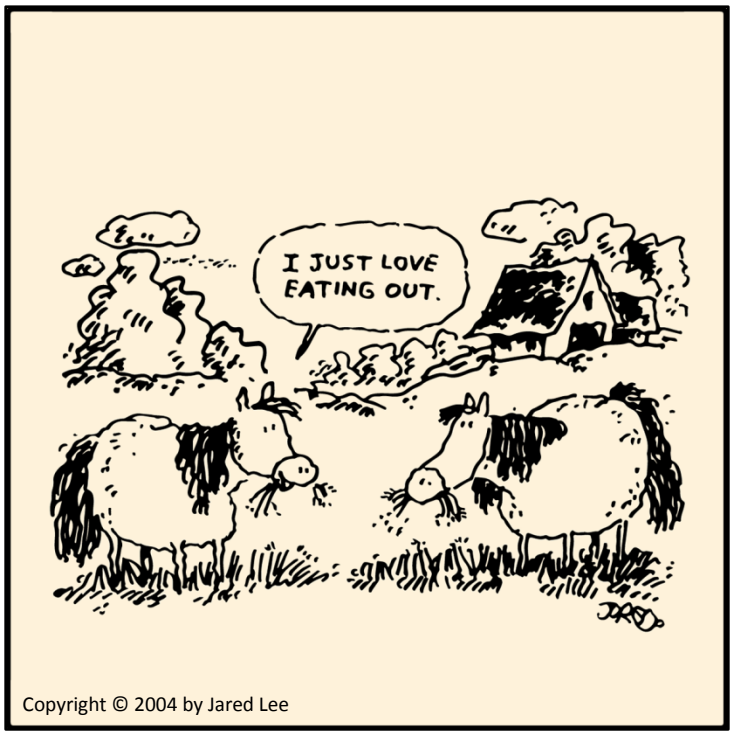
Calories 101

(Originally published on www.enlightenedequine.com)



Thanks to COVID-19, most of us probably aren't spending much time in restaurants these days. But many of our horses, on the other hand, may nevertheless be spending more time eating higher-calorie food than they should be! Yes, I realize I'm not an equine nutritionist, and I don't pretend to be one. But I *have* spent a fair amount of time studying enough of the basics of equine nutrition with Dr. Jessica Bedore, my former equine nutritionist colleague at The Ohio State University, to feel competent talking about how to determine proper caloric intake.

My decision to discuss it now is being driven by three things: 1) the ever-increasing number of overweight horses we encounter on a daily basis, 2) the apparent lack of knowledge by horse owners and barn managers about how to determine how much a horse should be eating, and 3) the usual annual increase in the incidence of laminitis in the area because of the rapidly-growing (and sugar-laden) grass. And because truly comprehensive hoof care involves a great deal more than just proper hoof trimming (which, by the way, is why we spend a tremendous amount of time discussing other contributing factors to hoof quality and form in the Liberated Horsemanship Gateway Clinics), I feel compelled to share this knowledge in a sincere effort to help horses avoid the health issues that result from obesity.

Yes, I'm well aware many people find the idea of having to do any sort of calculations intimidating and even frightening. But the good news is the math we need for diet planning is extremely simple and straightforward, and can be done by anyone using even the lowliest of calculators, including the one on your phone. So let's get started!

Part 1 of this series is aimed at teaching you to recognize whether your horse is too fat, too thin, or just right, and how to calculate how many calories per day he needs to maintain a proper weight. Probably the most standardized way of starting this process is to figure out your horse's *Body Condition Score*, or BCS. This method of assessing the amount of fat on a horse's body was developed in 1983 by Dr. Don Henneke at Texas A&M University, and the Henneke System has become the de facto standard for describing a horse's condition.

For many, this will undoubtedly be the most difficult part of our task, simply because we horse owners can't seem to look at our horses with an unbiased eye. But there's no upside to convincing ourselves that our horse isn't overweight if, in fact, he is - only a potentially horrible downside. Just make certain whoever does the evaluation is as objective as possible: someone with a discerning eye who's willing to put aside all feelings and opinions and honestly assess your horse. And if you or your chosen evaluator isn't reasonably familiar with the process of calculating BCS, I strongly suggest you both familiarize yourselves with this very useful process; you can find a good step-by-step article on Body Condition Scoring here, although there are a number of articles and video guides available. To help you with the actual process of Body

Condition Scoring your horse, I've created the following worksheet and guide –

Body Condition Score Worksheet

Score →	1	2	3	4	5	6	7	8	9
Body Area ↓	Poor	Very Thin	Thin	Moderately Thin	Moderate	Moderately Fleshy	Fleshy	Fat	Extremely Fat
Ribs Your Horse's Score ↓	Ribs protruding prominently	Ribs prominent	Slight fat over ribs; ribs easily discernable	Faint outline of ribs discernable	Ribs cannot be visually distinguished, but can be easily felt	Fat over ribs feels spongy	Individual ribs can be felt with pressure, but noticeable fat filling between ribs	Difficult to feel ribs	Patchy fat appearing over ribs
Shoulder Your Horse's Score ↓	Bone structure easily noticeable	Bone structure faintly discernable	Shoulder accentuated	Shoulder not obviously thin	Shoulder blends smoothly into body	Fat beginning to be deposited	Fat deposited behind shoulder	Area behind shoulder filled in flush with body	Bulging fat
Withers Your Horse's Score ↓	Bone structure easily noticeable	Bone structure faintly discernable	Withers accentuated	Withers not obviously thin	Withers rounded over spinous processes	Fat beginning to be deposited	Fat deposited along withers	Area along withers filled with fat	Bulging fat
Loin Your Horse's Score ↓	Spinous processes projecting prominently	Slight fat covering over base of spinous processes. Transverse processes of lumbar vertebrae feel rounded. Spinous processes are prominent.	Fat buildup halfway on spinous processes, but easily discernable. Transverse processes cannot be felt.	Negative crease (peaked appearance) along back	Back is level	May have a slight positive crease (a groove) down back	May have a positive crease down back	Positive crease down the back	Obvious crease down the back
Tailhead Your Horse's Score ↓	Tailhead, pinbones, and hook bones projecting prominently	Tailhead prominent	Tailhead prominent but individual vertebrae cannot be visually identified. Hook bones appear rounded, but are still easily discernible. Pin bones not distinguishable.	Prominence depends on conformation. Fat can be felt. Hook bones not discernible	Fat around tailhead beginning to feel soft	Fat around tailhead feels soft	Fat around tailhead is soft	Fat around tailhead very soft	Bulging fat around tailhead
Neck Your Horse's Score ↓	Bone structure easily noticeable	Bone structure faintly discernable	Neck accentuated	Neck not obviously thin	Neck blends smoothly into body	Fat beginning to be deposited	Fat deposited along neck	Noticeable thickening of neck	Bulging fat

Compiled from information provided by HabitatForHorses.org and the University of Kentucky College of Agriculture, Food and Environment.

← Total of Your Horse's Scores

← (Total ÷ 6) = Your Horse's BCS

Body Condition Score Guide

(from The University of Kentucky College of Agriculture, Food and Environment)

Ribs

The first place to look when assessing a horse's body condition score (BCS) is the ribcage. If the ribs are easily seen, the horse will have a score over the ribcage below a 5. If you cannot see the ribs, then the score should be a 5 or above. During winter and spring it might be difficult to see ribs because of the horse's coat, so it is always important to run your fingers across the ribcage to assign the correct score. A very thin horse will have prominent ribs – easily seen and felt – with no fat padding. As the horse gains weight and body condition, a little padding can be felt around the ribs. By score 5, the ribs will no longer be visible, but can easily be felt. Once the body condition score is above 7, the ribs become more difficult to feel.

Shoulder

A BCS of 5 means the shoulder blends smoothly with the body. At increasing condition scores, fat is deposited behind the shoulder and becomes bulging. This observation is especially true in the region behind the elbow. The shoulder's bony structures will become more visible as the scores drop below 5.

Withers

If a horse is very thin, no fat will be deposited between the top of the shoulder blade and the spinal vertebrae, making the two structures easily discernable. As the horse's condition score increases, fat fills in between the top of the shoulder blade and the spinal vertebrae; so, at a condition score of 5, the withers will appear rounded. As horses approach the high end of the condition scoring scale, the withers will be bulging with fat.

Loin

The loin is the area of the back just behind where the saddle sits. At a condition score of 5, the loin will be relatively level – the spine is not sticking up, nor is there a dent or crease along the spine. At condition scores below 5, the spine starts to become prominent; this is sometimes called a "negative crease." A very thin horse will have an obvious ridge down the back where the vertebrae of the spine become obvious. As the condition score increases above a 5, fat begins to build up on either side of the spine and a visible crease starts to appear.

Tailhead

In a very thin horse, the tailhead is prominent and easily discernable. Once the horse starts gaining weight, fat starts to fill in around the tailhead. As the condition score exceeds 7, the fat will feel soft and start to bulge.

Neck

In a very thin horse, you might be able to see the neck's bony structures. As the horse gains condition, fat will be deposited on the top of the neck. At a condition score of 5, the neck blends smoothly into the body. Body condition scores of 8 and 9 are characterized by a neck that is thick all around with fat evident at the crest.

Incidentally, to make all this information a bit easier to read, use, and share with others, I've created a PDF file containing all of the tables, charts, and worksheets in this article for downloading and printing here!

Once you've determined the BCS, the next step is to find out how much weight your horse needs to lose or gain. The following chart should help; just look up your horse's BCS in the column under his height, and compare it to the weight given for the same height with a BCS 5. For example, a 15-hand horse with a BCS 6.5 (extremely common, in my experience) has an approximate weight of 1,133 pounds and a target weight of 1,014 pounds; therefore, he needs to lose about 119 pounds. Of course, these are approximations, and are presumably based on average-build i.e. riding horses. But the numbers should be accurate enough to give you a solid feel for how much weight change your horse requires. This table is in hands and pounds –

Equine Weight Estimation

Body Condition Score	Height (hands) 12	13	14	15	16
	Predicted Weight (lb)*				
1	419	529	683	860	926
1½	423	554	694	882	966
2	432	579	705	899	994
2½	448	604	717	913	1,019
3	463	628	728	926	1,036
3½	483	668	761	941	1,054
4	503	705	796	961	1,071
4½	527	736	833	985	1,091
5	551	761	871	1,014	1,113
5½	578	778	908	1,049	1,142
6	604	791	944	1,089	1,175
6½	633	802	979	1,133	1,213
7	661	816	1,014	1,179	1,257
7½	692	836	1,052	1,226	1,305
8	723	871	1,091	1,272	1,360
8½	758	926	1,138	1,312	1,418
9	794	1,014	1,190	1,345	1,477

* Based on data from *Condition Scoring and Weight Estimation of Horses* (P. Ellis, *Agriculture Victoria*, 2000), with intermediate-value 4th-order polynomial interpolation by S. Hebrock.

This is the metric version, with the hands heights converted to centimeters and the weights in kilograms –

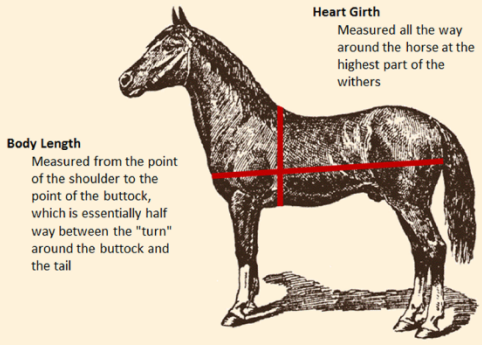
Equine Weight Estimation

Body Condition Score	Height (cm) 122	132	142	152	163
	Predicted Weight (kg)*				
1	190	240	310	390	420
1½	192	251	315	400	438
2	196	263	320	408	451
2½	203	274	325	414	462
3	210	285	330	420	470
3½	219	303	345	427	478
4	228	320	361	436	486
4½	239	334	378	447	495
5	250	345	395	460	505
5½	262	353	412	476	518
6	274	359	428	494	533
6½	287	364	444	514	550
7	300	370	460	535	570
7½	314	379	477	556	592
8	328	395	495	577	617
8½	344	420	516	595	643
9	360	460	540	610	670

* Based on data from ***Condition Scoring and Weight Estimation of Horses*** (P. Ellis, *Agriculture Victoria*, 2000), with intermediate-value 4th-order polynomial interpolation by S. Hebrock.

At this point you may be wondering why we don't simply use the ubiquitous weight tape instead of bothering with figuring out the horse's BCS. A couple of reasons: 1) we know weight tapes aren't particularly accurate, and 2) we want to actually ***look at the horse's body fat*** to assess his condition, and not base our diet decisions solely on a string of numeric approximations. Still, the weight tape *is* a useful tool when it comes to tracking *changes* in our horse's weight, so knowing what your horse weighs in addition to calculating his BCS is useful. However, Texas A&M University has developed a far more accurate method of estimating a horse's weight than with a weight tape, using an ordinary cloth tape measure and some simple math as described below. I've discovered, by the way, that most of us will need some assistance to measure the Body Length on the average-sized riding horse; my arms just aren't that long!

Estimating a Horse's Weight

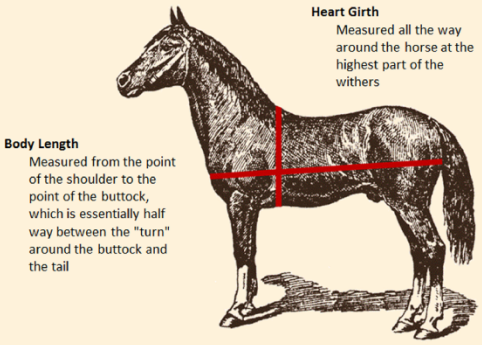


1. Measure the Heart Girth and the Body Length in inches
2. Calculate the Estimated Weight in pounds with -
   (Heart Girth × Heart Girth × Body Length) ÷ 330 = Estimated Weight

Example: A pony has a measured Heart Girth of 61 inches and a measured Body Length of 62 inches. Therefore, (61 × 61 ×62) ÷ 330 = 699

Again - here's the metric version, with lengths in centimeters and weight in kilograms –

Estimating a Horse's Weight



1. Measure the Heart Girth and the Body Length in centimeters
2. Calculate the Estimated Weight in kilograms with -
   (Heart Girth × Heart Girth × Body Length) ÷ 11,922 = Estimated Weight

Example: A pony has a measured Heart Girth of 155 cm. and a measured Body Length of 158 cm. Therefore, (155 × 155 ×158) ÷ 11,922 = 318

So you now know approximately how much your horse weighs, and how much he *should* weigh. Now it's time to figure out how many calories per day are necessary for your horse to maintain his target weight, which is probably *not* his current weight. And just as with the BCS, determining caloric requirements requires you to be absolutely honest about how much you actually ride (or drive) your horse, because the amount of work he does is key to calculating caloric needs.

This is really the easiest and most straightforward part of the process; all we need is some accurate information about your riding or driving habits. You'll need to collect some information about how much you ride, and then do some simple calculations using the worksheet below to figure out how many calories per day your horse needs to maintain his target weight -

Calculating Your Horse's Daily Caloric Requirements
(Imperial Version)

	Minutes Ridden (or Driven) per Day							Total Minutes Ridden per Week	Average Minutes Ridden per Day (Total Minutes ÷ 7)
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday		
Step 1 →								Step 2 ↑	Step 3 ↑

How to Use this Chart

Step 1: Write in the minutes above spent riding or driving your horse each day. Do not count time spent tacking up, leading your horse, or just sitting on your horse; only time spent with the horse actually working.
Step 2: Add up the minutes and write the total in the *Total Minutes Ridden per Week* box.
Step 3: Divide the *Total Minutes Ridden per Week* by seven (7), and write the result in the *Average Minutes Ridden per Day* box.
Step 4: Look up the *Average Minutes Ridden* in the table, and write the corresponding *Work Load Factor* in the *Work Load Factor (WLF)* box.
Step 5: Write your horse's target weight in pounds in the *Target Weight (TW)* box.
Step 6: Multiply the *Work Load Factor (WLF)* by the *Target Weight (TW)*, and write the result in the *Required Calories* box. This is the number of calories required to maintain your horse's target weight.

Step 4 ↓

Average Minutes Ridden	Daily Work Load	Work Load Factor
Less than 15	None	15
15 - 60	Light	18
61 - 120	Moderate	21
121 - 240	Heavy	24
More than 240	Very Heavy	31

Work Load Factor (WLF)	Target Weight (TW) in lb	Required Calories (WLF × TW)
	Step 5 ↑	Step 6 ↑

Here's the metric version, with the target weight in kilograms -

Calculating Your Horse's Daily Caloric Requirements
(Metric Version)

	Minutes Ridden (or Driven) per Day							Total Minutes Ridden per Week	Average Minutes Ridden per Day (Total Minutes ÷ 7)
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday		
Step 1 →								Step 2 ↑	Step 3 ↑

How to Use this Chart

Step 1: Write in the minutes above spent riding or driving your horse each day. Do not count time spent tacking up, leading your horse, or just sitting on your horse; only time spent with the horse actually working.
Step 2: Add up the minutes and write the total in the *Total Minutes Ridden per Week* box.
Step 3: Divide the *Total Minutes Ridden per Week* by seven (7), and write the result in the *Average Minutes Ridden per Day* box.
Step 4: Look up the *Average Minutes Ridden* in the table, and write the corresponding *Work Load Factor* in the *Work Load Factor (WLF)* box.
Step 5: Write your horse's target weight in kilograms in the *Target Weight (TW)* box.
Step 6: Multiply the *Work Load Factor (WLF)* by the *Target Weight (TW)* times 2.205, and write the result in the *Required Calories* box. This is the number of calories required to maintain your horse's target weight.

Step 4 ↓

Average Minutes Ridden	Daily Work Load	Work Load Factor
Less than 15	None	15
15 - 60	Light	18
61 - 120	Moderate	21
121 - 240	Heavy	24
More than 240	Very Heavy	31

Work Load Factor (WLF)	Target Weight (TW) in kg	Required Calories (WLF × TW × 2.205)
	Step 5 ↑	Step 6 ↑

As an example, suppose I ride my 15-hand horse with a target weight of 1,014 pounds for 20 minutes every Tuesday, Thursday, Saturday, and Sunday. Just for the record, I've not counted the 10 minutes it takes to collect my horse from the pasture, the 10 minutes it takes to clean and tack him up, the 5 minutes each of a leisurely warm-up and cool-down walk, or the 10 minutes to get to and from the arena and untack and put him away when I'm done. So, following through the worksheet:

Steps 1 & 2 -

20 + 20 + 20 + 20 = 80 Total Minutes Ridden per Week

Step 3 -

80 ÷ 7 = 11 Average Minutes Ridden per Day

Step 4 -

11 = Less Than 15 = 15 Work Load Factor

Steps 5 & 6 -

15 x 1,014 = 15,210 Required Calories per Day

And now we know how many calories our horse needs to maintain a healthy weight! So take an objective look at your horse's body and your riding or driving patterns, and figure out how many calories your horse should be consuming in preparation for the second part of this series.

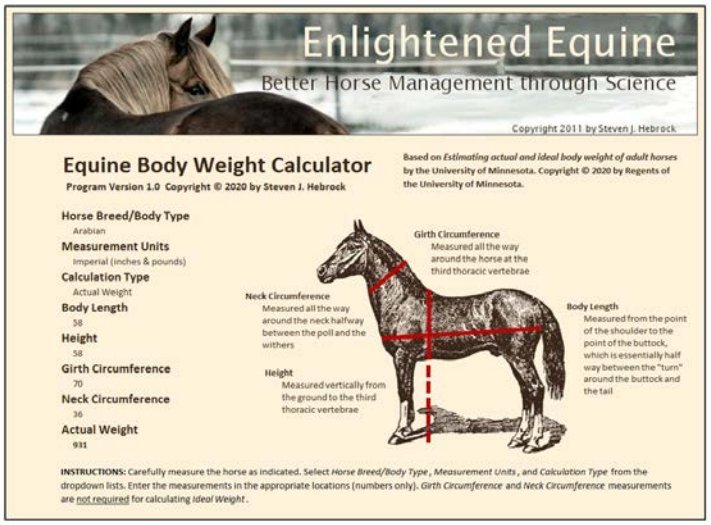
In the next installment, we'll discuss the potential challenges of selecting appropriate types and amounts of forages and feeds to meet, but not exceed, this requirement. Why will it be challenging? Primarily for two reasons: 1) in the case of forage, the calorie content of *all* of them, including green grass, varies by a number of factors, including forage type, maturity when cut or consumed (in the case of green grass), time of day when cut or consumed, moisture content, and storage conditions, and 2) in the case

of feeds, manufacturers don't generally publish the calorie content of their products so you have to directly contact the company to get the information you need to plan the diet. But in spite of all these apparent obstacles, it's fairly easy to ensure your horse is getting adequate, but not excessive, calories.

All for now...

Copyright © 2004 by Jared Lee

UPDATE: I happened across some new information on approximating current and ideal (target) body weight based on research done at the University of Minnesota. Because they use different formulae for different body types, their method appears to yield more precise approximations than previous methods, so my advice would now be to use their method to determine the target weight for your horse. You can find a description of their research and method here; note they also have an app available for Apple and Android devices at a minimal cost. I decided to create my own MS Excel-based calculator using their formulae that can be used or downloaded from here at no cost. Here's a preview –



Humorous as Jared Lee's cartoon may be, the overweight horse is genuinely at risk for increased health and performance problems. Overheating, poor performance, and metabolic disorders are all common consequences of excess body fat, causing discomfort, pain, and even loss of use for your horse, plus costly vet bills, headache, and heartache for you as the owner.

In Calories 101 - Part 1, we looked at several methods for estimating a horse's current and target weights, and calculated the total number of calories necessary for maintaining a horse's ideal body weight. And now, equipped with that necessary information, we can next take on the task of planning a proper diet for your horse. But first, I want to reiterate that I'm *not* an equine nutritionist; I'm merely a guy with an extensive math background who understands and can explain how to do the well-established calculations necessary for the task at hand! For advice about specific nutrients and nutrient ratios, please consult an equine nutritionist - ideally (in my opinion), one at a university, who's not likely to be employed by the feed or supplement industries, to minimize the possibility of any specific product biases. So let's get started!

First of all, absolutely everything in diet calculations is measured by ***weight***. Not flakes, scoops, coffee cans, bales, pudding containers, or anything else volume-related. Weight. Period. So you'll need some reasonably-accurate method of weighing out forage and feed. Yes, we could do

some get-it-in-the-ballpark volume-based "guesstimating," and possibly get within a factor of 2 by the time we figure out the actual amounts to feed, but why knowingly add to the already-present inaccuracies in horse weight and exercise estimations? You'll need probably two different scales - a small platform-style scale (like a kitchen or postage scale) to weigh feed, and a hanging scale (like a fish scale) with a bag or hay net to measure forage.

When we talk about things that go in your horse's mouth, it's important to understand the difference in calories between what we're actually feeding the horse, known as *as-fed basis*, and the values listed on any sort of analysis, called *dry matter basis*. The idea is a simple one: Everything your horse eats contains some amount of moisture. Whether it's cured hay, with a relatively small water content of around 8 - 13%, or grass pasture, with much higher moisture values of 60% or more, that water needs to be accounted for in any calculations. So for an apples-to-apples comparison, dry matter basis is the way to go!

Our calorie estimations depend on two numbers listed in an analysis: the digestible energy (DE), which is a measure of the number of megacalories per pound in the sample, and the percentage of dry matter (% Dry Matter) present in the sample. For example, suppose my hay sample analysis results state that all figures are on a dry matter basis, and list a DE (Digestible Energy) of 1.000 Mcal/Lb. and a % Dry Matter of 90.000. Since the DE on my report is listed as a dry matter basis figure (in other words, with no water), but what I actually feed contains water, I need to do a bit of math to figure out how many calories are in a pound of what I'm actually feeding. First of all, 1.000 Mcal is equal to 1,000 calories; we have to multiply by 1,000 (i.e. move the decimal point 3 places to the right) to convert megacalories to kilocalories, which are what we usually refer to as just "calories." Next, we have to multiply the calories by the % Dry Matter to figure out how many calories are in an as-fed pound of hay, so 1,000 × 0.90 = 900 calories per pound. The easy way to help remember that you need to multiply rather than divide is that **the as-fed calories will always be lower than the dry matter calories**. And now I know how many calories are in a pound of my hay!

So we'll begin by talking about how to plan a diet using already-provided average values for forage and feed, and then we'll describe how to properly collect and prepare a forage sample for actual laboratory analysis. And this seems like an appropriate time to mention my general approach to feeding horses.

As with hoof care, I believe our feeding perspective should emulate nature's process of feeding feral horses in their aboriginal environment to the extent possible. Even though our horses' energy (calorie) needs may at times exceed those of the feral horse, what they eat and the method of delivering it can still be consistent with nature's methods. By doing so, we can minimize or even eliminate most of the feeding-related problems; laminitis, choke, insulin-related metabolic issues, and colic are all examples of conditions most properly-fed horses rarely suffer from. So keep this in mind as I describe the diet planning.

The table below lists the average DE and % Dry Matter values for some of the most common forages and grains, including fresh forages like grass pasture. These values come from a fabulous and absolutely free resource: Dairy One's Interactive Feed Composition Libraries. While not every possible thing you might want to feed your horse can be found in their libraries, most typical items - and even some seemingly-odd ones (for horse people) like fresh pineapple forage - are definitely provided! And, being the nice guy that I am, I've calculated the As-Fed Basis DE calories as well -

Average Calorie Content of Some Common Forages & Grains

Forage/Grain	% Dry Matter*	Dry Matter Basis Digestible Energy Mcal/Lb.*	As-Fed Basis Digestible Energy cal/Lb.
Grass Pasture	35.135	0.911	320
Mixed, Mostly Legume, Pasture	29.932	1.078	323
Mixed, Mostly Grass, Pasture	36.966	0.962	356
Straw	93.504	0.807	755
Bermudagrass Hay	93.209	0.895	834
Grass Cubes	91.722	0.914	838
Grass Pellets	91.731	0.930	853
Grass Hay	92.255	0.937	864
Mixed, Mostly Grass, Hay	91.759	0.951	873
Alfalfa Cubes	90.934	1.002	911
Alfalfa Pellets	91.039	1.016	925
Mixed, Mostly Legume, Hay	90.700	1.038	941
Legume Hay	90.823	1.109	1,007
Beet Pulp, Dry	91.666	1.168	1,071
Rice Bran, Dry	92.478	1.427	1,320
Oats, Dry	90.226	1.504	1,357
Shelled Corn	88.718	1.745	1,548

*Average values obtained online from *Dairy One Interactive Feed Composition Libraries*.

Let's begin with dry forage (hay), since that's crucial to every horse's digestive health, and should by far constitute the largest percentage of any horse's diet. The *absolute minimum amount of forage* required to keep a horse's digestive system working properly is considered to be 1% of his Target Weight per day, on a dry-matter basis. That means my 15-hand horse with an ideal weight of 1,014 pounds needs *at least* 1,014 × 0.01 = 10.14 pounds of dry-matter-equivalent forage each and every day just to keep things operating properly. According to the above table, grass hay has a % Dry Matter of 92.255, so the easiest conversion to as-fed would be 10.14 ÷ 0.92255 = 11 pounds. Remember, the as-fed amount will always be higher than the dry-matter basis amount, so dividing by the percentage of dry matter gives us the increase in weight due to water. The table also lists an average digestible energy (DE) content of 864 calories per pound, so feeding the absolute minimum forage requirement for my 15-hand horse would provide only 11 × 864 = 9,504 calories. But if you remember from Part 1, my 15-hand horse requires 15,210 calories per day to maintain his target weight, so we have a calorie deficit of 15,210 - 9,504 = 5,706 calories. So let's see how much additional grass hay I would need to take care of this deficit.

If we divide the deficit by the average as-fed DE for our grass hay, we have 5,706 ÷ 864 = 6.6 pounds. So, by feeding my horse 11 + 6.6 = 17.6 pounds of grass hay per day, we've provided *all* of the calories necessary for him to maintain his Target Weight - no other feed required! Admittedly, that was more complicated than it needed to be, because **directly computing the forage amount from the required calories will always more than satisfy the 1% requirement**. So, making certain to use appropriate values to end up with as-fed weight:

> Required Calories per Day ÷ Digestible Energy per Pound of Forage = Required Pounds of Forage per Day, or
>
> 15,210 ÷ 864 = 17.6 pounds

Simple enough, right?

...but now I need to mention there are several caveats to keep in mind when using the information. Keep in mind that the Digestible Energy number, like *all* of the numbers, is an *average value* based (in this case) on 66,310 samples, and, in reality, the values can and will vary over a fairly wide range. For grass hay's DE, for example, those samples had a Standard Deviation of 111 calories. Without getting into the statistics behind these numbers, let me just say this indicates that 95% of the samples tested actually had a DE somewhere between 715 and 1,159 calories per pound (dry matter basis), or 660 and 1,069 calories per pound as-fed. Let's try to understand the implications of that on our simple feeding program.

If you feed the originally-calculated 18 pounds of grass hay (yes, I rounded it up to the nearest pound) per day which used the average DE for the calculation:

> 18 × 660 = 11,880 calories per day with a DE at the lower end of the samples, leaving a deficit of 3,330 calories and thus *underfeeding* the horse by 22%
>
> 18 x 1,069 = 19,242 calories per day with a DE at the higher end of the samples, creating a surplus of 4,032 calories and thus *overfeeding* the horse by 27%

Conversely, if you adjust the forage amount for the lower and higher ends of the samples:

> 15,210 ÷ 660 = 23 pounds per day will be required if the hay is actually at the lower end of the samples measured
>
> 15,210 ÷ 1,069 = 14.23 pounds per day will be required if the hay is actually at the higher end of the samples measured

This same variability, of course, is present in the % Dry Matter numbers as well; more or less water present than the average value will have a potentially serious effect on the calculated as-fed amounts, thus throwing your feeding program off even farther! Hopefully, you're starting to understand from this example why it's so important to have

your hay tested; you could very easily be underfeeding or overfeeding by a significant amount if your hay's DE and % Dry Matter aren't very close to the averages! Fortunately, hay testing is very easy and inexpensive, and will provide an in-depth look at the composition of your hay. A basic analysis from Dairy One, for example, will cost you only $23, and they'll provide you with a postage-paid mailer for the sample, and email you the test results in very short order. The international handling fee is only an additional $7. Well worth the money! On to feed...

As we just saw in the above calculation, we were able to meet the calorie requirements of my 15-hand horse with 18 pounds of grass hay per day, and no other feed or grain. Horses are able to eat upwards of 2% of their body weight in dry matter per day, which translates to:

> 1,014 pounds body weight × 0.02 = 20.28 pounds Dry Matter
>
> 20.28 pounds Dry Matter × 0.937 Mcal/lb. DE = 19,002.36 calories

This means my horse is able to eat enough of this grass hay per day to meet **all** of his calorie needs even if he were being ridden or driven an hour every single day - no concentrates required! And in keeping with my philosophy about emulating nature's process of feeding feral horses, let me also state now that I'm **not** of the opinion that horses should have unlimited access to hay - for a very simple and logical reason: Although feral horses have a *theoretical* 24-hour access to forage, in reality they must work hard to get that forage. Unlike our domestic horses, who can simply stand in front of a mountain of hay and gorge themselves, feral horses are eating sparsely-spaced dry, bunch grasses, and typically travel just under 12 miles every day to eat enough to satisfy their calorie requirements. While some domestic horses may eventually "self-regulate," and eat only an amount necessary to meet their daily caloric needs, many others will simply continue to eat in excess - as evidenced by the tremendous number of overweight horses! So, your horse's hay - whatever the required amount - needs to be parceled out via some slow-feeding method over a 24-hour period, thus emulating nature's feeding method to the degree possible.

Feeding grain to horses came about at a time in history when horses were being used many hours per day, whether for farming, warfare, or transportation, and simply hadn't enough time available to consume sufficient forage to maintain their body weight. So the use of "concentrated calories" came about to allow horses to meet their calorie needs and still be able to do heavy work. Unfortunately, that tradition has continued, and many horse owners believe or are told that their horses must eat feed or grain to remain healthy. That's simply not the case; as you can see, most of our horses' much lower calorie requirements can easily be met just by feeding hay. And because horses **must** consume at least 1% of their body weight (dry matter basis) in forage to maintain proper gut function, concentrate manufacturers generally list their feeding recommendations with that 1% forage + maximum concentrate as the starting point, followed by progressively higher amounts of forage + lower amounts of concentrate. Enough of that for now!

The following data was provided to me by Dr. Don Walsh, founder of the now-closed Animal Health Foundation, which supported laminitis research all over the world (thank you, Don!). Don collected this information directly from feed manufacturers because they do not list calories on their products; sadly, you have to contact them for calorie information. This list is by no means comprehensive, but it can give us a pretty good sense of the calories in most concentrates. I've listed them in order of ascending calories, as that's more useful and interesting to me than the specific feed type -

As-Fed Feed Calorie Content*

Purina Wellsolve W/C	900	Blue Seal Coarse Sweet: Rider	1,450	TDI Senior	1,430	Purina Omoline 300	1,540
Nutrena Pelleted: Lite Balance	1,000	Blue Seal Pellets: Strider	1,450	Nutrena Pelleted: Safe Choice	1,431	Triple Crown TC Senior	1,546
Purina Horse Chow 100	1,000	Buckeye Growth Texture	1,450	Blue Seal Pellets: Contender	1,435	Blue Seal Vintage Victory	1,550
Blue Seal Hay Stretcher	1,100	Buckeye Supreme 10	1,550	Blue Seal Sentinal Senior	1,440	Buckeye Alfalfa Plus Performer	1,550
Blue Seal Pelleted Min A Vite	1,100	Buckeye Training Formula	1,550	Kent Dynasty Junior	1,445	Buckeye Grass Plus	1,550
Purina Equine Adult	1,100	Granolene Omni	1,550	Blue Seal Vintage Versatility	1,590	Buckeye Growth Sweet	1,550
Purina Nature's Essentials Enrich 12	1,100	Buckeye Pleasure	1,460	Nutrena Textured: Vitality Ultra	1,590	Buckeye Supreme	1,590
Purina Horse Chow 200	1,130	Blue Seal Horse 10	1,470	Triple Crown TC Complete	1,596	Buckeye Prominent	1,600
Triple Crown TC Lite Pellet	1,150	Granolene Mare & Foal	1,475	Blue Seal Vintage Racer	1,560	Purina Omoline 200	1,630
TDI 10	1,180	Kent Dynasty Pro	1,475	Blue Seal Vintage Sweet	1,560	Nutrena Textured: XTN	1,636
Buckeye Wrangler	1,200	Kent Dynasty Show	1,475	Granoline LS	1,560	Buckeye Cadence Formula	1,650
Purina Wellsolve L/S	1,200	Blue Seal Vintage Mare & Foal	1,480	Triple Crown TC Growth	1,568	Buckeye Endurance 101	1,650
Kent Dynasty Pride	1,225	Nutrena Pelleted: Milk Plus	1,318	Buckeye Race	1,575	Purina Omoline 500	1,650
Purina Equine Senior	1,230	Blue Seal Pellets: Trotter	1,325	Buckeye Unbeetable	1,575	Purina Race Ready	1,650
Buckeye Senior Texture	1,237	Kent Dynasty Senior	1,339	Blue Seal Pellets: Hunter	1,485	Triple Crown TC 14% Textured	1,708
TDI 30	1,240	Blue Seal Natural 36	1,350	Blue Seal Pellets: Demand	1,490	Triple Crown TC 10% Textured	1,725
Buckeye Safe N Easy Pellet	1,250	Blue Seal New Sunshine Plus	1,350	Blue Seal Pellets: Carb-Guard	1,500	Buckeye Trifecta	1,750
Buckeye Show Formula	1,250	Purina Equine Junior	1,350	Nutrena Pelleted: LD Complete 14	1,500	Blue Seal Omegatin	1,800
Triple Crown TC 30%	1,266	Blue Seal EZ Hoof	1,365	Purina Nature's Essentials Enrich 32	1,500	Nutrena Extruded: Empower	1,863
Triple Crown TC 12%	1,288	Purina Horseman's Edge 12%	1,400	Purina Strategy	1,500	Purina Athlete	1,900
Buckeye Senior GC	1,299	Purina Horseman's Edge 14%	1,400	Blue Seal Coarse Sweet: Charger	1,520	Purina Ultium	1,900
Buckeye Gro N Win Alfalfa	1,300	Purina Omoline 400	1,400	Blue Seal Coarse Sweet: Pacer	1,520	Triple Crown TC Training	1,900
Buckeye Grow N Win	1,300	TDI 12	1,410	Buckeye Foal Starter	1,520	Purina Nature's Essentials Amplify	2,000
Buckeye Mustang	1,300	TDI 16	1,410	Blue Seal Pellets: Sport	1,525	Buckeye Ultimate Finish 40	2,050
Buckeye Senior Pellet	1,316	Buckeye Growth Pellet	1,420	Granoline Elite	1,525	Buckeye Ultimate Finish 100	3,900
Nutrena Mixed LD Senior	1,318	Buckeye Safe N Easy Texture	1,420	Blue Seal Sentinal Safe Start	1,535		
Nutrena Pelleted: LD Prime 10	1,318	Triple Crown TC Low Starch Pellet	1,428	Purina Omoline 100	1,540		

Average†: 1,455 Standard Deviation†: 208 Most Common†: 1,550

†Buckeye Ultimate Finish 100 not included in calculations

*provided by Dr. Don Walsh, Animal Health Foundation.

As you can see, there's quite a range of calorie values here - from a low of 900 to a high of 3,900! Incidentally, the feeds at the lower end are typically *forage* or *ration balancers*, which are products designed to make up for forage deficiencies in a particular geographic area. They aren't intended to be major calorie sources, and are fed at lower amounts than complete feeds. If your forage analysis reveals deficiencies, a ration balancer is the ideal way to make certain your horse's vitamin and mineral needs are being met without adding a bunch of unnecessary calories to his diet.

Once equipped with the necessary feed calorie information (remember: you may need to call the manufacturer to get it), any feed component in your horse's diet can be calculated in the same manner. Let's use the numbers from our previous example: a 15-hand horse with a target weight of 1,014 pound requiring 15,210 calories per day, with 9,504 calories already provided by 11 pounds of grass hay. So if we use the most common calorie value for feed of 1,550 calories per pound (as-fed), our 5,706-calorie deficit can be met by:

5,706 ÷ 1,550 = 3.68 pounds of concentrate

So our entire diet calculates out to be 11 pounds of grass hay plus just under 4 pounds of feed per day. Remember that your horse **must have** the 11 pounds of hay; that's a well-established absolute minimum! And with only 4 pounds more of feed - or just under 7 pounds more of grass hay - we'll satisfy **all** of his calorie requirements. Anything beyond that is excess calories, which will be converted to fat! Based on what I see and hear on a daily basis, I'm certain these quantities seem quite small to you - especially the amount of feed. But keep in mind that that feeling exactly demonstrates my point: **We're grossly overfeeding our horses!**

To wrap up Part 2, let's discuss how to collect and prepare a forage sample for testing. The first step is to gather an appropriate sample, which needs to be collected in a random manner to be truly representative of our lot of hay. The table below will help you know how many samples to gather to create your final sample for submission -

Forage Sampling Chart

Total Quantity (Bales or Pounds)	# of Samples (Bales or Pounds)
2 - 8	2
9 - 15	3
16 - 25	5
26 - 50	8
51 - 90	13
91 - 150	20
151 - 280	32
251 - 500	50
501 - 1,200	80
1,201 - 3,200	125
3,201 - 10,000	200
10,001 - 35,000	315

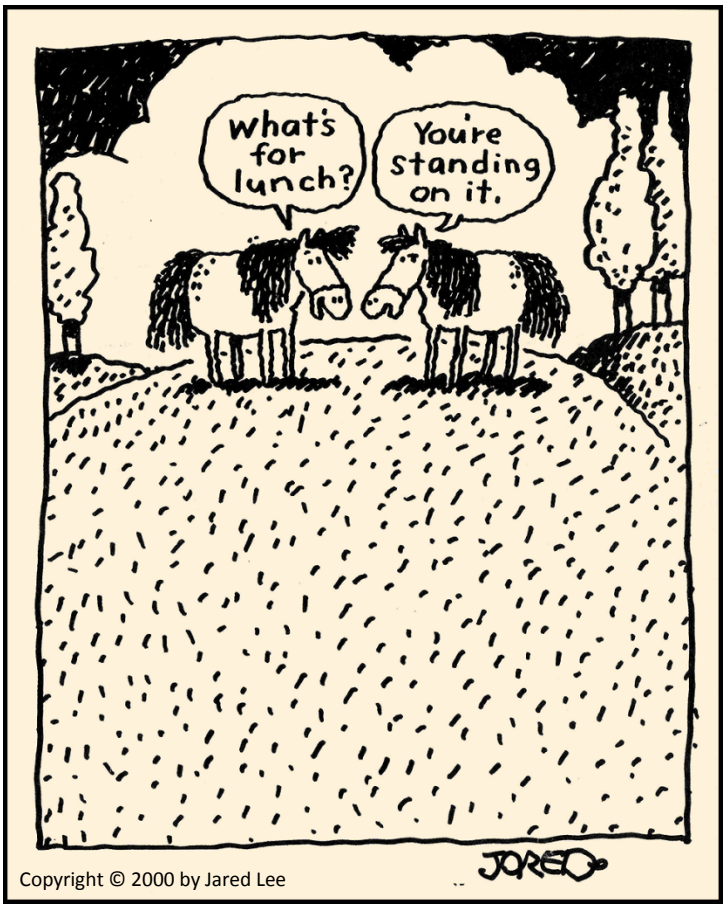
This particular approach to sampling, including the numbers in this table, is called the Acceptable Quality Limit standard, and dates back to World War II and the manufacture of bullets for the armed forces. It provides a method of determining the characteristics of a group of items by testing a randomly-chosen number of items from that group; how many items need to be tested is a function of the total number of items in the group. For diet planning, the numbers can represent some unit of hay - either bales or pounds probably being the most logical. For example, suppose we buy 100 bales of hay from a dealer. Looking at the table, we see that randomly testing 20 bales will give us a very good idea of the characteristics of the entire 100-bale lot. For our purposes here, we're interested in the two numbers we've been using to plan our horse's diet: the Digestible Energy (DE) and the % Dry Matter.

I can't stress the importance of a *random* sample enough. If we merely test the last 20 bales unloaded, for example, it might turn out they were leftover bales from an earlier crop, and therefore wouldn't be representative of the entire lot. So we need to be a bit creative in our approach to picking the 20 bales. It's really not difficult; for instance, as the hay is being unloaded, you could set aside every 3rd,

then every 5th, then every 7th bale, repeating that pattern until you had the 20 bales. At any rate, once you have the 20 bales set aside, you need to reach into the center of each of the bales and pull out 2 or 3 handfuls of hay (you could also use a hay probe for sampling, which is like a long, small-diameter hole saw, but it's not necessary). Take a pair of scissors, cut each of your handfuls into 2- to 3-inch pieces, and combine all of the cut samples in a clean, dry plastic bucket. Thoroughly mix the samples. Weigh out one (1) pound, place it in the sample bag, squeeze out the air, and seal the bag. That's it!

And rather than have a downloadable file of the tables in this Post, I've decided I'll create an MS Excel spreadsheet that'll incorporate the content of all 3 parts of this series in one "spot," and will automatically do all of the calculations for you!

In Calories 101 - Part 3, we'll tackle what I consider the most challenging part of basic diet planning: the pasture. Stay tuned...



Copyright © 2000 by Jared Lee

Now that we've examined the caloric impacts of forage and processed feeds on the horse's diet in Part 1 and Part 2, respectively, let's take a look at what happens when grass pasture is added to the mix.

According to Dairy One's data, "pure" grass pasture has a Digestible Energy of 911 calories per pound with a Standard Deviation of 171 calories, based on 8,436 samples, while mixed, mostly grass pasture (MMG) has a DE of 962 calories with a S.D. of 127 calories, based on 18,544 samples. That translates to 95% of grass pasture having a DE value between 569 and 1,253 calories, while 95% of mixed grass pasture has a DE content between 708 and 1,216 calories. Why so much variation? Because so many factors affect the amount of sugar in, and therefore the calorie content of, grass. Time of day, time of year, amount of moisture, amount of sunlight, temperature - all these and more influence sugar content.

Attempts to actually *measure* pasture calories are far more common in the cattle industry than in the horse world, but the process is the same regardless of what species is grazing on it. Most often, a device called a plate meter - either the rising or falling type - is used to collect a series of measurements in a random manner throughout the pasture. These devices work by using a (usually) round, weighted plate of a known size to rest on top of the forage, and the distance from the plate to the ground is then recorded. The plate meter must first be calibrated, however, by taking a distance measurement on forage of the same type, clipping the forage under the plate to post-grazing level (with horses, generally 2.5 cm), and then drying and analyzing the forage sample for calorie content. Although simple in concept, many such samples are required for the calibration process to ensure reasonably-accurate meter measurements - a time-consuming endeavor. But by first collecting and analyzing these samples, a correlation between forage height (the distance measurement) and calories per square unit can be derived. After calibration, the amount of calories in a pasture can be fairly quickly and easily estimated by collecting and averaging a set of measurements. Plate meters are available with a wide range of features from several companies, but you can also construct your own for very little cost.

Using a homemade falling plate meter. Image from www.fieldcropnews.com.

But...before you spend either a fair amount of money on a manufactured plate meter, or a fair amount of time constructing and calibrating your own plate meter, you may want to consider the following: Research has shown that horses' rate of consumption of grass pasture varies greatly - and not in an entirely predictable way - depending not only on how much time per day they spend on grass pasture, but also on type of horse, temperature, time of day, season, grass height, grass composition, grass density and other factors, making any attempt at calorie calculations for grazing extremely difficult. For example, grazing researchers at North Carolina State University (Dowler, L.E. et al. 2012. "Determination of Pasture Dry Matter Intake Rates in Different Seasons and Their Application in Grazing Management." *Journal of Equine Veterinary Science* 32: 85 - 92) note the following -

> ...this finding still suggests that horses have the potential to consume relatively large amounts of forage even when grazing for a relatively small portion of the day. These results suggest that DMI [dry matter intake] rate decreases with increased grazing duration and that the extrapolation of 24-hour DMI rates (eg, 2.5% of BW [body weight] in DM/d [dry matter per day]) to grazing periods of <4 hours may result in the underestimation of actual DMI. This may have implications for horse owners trying to manage BW/caloric intake of horses by reducing grazing time, in an effort to manage or prevent various diseases (e.g. laminitis, equine Cushing disease, metabolic disease, insulin resistance).

In other words, the relationship between pasture time and the amount of grass consumed is definitely **not** a linear one; rather, horses with limited pasture time tend to up their rates of pasture consumption, particularly in the first 4 hours. Simply put, this means: 1) even if the calorie content of a pasture is known, you cannot predict how many calories a horse will consume in a given amount of time with any reasonable degree of accuracy, and 2) you cannot use limited pasture time as a means of reducing calories without almost certainly limiting feed and/or hay availability as well. Interestingly, horses on continuous 24-hour grazing were found to voluntarily consume very close to their total

calculated daily energy requirement, with no additional feed and/or hay required.

To further complicate this already-complex situation, some horses simply cannot eat green grass without developing metabolic problems, while others can happily eat green grass all day long and never have an immediate issue. Usually, the older the horse, the more often grass consumption becomes a complication. Because the reasons for these differences in tolerance are not well understood, it falls to the owner to determine whether or not grass causes difficulties for their particular horse. In keeping with my sentiments about mimicking nature in feeding, my personal preference is to allow horses only a very limited amount of green grass, based on the idea that the feral horse in his aboriginal environment is **never** in a position to eat mouthful after mouthful of green grass. Feral horses have evolved to eat sparsely-spaced dry, bunch grasses, and have to travel up to 12 miles every day to find sufficient calories; contrary to the increasingly common notion that domestic horses should have as much hay as they'll eat, feral horses **do not** have unlimited access to forage, and certainly not to green grass. Expecting a horse to not overeat when plopped in the middle of the horse equivalent of a candy store all day strikes me as completely unreasonable.

Furthermore, I am becoming increasingly convinced that, like Type 2 diabetes in humans, we can help prevent the development of metabolic problems by feeding our horses as if they already had metabolic problems i.e. severely limiting the amount of green grass they eat. So, some sort of properly-designed (which, by the way, most of them are not) so-called "track system," in which whatever forage present (mostly grass hay, perhaps with very small and widely-spaced-apart patches of green grass) is spread out over as large an area as possible to force the horse to move to be able to eat, seems to be the best situation for our domestic horses at present.

So there you have it: Although we can use average values to give us a rough idea of the calorie impact of grazing, just as we did with hay and with feed, the (even greater) number of variables affecting not only the forage itself, but also the horse's rate of consumption, mean that such "guesstimates" should be used only as a very rough starting point for diet planning.

Based on what little published research has been done on the pasture dry matter consumption rates of horses, the average of the rates of consumption reported in these studies is 0.127 pounds of dry matter per 100 pounds of body weight per hour, plus or minus 0.032 pounds per 100 pounds body weight per hour. But keep in mind that that value is only reasonably accurate for longer grazing times - say, those over 3 or 4 hours. So instead of using that value, I've taken the 3-, 6-, 9-, and 24-hour measured grazing rate values from some North Carolina State University research, and extrapolated the intermediate values to create the following chart -

Pasture Calories*

Multiply your horse's weight in pounds or kilograms by the cal/lb factor or cal/kg factor, respectively, shown at the intersection of the Pasture Time row and the apropriate calories column. The highlighted row and column example is for a 1,000-lb horse on an average-calorie, mixed, mostly grass pasture for 8 hours, so 9.885 x 1,000 = 9,885 calories consumed. To use your own calorie values, use Total Consumption x measured calories per lb or kg x horse's weight in lb or kg. For example, a 400-kg horse grazing for 6 hours on 1,850 cal/kg pasture would be: 0.00888 x 400 x 1,850 = 6,571 calories consumed.

Pasture Time (hours)	Total Consumption	Grass Pasture (cal/lb)			Mixed, Mostly Grass Pasture (cal/lb)			Grass Pasture (cal/kg)			Mixed, Mostly Grass Pasture (cal/kg)		
	lb/lb or kg/kg	Low 569	Average 911	High 1,253	Low 708	Average 962	High 1,216	Low 1254	Average 2008	High 2762	Low 1561	Average 2121	High 2681
1	0.00269	1.532	2.453	3.373	1.906	2.590	3.274	3.377	5.407	7.437	4.202	5.710	7.217
2	0.00445	2.530	4.050	5.571	3.148	4.277	5.406	5.577	8.929	12.281	6.939	9.429	11.919
3	0.00585	3.326	5.325	7.324	4.138	5.623	7.108	7.333	11.740	16.147	9.124	12.397	15.670
4	0.00701	3.991	6.390	8.789	4.966	6.748	8.530	8.799	14.088	19.377	10.949	14.877	18.805
5	0.00801	4.559	7.300	10.040	5.673	7.709	9.744	10.052	16.093	22.135	12.507	16.994	21.482
6	0.00888	5.050	8.085	11.120	6.284	8.538	10.792	11.133	17.825	24.516	13.853	18.823	23.792
7	0.00962	5.476	8.767	12.059	6.814	9.258	11.702	12.072	19.328	26.584	15.021	20.410	25.799
8	0.01028	5.847	9.361	12.875	7.275	9.885	12.495	12.890	20.637	28.384	16.038	21.792	27.546
9	0.01084	6.169	9.877	13.585	7.676	10.430	13.184	13.601	21.775	29.950	16.923	22.994	29.066
10	0.01133	6.449	10.325	14.201	8.024	10.903	13.782	14.217	22.762	31.308	17.690	24.037	30.383
11	0.01176	6.690	10.711	14.732	8.324	11.310	14.297	14.748	23.613	32.478	18.351	24.935	31.519
12	0.01212	6.896	11.040	15.185	8.580	11.658	14.737	15.202	24.340	33.477	18.916	25.703	32.489
13	0.01242	7.070	11.319	15.568	8.797	11.952	15.108	15.586	24.953	34.321	19.393	26.350	33.308
14	0.01268	7.214	11.549	15.885	8.976	12.196	15.416	15.903	25.462	35.021	19.788	26.888	33.987
15	0.01288	7.330	11.736	16.142	9.121	12.393	15.665	16.160	25.874	35.587	20.108	27.322	34.536
16	0.01304	7.421	11.882	16.342	9.234	12.547	15.860	16.361	26.195	36.029	20.358	27.661	34.965
17	0.01316	7.488	11.989	16.489	9.317	12.660	16.002	16.508	26.431	36.353	20.541	27.910	35.279
18	0.01324	7.532	12.059	16.587	9.372	12.735	16.097	16.606	26.586	36.567	20.662	28.075	35.487
19	0.01328	7.555	12.096	16.637	9.400	12.773	16.145	16.656	26.667	36.678	20.724	28.159	35.595
20	0.01328	7.557	12.100	16.642	9.404	12.777	16.151	16.661	26.675	36.689	20.731	28.169	35.606
21	0.01325	7.541	12.073	16.605	9.383	12.749	16.115	16.624	26.616	36.608	20.685	28.106	35.527
22	0.01319	7.505	12.016	16.528	9.339	12.689	16.040	16.546	26.492	36.437	20.589	27.975	35.361
23	0.01310	7.453	11.932	16.412	9.273	12.600	15.927	16.430	26.306	36.181	20.444	27.778	35.113
24	0.01298	7.383	11.821	16.259	9.187	12.483	15.779	16.277	26.061	35.844	20.254	27.520	34.786

* Extrapolated from data presented in Glunk, E.C. et al. "Effect of Restricted Pasture Access on Pasture Dry Matter Intake Rate, Dietary Energy Intake, and Fecal pH in Horses." 2013. *Journal of Equine Veterinary Science* 33: 421-426

Make no mistake: This is a very rough estimate of calories consumed through grazing, as you'll note by the wide range of values between the Low and High numbers. The next step towards improving the accuracy would be to use actual measured calorie values from your pasture, but, again, it's still going to be an approximation.

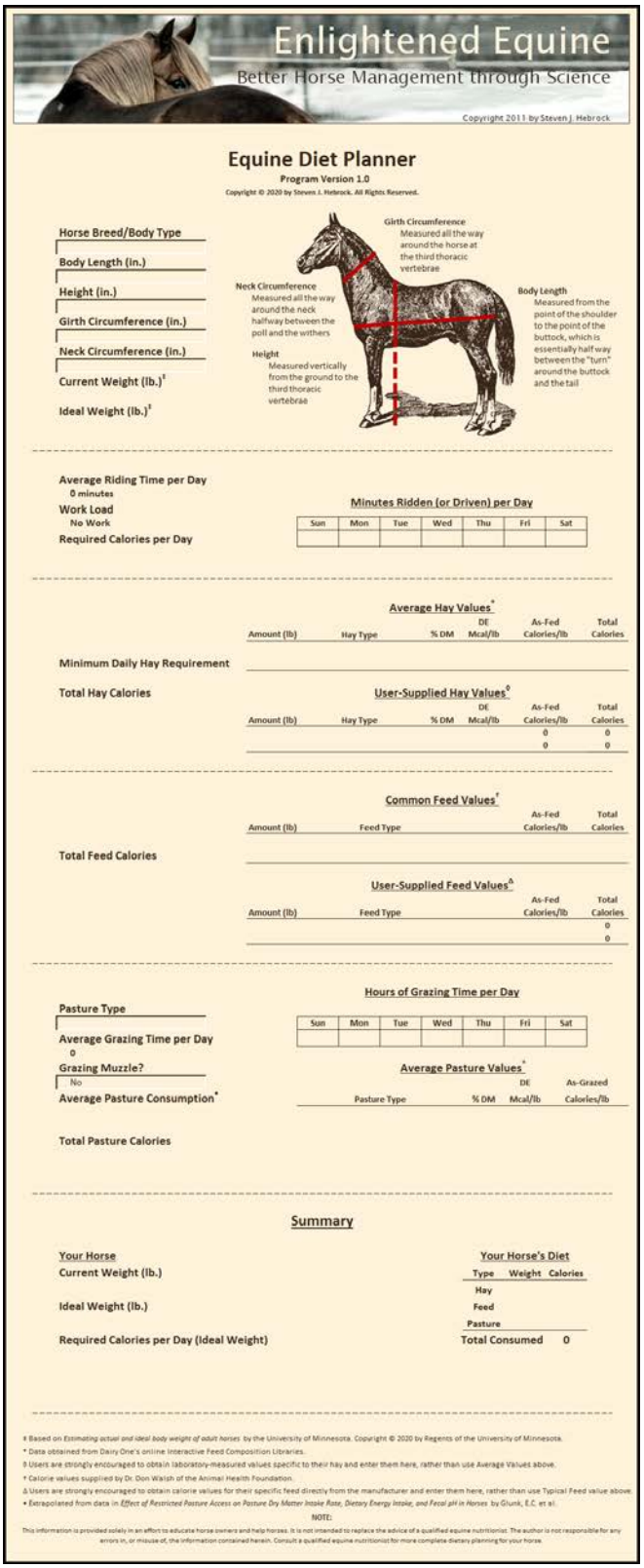
In an attempt to make things a bit simpler, I've created an Equine Diet Planner in MS Excel, which you can either download for use on your own computer or use online within your browser.

As you can see in the screenshot of the Planner below, it incorporates the University of Minnesota weight calculator, which calculates Current and Ideal Weights, and then continues in the following section to calculate Required Calories by entering daily riding times.

The next section allows you to choose the amount and type of hay you're feeding, or enter your own hay sample results, to calculate Total Hay Calories. Similarly, the feed section computes Total Feed Calories from the amount and type of feed, including allowing you to use values for a brand not on the drop-down list, which you can either obtain directly from the manufacturer or have tested by an independent testing laboratory.

The pasture grazing section has several choices for types of pasture, and then estimates Total Pasture Calories based on grazing time and whether or not your horse is muzzled. As I've noted above, pasture consumption is undoubtedly the most difficult to predict, but this will help give you at least a point of departure for diet planning.

Finally, the Summary section at the end adds together the previously-calculated calorie values to give an overall picture of your horse's diet. It also cautions you when the calorie intake exceeds or falls short of the calories required to maintain proper (ideal) body weight by more than 5%.



I would strongly encourage you to use this Planner to develop a better understanding of what and how much your horse is currently eating versus what he actually needs to maintain a healthy body weight, and I would encourage you to share it - and the information/videos from the first two parts of this series - with your friends and your barn owner as well. Because of the very large number of variables involved, though, please remember that ultimately the only certain guide to whether or not you're under- or over-feeding your horse is an honest eye!

To wrap up both this Post and this series, here are a few things to keep in mind:

- Be honest about your horse's weight. If you can't be objective, ask someone else to take a look. Better still, use accurate measurements in the weight calculator and trust the results.
- Be honest about how much you actually *work* your horse. Time spent tacking up, walking to and from the arena, etc. doesn't count as work time, nor does simply sitting on your horse while he walks around. Think of it this way: If you wouldn't be sweating and/or breathing hard doing what he's doing, it's not work and shouldn't be counted as such.
- Be honest about what and how much your horse is eating. Weigh everything. Do the math, and figure out the best way to feed *only* what he requires to attain/maintain a healthy weight, spread over a 24-hour period.
- Have your hay tested. It's relatively easy and inexpensive, and since hay should far and away constitute the bulk of every horse's diet, knowing how many calories are in it is important.
- Remember that you can't feed muscle onto a horse. If your horse has a bad top line or otherwise lacks muscle mass, increase his work load and feed the consequent higher calorie demand; don't expect to put healthy weight on a horse with just food. And don't try to rush either the weight loss or the weight gain process; feed for his calorie requirements, and things will take care of themselves.
- Consider your particular situation when planning your horse's diet. If you board, you may have very little to no control over certain aspects of your horse's diet, such as pasture time or brand of feed, so control what you can: Use a grazing muzzle, reduce the amount of feed, increase the amount of hay, etc.
- Remember that things can, and do, change. Your horse's current dietary requirements may be very different from his requirements several years ago. Be aware of the impact of pasture time on his diet, and adjust his diet accordingly.
- Finally, be logical in your approach to feeding. Consider how nature feeds the feral horse, and remember that mimicking nature will generally yield good results. Keep in mind there is plenty of bad advice out there, including from those with PhD and DVM after their names. If what is offered is inconsistent with what I've presented in this series of articles, be suspicious!

Much more to come...

***About the author**: Retired professor and award-winning product designer, musician, and recording engineer Steve Hebrock taught, among a number of other technical subjects, hoof care at The Ohio State University ATI for many years. He now concentrates his efforts on his and his wife Dora's hoof care practice, on developing technical products for horse and hoof care, and on writing for Enlightened Equine — his blog dedicated to applying science to horse management. An AANHCP-Certified Hoof Care Provider and Liberated Horsemanship Master Hoof Care Professional and instructor, he is a frequent speaker at the Equine Affaire and other horse events, including the American Veterinary Chiropractic Association's national conferences.* www.enlightenedequine.com