that is otherwise of no value, and it is sometimes the deciding element. It is well known among engineers that the internal combustion engine is capable of, and in fact, gives a higher efficiency than the steam engine, but this is ordinarily of little interest to the purchaser. What is of vital importance to him is the actual cost of the fuel per unit of power delivered at the belt or at the draw-bar. It should not be difficult to obtain this, but one obstacle in the way of so doing is the lack of a uniform unit of power, or rather the lack of uniformity in the popular conception of the unit of power among users. Public motor contests, such as those held at Winnipeg and Brandon last summer should be encouraged, as they are of considerable importance not only in the interests of science, but to both the users and the manufacturers of the engines represented, in that they give some authentic figures to use as a working basis.

In obtaining fuel costs and in selecting an engine for a given purpose, the intending purchaser of a traction engine is confronted by a very confusing problem on account of the differences in the methods of rating by the various manufacturers. Steam traction engines have been rated at from a half to a quarter of their actual horse-power, while internal combustion engines have been rated at figures more closely approximating their actual horse-power. Most manufacturers publish only the rated or nominal horse-power, altho several now publish both rated and brake horse-power, and a few publish only the brake horse-power. Actual horse-power, as determined by the Prong brake test, is becoming better known, but ordinarily the purchaser has no means of applying this test; consequently a uniform system of rating, based on the cylinder dimensions, pressure and piston speed is very desirable. It would not be a difficult thing to arrive at and it seems that the necessity for it is becoming more apparent each season. If it falls within the scope of work of the American Society of Agricultural Engineers to propose some system of uniform rating or to work towards the adoption of uniformity in this matter, it would, in the writer's opinion, be conferring a great benefit on the man who purchases or operates the traction engine—the traction engine which embodies more engineering than any other piece of farm machinery.

The Association of Licensed Automobile Manufacturers have adopted a horse-power formula as a ready reference guide by which the power of different motors may be computed with reasonable accuracy in a short period of time. It has been possible to reduce this formula to the simplest condition, because American practice in automobile motor construction is quite uniform. This formula is simply

$$\text{H P equals } \frac{D^2 \times N}{2.6}$$

where D equals bore of cylinder in inches
and N equals the number of cylinders.

This is based on the assumption of a piston speed of 1,000 feet per minute, of a mean-effective pressure of say about ninety lbs. per sq. in. and a mechanical efficiency of about seventy-five per cent, all of which approximate American practice in this line, with sufficient accuracy to serve the purpose for which the formula was intended.

As the practice is not so uniform among the builders of traction engines, either steam or internal combustion, it is not possible to use such a simple formula. However, we may find comparatively simple formula which can be applied by most of the buyers or operators of these engines, which will give reasonably accurate results.

We will take the usual formula for indicated horse-power as determined by the indicator,

$$\text{H P equals } \frac{P\ L\ A\ N}{33000}$$

where P equals mean effective pressure,
L equal lengths of stroke in feet
A equal area of piston in sq. ft.
N equal number of power strokes per minute.

The "number of power strokes per minute" is twice the number of revolutions in the steam engine, and one-half the number of revolutions per minute in the four-cycle internal-combustion engine. The area of the piston-rod of the steam engine is neglected in these calculations, but this does not materially affect the results. Practically all steam traction engines have the point of cut-off such that the mean-effective-pressure may be as much as one-half the boiler pressure. Now, we ordinarily have the boiler pressure expressed in pounds per square inch, the cylinder bore and stroke in inches and speed in revolutions per minute, so for simplicity we can write our formula in these terms and combine all of the constants. For indicated horse-power it then becomes practically as follows:

$$\text{I H P equals } \frac{2\ P\ L\ D^2\ N}{1{,}000{,}000}$$

in which P equals boiler pressure,
L equals length of stroke in inches,
D equals diameter of cylinder in inches,
N equals number of revolutions per minute.

In these engines the mechanical efficiency should be (and is under proper conditions) about ninety per cent., so we may write our formula for brake horse-power as follows:

$$\text{(A)} \quad \text{B H P equals } \frac{18\ P\ L\ D^2\ N}{10{,}000{,}000}$$

TABLE II

HORSE POWER OF STEAM ENGINES

Twenty-five examples computed by formula compared with horse-power by other methods.

Rated H.P.	Cyl. Bore (inches)	Stroke (inches)	No. of Cylinder	Steam Pressure (lbs. per sq. in.)	Rev. per min.	Brake H.P. Claimed.	Brake H.P. in public test.		Brake H.P. by formula.
1	..	6	8	1	125	300	20.6	.....	19.4
2	10	7	9	1	120	240	.....	.....	22.9
3	10	7¼	10	1	150	225	.....	.....	31.9
4	12	8	8	1	125	250	28	.....	28.8
5	..	8	10	1	125	250	.....	.....	36.
6	13	8	10	1	130	252	.....	.....	37.7
7	14	7½	10	1	175	220	42	.....	39.
8	14	6	10	2	150	260	42	.....	50.5
9	15	7¾	10	1	150	225	.....	.....	36.5
10	16	8½	10¼	1	135	240	48	.....	43.2
11	18	8	11	1	135	250	.....	.....	42.8
12	18	8½	12	1	150	260	54	.....	60.9
13	19	6 & 7	10	2	125	230	45	.....	44.
14	20	8¾	10	1	125	250	.....	.....	43.
15	20	10	10	1	130	250	60	62.9	58.5
16	22	9	11	1	150	220	.....	.....	52.9
17	25	9¼	12	1	150	230	60	.....	63.8
18	25	7	11	2	160	257	76	76	79.8
19	30	11	12	1	135	240	116	.....	84.7
20	30	7	10	2	145	300	90	73.6	76.7
21	32	7 5-8	14	2	125	230	.....	.....	84.2
22	32	12	12	1	160	230	110.	97.5	114.5
23	35	7 7-8	11	2	150	225	.....	.....	82.6
24	35	7¾	12	2	135	250	.....	.....	87.6
25	36	7¾	14	2	165	235	120	105.5	117.4

$$\text{For one cylinder B.H.P. equals } \frac{18\ P.L.D^2\ H.}{10{,}000{,}000}$$

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