



Bales ain't bales

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Do you pay your hay contractor on a cost/bale basis? Do you buy your hay on a \$/bale basis? Do you really know the weights of these bales? Do you know how much money you may actually be over paying contractors or hay sellers and I am sure, rarely, under paying? Although there are contractors and sellers trying to do the right thing price-wise, to maintain credibility and continue their good rapport with valued clients.

To be fair, it is almost impossible to have every bale of identical size and weight.

Both can vary due to plant maturity at harvest, hay moisture content, bale density and if and how the bale diameter is determined by either the equipment alert system and/or the operator. This article is more about alerting you to some concerns about the charge rate or cost of hay based on bale size and particularly bale weight outside of realistic expectations.

A recently conducted hay bale weight guessing competition by the Australian Fodder Industry Association (AFIA) found 200 entries estimated a bale ranging from 250 – 2000 kg fresh weight, with most guesstimates between 500 – 800 kg. Actual bale weight was 404 kg and only eight guesstimates were in the 400 – 450 kg range.

When cattle are sold by weight or when you buy grain or fertiliser, you expect to be paid or to pay on their accurate weight as per scales. Yet when dealing with hay, this rarely happens unless the purchased load is put across a weigh bridge. Admittedly when paying a contractor on per bale basis the nearest weigh bridge may be far away so not easy to get a weight on the bales being produced. However, is it possible to beg, borrow or steal a set of cattle weighing scales, set them up and weigh a few bales, or something similar? Yes, a hassle but look at the numbers later in article.

Unlike silage, hay does have reasonably consistent moisture content at baling. Mind you, large squares, large rounds and small square bales do require slightly different moisture contents to ensure safe baling. However, even if identical bale volume could be produced with any bale size (and form), bale weights will vary a bit due to the moisture content at baling, bale density and the maturity and forage type.

Hay bought or baled on a per bale basis can be a minefield and, if possible, should be avoided.

Buying price/baling charges should be on a weight basis, or at least with agreed bale size and reasonable density. Bales slumping within an hour or so of baling or after purchased hay is unloaded are way too soft, that is, not dense enough (Figure 1. Bales that hold their shape into the next day are very dense, will weigh heavy and result in fewer bales per hectare. You may be very happy to pay a reasonable price per bale in this case.

However, in practice, variation in bale weight for a given bale size is frighteningly wide. The average round bale weight for various bale sizes is shown in Table 1 but there is a wide variation in weights around the average bale weight. This would be due to slight differences in bale diameter but, within any bale size, is mostly due to bale density.

Bale density is influenced by wrap tightness and bale compression and can vary substantially according to the operator's preference and ability of the equipment used. Most balers have a range of settings that enable wrap tightness and bale compression can be increased or decreased. Mind you, some balers can produce soft centres or the compression backed off for forage which may not be fully cured to allow heat and sweat loss.

Density is also affected by plant maturity, leafy pasture being more dense than older, stemmy pasture. Similarly, lucerne is more dense than cereal hay and forage species

Table 1. Average round bale weight and range (kg DM) for various bale sizes (m)

Bale Size (m)		Fresh Bale Weight (kg)	
Width (m)	Diameter (m)	Average Weight (kg)	Weight Range (kg)
1.22	1.22	265	195 - 390
1.22	1.52	390	273 - 512
1.52	1.52	475	356 - 658
1.52	1.83	685	658 - 703

Source: Mat Thomas, The University of Kentucky

So if you are buying or having 1.22 x 1.52 (4' x 5') sized bales baled, and you are paying, say \$50/bale for the average 390 kg fresh weight (Table 1), you are paying $\$50 \times 100 \div 390 \text{ kg} = 12.8$ cents per kilogram or \$128 per tonne (\$/t). For a 273 kg bale, you are actually paying \$183/t and for a 512 kg bale, \$98/t. How often would the latter occur?

Apart from weighing bales, not easy, how can you be confident of getting value for your dollar?

For pastures, a very dense bale is one where you must push hard to get your fingers into the end of the bale to the second knuckle. If left on its side the bale will hold its shape, remaining round, perhaps settling very little. On the other end, a very loose bale is where your whole hand is easily pushed in to the wrist and the bale slumps with a flat bottom. The full range is in between these two extremes so where does your hay sit?

Another approach to more accurately estimating bale weight without scale was reported by a USA Extension Forage Agronomist, Dennis Hancock of The University of Georgia. He developed a guide for estimating bale weight over a range of bale sizes and densities (Table 2). I have converted the figures in Table 2 that he quotes as USA pounds to kilograms, density values of pounds/cubic foot to kilogram/cubic metre and length feet to metre, all on a dry matter (DM) basis.

Make no mistake, bale density (Figure 2) is very difficult to estimate and any average bale weight for each bale size depends on the range of bales weighed, species and its maturity at baling, etc. Most current round balers will produce a bale that is between 145 kg DM/cu. m (9 lbs DM/cu. ft) and 192 kg DM/cu. m (12 lbs DM/cu. ft).

Dennis suggests that "If the bales are very loose and spongy when pressed, it is likely that those bales will have a bale density of 9 lbs DM/cu. ft. or less. If the bale deforms only slightly when pressed or spiked, it is likely to be approximately 10 lbs DM/cu. ft. If the bale is rigid but deforms when pressed hard or spiked, it is likely to be approximately 11 lbs DM/cu. ft. If the bale is very rigid and only deforms under the tractor's weight, it is likely to be approximately 12 lbs DM/cu. ft."

Table 2. Estimated dry matter (DM) of bales of common dimensions at various bale densities

Bale Size (m)		Bale Weight (kg DM/bale)			
Width (m)	Diameter (m)	Density kg DM/cu. m (lbs/cu. ft)			
		144 (9) ¹	160 (10)	176 (11)	192 (12)
1.22	1.22	204	227	249	272
1.22	1.37	259	290	318	345
1.22	1.52	322	358	390	426
1.52	1.22	259	286	313	340
1.52	1.37	327	363	395	431
1.52	1.52	399	445	490	535
1.52	1.68	485	540	594	649
1.52	1.83	576	640	708	771

Source: Dennis W. Hancock, The University of Georgia

¹Numbers in brackets are in feet.

To calculate the “as-fed” or fresh weight, divide (÷) the DM weights in Table 2 by one, minus the moisture content of the bale. If the hay is well cured, assume 15 per cent moisture. Example a 1.52m x 1.52m (5' x 5') bale of 490 kg DM is $490 \div (1 - 0.15) = 576$ kg fresh weight. Be aware that as balers are further developed, they will tend to produce heavier/denser bales than suggested in Table 2.

Table 3 shows the effect of bale weight on the number of trips to transport them to a stack elsewhere.

Table 3 also allows you to compare whether you are better off to pay for larger bales at a higher cost vs smaller bales when being charged on a per bale basis. Don't forget bale density within any bale size can vary substantially affecting bale weight and number of bales per hectare (Table 2).

Table 3. Effect of bale weight on number of trips to move bales from paddock

Bale width (m)	Bale Diameter (m)	Bale weight (kg/Bale ¹)	Forage Production per hectare (kg/ha)	Bales produced per hectare (Bales/ha)	Number trips to move bales per hectare (Trips/ha ²)
1.22	1.22	255	5000	19.6	10
1.22	1.52	400	5000	12.5	7
1.22	1.83	574	5000	8.7	5
1.52	1.52	500	5000	10	5
1.52	1.83	718	5000	7	4

¹Assumes all bales are same density as 1.52 x 1.52 bales of 500 kg fresh weight

²Assumes that 2 full-sized bales carried each trip, except last trip but not always possible

Source: J. Banta, Texas AgriLife Extension Service, Overton

Remember also that all the average bale weights in Tables 1, 2 and 3 will vary according to all the factors mentioned throughout this article. Large square hay bales will also vary in density, therefore weight, within each bale size but probably less variation than round bales. The only bale weights that really matter are the ones you measure or on a weight bridge ticket which allows you to assess the real price of the hay. Weight is also very useful when rationing hay out to animals.



Figure 1. Bales slightly denser on RHS



Figure 2. Dense bale. Fingers can only be pushed into 1st. knuckle