Cattle tend to consume additional feed just prior to a weather change and then reduce intake after the change has occurred. Adjustments in management that reduce the effect of mud, rain, wind, and severe weather changes will contribute to an over-all reduction in energy requirements for maintenance.

The values given in these tables were developed from research using cattle of average mature size, where the steers and heifers reach the fatness of the low choice grade and/or yield grade 2 1/2 to 3 at 800 to 900 lb. for the heifers and 1000 to 1100 lb. for the steers. Until more complete energy requirement tables are developed, it may be that the expected rate of gain for bulls or larger type cattle on a given ration can be estimated by using the NE_m under the actual weight of the cattle as given in these tables, and using the energy requirements for gain given under a 100 to 200 lb. lighter weight. For example, the NE_m requirement for a 600 lb. Holstein steer is 5.21, but the energy requirement for a 2.5 lb. per day gain may be near 4 MCal. per day rather than 4.59 MCal. per day. Below are estimated equivalent weights.

It should be noted that smaller type, early maturing cattle will likely have higher energy requirements for gain at a given weight than those in the tables.

These tables were developed from performance of cattle fed or implanted with a growth stimulating compound. Therefore, if one of these compounds is not used (MGA, Ralgro or Synovex H for heifers and Ralgro or Synovex S for steers) energy requirements will be about 10% higher for any specific rate of gain shown in these tables.

Lightweight yearling cattle previously fed for slow rates of gain may have a 5 to 10% lower energy requirement for any given rate of gain as they utilize energy more efficiently than similar cattle previously fed higher levels of nutrition. Therefore, thin, lightweight yearlings will likely gain about 10% faster than normal on a given ration.

When appropriate feed net energy values and these net energy requirements are used along with a growth stimulant experience has shown that projected gains will usually be within 5 to 10% of actual gains on average commercial cattle in feedlots under average environmental conditions. Thus, this system can be used to estimate rate and cost of gain on a given combination of feedstuffs with a reasonably high degree of accuracy, enabling cattle feeders to project break-even costs and profits on cattle when they are purchased, as well as the time required to reach market weights.

The tables given here were developed to be used with fact sheets 1010 and E-1655, and the reader should refer to those fact sheets for an explanation on the meaning and use of various feed energy values, and formulating least cost rations. The following brief description may be useful as a simple guide in using these tables, however. The examples will be given for an average size 600 lb. steer consuming 14.5 lb. of ration dry matter that contains .70 MCal. NE_m and .45 MCal.NE_g per lb.

1. Divide the net energy required daily for maintenance (NE_m) for the weight of the cattle by the NE_m value of the ration per lb. to get lb. of the ration required daily for maintenance ($\frac{5.21}{.70}$ = 7.5 lb. of ration for maintenance for the example steer).
2. Subtract lb. needed for maintenance from total lb. consumed to get lb. of ration left for gain (14.5 – 7.5 lb. left for gain for the example 600 lb. steer).
3. Multiply lb. left for gain times NE_g value of the ration per lb. to get energy available for gain per day (7 x .45 = 3.15 MCal left for gain).
4. Look down the NE_g column under the weight and sex of the cattle for the value nearest the energy left for gain, and find the expected rate of gain in the lb. daily gain column across from this value (3.15 is near 3.19, which gives a 1.8 lb. per day gain for the example 600 lb. steer).

The expected rate of gain can be determined on various combinations of the feeds available, and then the cost of the ration plus overhead costs can be divided by the expected rate of gain to find the least cost ration.(Refer to fact sheets E-1624 and E-1655 for a more complete discussion on ration formulation and finding the most profitable feeding system).

ESTIMATED EQUIVALENT WEIGHTS WHERE PROPORTION OF BODY FAT AND PROTEIN ARE SIMILAR

Steers	Weight, lb.									
Small frame	240	320	400	480	560	640	720	800	880	1140
Average frame	300	400	500	600	700	800	900	1000	1100	1430
Large frame	360	480	600	720	840	960		1200	1320	1720
Heifers										
Small frame	200	260	330	390	460	530	590	660	720	940
Average frame	240	320	400	480	560	640	720	800	880	1140
Large frame	280	375	470	560	660	750	840	940	1030	1340
% of mature wt.	21	28	35	42	49	56	63	70	77	100

Mature weight **= point where no additional weight of muscle tissue is deposited.**

Small Frame **= will reach fatness of low choice—yield grade 2½- 3 at 800-880 lb. for steers and 660-720 lb. for heifers.**

Average Frame **= will reach fatness of low choice and yield grade 2½- 3 at 1000-1100 for steers and 800-880 for heifers.**

Large Frame **= will reach fatness of low choice and yield grade 2½- 3 at 1200-1320 for steers and 940-1030 for heifers.**

NET ENERGY REQUIREMENT TABLES FOR GROWING AND FINISHING CATTLE

Body Wt., Lb.	300		400		500		600	
	NE_m / 3.10		NE_m / 3.85		NE_m / 4.55		NE_m / 5.21	
Daily Gain	NE_g		NE_g		NE_g		NE_g	
Lb.	Steers	Heifers	Steers	Heifers	Steers	Heifers	Steers	Heifers
				-----Mcal/day -----				
.5	.47	.52	.59	.64	.72	.78	.83	.90
.6	.59	.64	.73	.80	.87	.95	1.00	1.09
.7	.68	.74	.84	.92	1.02	1.12	1.17	1.28
.8	.79	.87	.98	1.08	1.17	1.29	1.34	1.48
.9	.88	.97	1.10	1.21	1.33	1.46	1.52	1.68
1.0	1.00	1.11	1.24	1.38	1.48	1.64	1.70	1.88
1.1	1.12	1.24	1.39	1.54	1.64	1.82	1.88	2.09
1.2	1.21	1.35	1.51	1.68	1.80	2.00	2.06	2.30
1.3	1.33	1.49	1.66	1.86	1.96	2.19	2.24	2.51
1.4	1.43	1.61	1.78	2.00	2.12	2.38	2.43	2.73
1.5	1.55	1.75	1.93	2.18	2.28	2.57	2.62	2.95
1.6	1.65	1.87	2.06	2.32	2.45	2.77	2.81	3.17
1.7	1.78	2.02	2.21	2.51	2.61	2.97	3.00	3.40
1.8	1.88	2.14	2.34	2.66	2.78	3.17	3.19	3.63
1.9	2.01	2.29	2.50	2.85	2.95	3.37	3.39	3.87
2.0	2.14	2.42	2.63	3.01	3.12	3.58	3.58	4.11
2.1	2.24	2.57	2.79	3.20	3.30	3.79	3.78	4.35
2.2	2.37	2.74	2.95	3.40	3.47	4.01	3.98	4.59
2.3	2.48	2.87	3.08	3.57	3.65	4.22	4.18	4.84
2.4	2.61	3.03	3.25	3.77	3.83	4.44	4.39	5.09
2.5	2.72	3.17	3.38	3.93	4.01	4.66	4.59	5.35
2.6	2.86	3.33	3.55	4.15	4.19	4.89	4.80	5.61
2.7	2.97	3.47	3.69	4.32	4.37	5.12	5.01	5.87
2.8	3.11	3.65	3.86	4.54	4.56	5.35	5.22	6.14
2.9	3.22	3.79	4.00	4.71	4.74	5.59	5.44	6.40
3.0	3.36	3.97	4.18	4.94	4.93	5.82	5.65	6.68
3.1	3.47	4.11	4.32	5.12	5.12	6.06	5.87	6.95
3.2	3.62	4.30	4.50	5.34	5.31	6.31	6.09	7.23
3.3	3.76	4.48	4.68	5.51	5.51	6.56	6.31	7.52
3.4	3.88	4.63	4.83	5.76	5.70	6.81	6.54	7.80

Body Wt., Lb.	700		800		900		1000	
	NE_m		NE_m		NE_m		NE_m	
	5.85		6.47		7.06		7.65	
Daily Gain	NE_g		NE_g		NE_g		NE_g	
LB.	Steers	Heifers	Steers	Heifers	Steers	Heifers	Steers	Heifers
				----Mcal/day -----				
.5	.93	1.01	1.02	1.11	1.12	1.22	1.21	1.32
.6	1.12	1.22	1.24	1.35	1.35	1.47	1.46	1.59
.7	1.31	1.44	1.45	1.59	1.58	1.73	1.71	1.88
.8	1.51	1.66	1.67	1.83	1.82	2.00	1.97	2.17
.9	1.71	1.88	1.89	2.08	2.06	2.27	2.23	2.46
1.0	1.91	2.11	2.11	2.33	2.30	2.55	2.49	2.76
1.1	2.11	2.34	2.33	2.59	2.55	2.83	2.76	3.06
1.2	2.31	2.58	2.56	2.85	2.79	3.11	3.02	3.37
1.3	2.52	2.82	2.78	3.12	3.04	3.40	3.29	3.68
1.4	2.73	3.06	3.01	3.39	3.29	3.70	3.56	4.00
1.5	2.94	3.31	3.25	3.66	3.55	4.00	3.84	4.33
1.6	3.15	3.56	3.48	3.94	3.80	4.30	4.12	4.66
1.7	3.37	3.82	3.72	4.22	4.06	4.61	4.40	4.99
1.8	3.58	4.08	3.96	4.51	4.33	4.92	4.68	5.33
1.9	3.80	4.34	4.20	4.80	4.59	5.24	4.97	5.67
2.0	4.02	4.61	4.45	5.09	4.86	5.57	5.26	6.02
2.1	4.25	4.88	4.69	5.39	5.13	5.89	5.55	6.38
2.2	4.47	5.16	4.94	5.70	5.40	6.23	5.84	6.74
2.3	4.70	5.44	5.19	6.01	5.67	6.56	6.14	7.10
2.4	4.93	5.72	5.45	6.32	5.59	6.90	6.44	7.47
2.5	5.16	6.01	5.70	6.64	6.23	7.25	6.74	7.85
2.6	5.39	6.30	5.96	6.96	6.51	7.60	7.05	8.23
2.7	5.63	6.59	6.22	7.28	6.80	7.96	7.35	8.61
2.8	5.87	6.89	6.48	7.61	7.08	8.32	7.67	9.00
2.9	6.11	7.19	6.75	7.95	7.37	8.68	7.98	9.40
3.0	6.35	7.50	7.02	8.29	7.67	9.05	8.30	9.80
3.1	6.59	7.81	7.29	8.63	7.96	9.43	8.61	10.20
3.2	6.84	8.12	7.56	8.98	8.26	9.81	8.94	10.61
3.3	7.09	8.44	7.83	9.33	8.56	10.19	9.26	11.03
3.4	7.34	8.76	8.11	9.68	8.86	10.58	9.59	11.45

(Originally Prepared by Danny G. Fox, formerly Animal Science Dept., MSU.)

MICHIGAN STATE UNIVERSITY
CES
COOPERATIVE EXTENSION SERVICE

MSU is an Affirmative Action/Equal Opportunity Institution. Cooperative Extension Service programs are open to all without regard to race, color, national origin, or sex.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

FILE: 19.211 1P-5M-9:82-KMF-GP, Price 10¢, Single copy free to Michigan residents