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S. W. STRATTON, Director

No. 34

THE RELATION OF THE HORSEPOWER TO THE KILOWATT

[3d Edition]
Issued May 15, 1915

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THE RELATION OF THE HORSEPOWER TO THE KILOWATT

The horsepower is taken by the Bureau to be 746 watts. This equivalent is also accepted by the American Institute of Electrical Engineers, and is the same value which was recommended by the British Association Committee on Units in 1873. This equivalent has been used extensively in practice, but, on the other hand, it has also been common to consider the horsepower as equal to a definite number of foot-pounds per second, in which case the number of watts equal to a horsepower varied with the value of the acceleration of gravity. It is desirable, both on theoretical and practical grounds, that the horsepower represent an absolute and invariable amount of power, and to do so it must equal a definite number of watts. So defined, its equivalent in local foot-pounds per second varies with latitude and altitude in a determinate manner. The definition of the pound as a unit of force is intimately involved, and it is, accordingly, treated in the following pages. The horsepower defined as 746 watts is equivalent to 550 foot-pounds per second at 50° latitude, very near where the original experiments were made by James Watt to establish the value of the horsepower.

The "continental horsepower," which is used in Germany and France and generally on the continent of Europe, is equal to 736 watts, or 75 kilogram-meters per second at Berlin. It is thus more than 1 per cent different from the horsepower as used in the United States and Great Britain.

Modern practice is tending toward the more general use of the kilowatt and the disuse of the horsepower. This practice is recommended by the Bureau.

The second edition (Aug. 1, 1914) of this circular differed from the first (June 1, 1912) in the addition of sections treating the definition of the pound as a unit of force and giving standard data on the acceleration of gravity. The values used for gravity supersede those used in the first edition and also the value used in this Bureau's "Tables of Equivalents." In the present (third) edition only minor corrections and changes have been made.

S. W. Stratton,
Director.

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I. INTRODUCTION

The value of the "horsepower" may be expressed either in gravitational or in absolute units of power. Confusion often results when one equivalent is reduced to the other, since the gravitational units depend on the force of gravity, which varies from place to place, and the absolute units do not. Thus, the usual gravitational value for the English horsepower, 550 foot-pounds per second, when reduced to watts gives a different number according to the value of the acceleration of gravity employed in the conversion, and hence we find different values in various reference books, of which the following may be cited:

	Watts.
Supplee's Mechanical Engineer's Reference Book (1904), page 801	746
Kent's Mechanical Engineers' Pocketbook:	
(1912), page 1347	746
(1913), page 1347	745.7
Standard Handbook for Electrical Engineers (1908), page 20, and (1910), page 21	745.6
Foster's Electrical Engineer's Pocketbook (1908):	
Page 3	746
Page 12	745.650
Trautwine's Civil Engineers' Pocketbook (1909), page 244	745.956
American Civil Engineers' Pocketbook (1911):	
Page 1197	746
Page 1313	745.7
Hering's Conversion Tables (1904), page 81	745.650

Such confusion has arisen because there has been no accepted authoritative definition of the horsepower. When the horsepower is taken as a specified number of watts, it represents the same amount of power at all places. But when the horsepower is taken as a specified number of foot-pounds per second, the amount of power represented by it varies for different places. This is evident, since the weight of a "pound," as a unit of force, varies in value as g, the acceleration of gravity, varies. Thus, since g is greater for northern latitudes than for southern, the force represented by a definite number of pounds increases as one goes north. This makes this mode of definition of the horsepower very unsatisfactory. It is similar to a proposal once made to define the meter as the length of the seconds pendulum. No one would now consider seriously a unit of length which varies at different parts of the earth. Nevertheless, units of force having precisely that characteristic are in common use at the present time. The gravitational system of units centers about the gravitational unit of force, and it is accordingly impossible to understand the subject without careful consideration of the pound and other gravitational units of force. For the attainment of precise numerical relations, the value of g must also be carefully considered, and authoritative data on this will be given below.

II. THE POUND AS A UNIT OF FORCE

The pound and the kilogram are primarily units of mass. It is convenient to use the force of gravity upon masses to measure forces, so that units of the same names are used for force (or weight) as for mass. The inherence of the acceleration of gravity in these units of force is often forgotten and is the cause of some confusion. The pound as a unit of force has generally been used as a "gravitational" unit, the characteristic of the gravitational units being that their magnitudes vary with locality as g varies. Thus, a pound force is equal to the force of gravity on a pound mass at any place where measurements happen to be made. The one advantage of the gravitational system is that a given mass exerts the same *number* of pounds of force no matter what its location. But by this mode of definition the *magnitude* of the pound force is not constant, as it varies with g. A few writers, on the other hand, have defined the pound force as a fixed unit, taking it as equal to the force of gravity on a pound mass at some one particular place—e. g., Paris, or 45° latitude and sea level—thus destroying the gravitational character of the unit.

The unit of force can be made definite and fixed, however, without abolishing the gravitational system. This is done by recognizing the difference between the absolute and the gravitational pound by the use of the terms "standard" and "local," respectively. The principle involved is that contained in the definition of "standard weight" by the International Conference on Weights and Measures in 1901. The statement [1] by the conference is given herewith:

> The term weight designates a quantity of the same nature as a force; the weight of a body is the product of the mass of that body, by the acceleration of gravity; in particular, the standard weight of a body is the product of the mass of that body by the standard acceleration of gravity.
>
> The number adopted in the International Service of Weights and Measures for the value of the standard acceleration of gravity is 980.665 cm per sec.^{2}

By analogy with "standard weight," the "standard pound force" may be defined as equal to the force of gravity on a pound mass at a place where g has the standard value, 980.665 cm per second per second or 32.1740

[1] Procès-Verbaux des Séances, Comité International des Poids et Mesures, p. 172; 1901.

feet per second per second. Likewise the "local pound force" in any given locality may be defined as equal to the force of gravity on a pound mass in that given locality. Similar definitions apply to the terms "standard kilogram force" and "local kilogram force." In specifying a force in local units, it is desirable to give the location of the place by such expressions, e. g., as "London pounds," "New York kilograms," "local kilograms ($g=981.26$)," etc. The term "standard" is familiar in the sense here used, and this application of the term "local" was proposed to the Bureau by Prof. E. V. Huntington, of Harvard University, in 1913. To express the force of gravity on a mass in standard pounds, the mass in pounds must be multiplied by the ratio of the local value of g to 980.665.

The words "pound" and "kilogram" used alone as units of force are ambiguous. When so used, the local unit must usually be understood. This has been the usual sense of the terms as used in the past. Such an interpretation is clearly implied in the analogous statement on "weight" by the international conference above. Writers who are careful enough to use standard pounds or kilograms may be expected to use the word "standard" explicitly, while those who use the "pound" without thinking how it is defined will naturally employ the local unit.

The terms here given are readily extended to derived units, based upon the units of force. Thus, definitions follow at once for "standard foot-pound," "local foot-pound," "standard kilogram-meter," etc.

III. THE VALUE OF THE ACCELERATION OF GRAVITY

The standard value of g, 980.665 cm per second per second, was originally intended to represent the latitude of 45° and sea level. It has been widely used as a standard value for barometric reductions, etc., since 1901, and there is no reason why it should not continue in use as a standard value, although the actual value for 45° and sea level is now known to be a few parts in 100 000 different. The exact value obtained for 45° and sea level varies with the gravity observations utilized, and also with the theory adopted for the "anomalies," or departures of the observed values of gravity for any particular stations from the values calculated by a general formula. It is generally conceded to be better to retain a certain value as standard rather than to correct it from time to time to make it agree with a theoretical location. The value, 980.665, is the result of a calculation made by the International Committee on Weights and Measures [2] from Defforges' absolute determination [3] of g at the International Bureau in 1888.

[2] Procès-Verbaux des Séances, p. 165; 1901.

[3] Ibid., p. 181, 1891; Mémorial du Dépôt Général de la Guerre, 15, (1), 1894.

In calculating the equivalent of the horsepower in various units for different latitudes the following formula is used:

$$g = 978.038\ (1 + 0.005\,302\ \sin^2\phi - 0.000\,007\ \sin^2 2\phi),$$

where ϕ is the latitude. This formula [4] is accepted by the United States Coast and Geodetic Survey, and is the result of observations all over the United States with Hayford's corrections for "isostatic compensation." It is referred to the absolute determination of g at Potsdam about 1900. (The Smithsonian Physical Tables, sixth edition, 1914, give this same formula, except for the use of 978.030 in place of 978.038. The value 978.030 is based on observations all over the world, but neglects the isostatic corrections. The formula here given is certainly the best available for the United States.) The theoretical values given by any formula will not in general agree exactly with the actual values at any particular place, because of the local "anomalies" caused by topography, etc. The departures are in general only a few parts in 100 000. As this formula does not give $g = 980.665$ for $\phi = 45°$, the point is once more emphasized that 980.665 is an independent standard value, not precisely related to a fixed locality.

IV. PRACTICAL NEED FOR AN INVARIABLE UNIT OF POWER

Power is very commonly measured with considerable precision, and hence it is important that the magnitude of the unit should not vary from place to place. From the standpoint of metrology the definition of any unit should be rigorous and free from ambiguity. The necessity for a precise definition exists at the present time in engineering practice. When extensive research is being made upon steam turbines, when tests are made carefully and results are interpreted minutely, there should be no uncertainty in the units used.

A precise definition is desirable even in the commerce of to-day. Misunderstandings might arise over the acceptance or rejection of an engine under test because of the definition of the unit of power. If the power delivered by the engine is measured by the use of a brake with weights, the number of foot-pounds per second observed would be greater, for example, at New Orleans than at New York, since the force exerted by the weights is different for different latitudes and altitudes. Consequently, if the horsepower is defined as a definite number of foot-pounds per second, the same at all places, it is possible that the engine might be accepted if the test were made

[4] Special Publication No. 12, U. S. Coast and Geodetic Survey, p. 10, 1912.

at New Orleans and rejected if the test were made at New York. These remarks also apply to the case of testing an engine when the force is measured by a dynamometer or an indicator, as well as when measured directly by weights. If the springs were all standardized at the same place, then the variation of the force of gravity would not enter the problem. However, the elasticity of springs varies with temperature, etc., and hence in the making of an accurate test the spring is calibrated by weights at the time and place of the test. Consequently, in any case the variation of the force of gravity with locality must be considered in interpreting the results of a test. The differences here discussed are less than 1 per cent, and greater errors than this would be introduced in any practical case by variation in the lubrication, in the measurement of power, and in the quality of steam. Nevertheless, the mean of a series of tests would be taken as the performance of an engine, and if this figure were just on the margin of tolerance, an uncertain definition of the horsepower might cause misunderstandings. No such confusion is possible if the horsepower is defined in such a way as to represent the same amount of power at all places.

On account of the variation with g, and because the equivalents of the horsepower are not decimal multiples of any of the fundamental units, and, further, because its definition and value are different on the Continent of Europe from its definition and value in England and America, it has long been felt that the horsepower is an unsuitable unit for many purposes. Modern engineering practice is constantly tending away from the horsepower and toward the watt and kilowatt. In Germany it has been proposed to call the kilowatt "Neupferd" (new horsepower), to make its use appeal more strongly to those who have become firmly attached to the horsepower. The objection to the horsepower has been particularly strong in electrical engineering. The International Congress of Electricians at Paris in 1889 recommended that the power of machines be expressed in kilowatts instead of in horsepower. A more definite and powerful action with a view to the elimination of the horsepower was taken by the International Electrotechnical Commission at Turin, Italy, in 1911. This body, composed of the representatives of great electrical interests all over the world, recommended that in all countries electrical machinery, including motors, be rated in kilowatts only. Also, the Standards Committee of the American Institute of Electrical Engineers in 1911 recommended that the kilowatt instead of the horsepower be used generally as the unit of power.

V. HISTORICAL

The term "horsepower" as a measure of the activity of machinery was introduced [5] by Thomas Savery, the inventor of an early type of steam engine. The earliest application of the steam engine was in the pumping of water from mines, work which had formerly been done by horses. Savery, in his Miners' Friend, page 29, in the year 1702, says that an engine which will raise as much water as 2 horses working continuously in a given number of hours will do the work or labor of about 10 horses, since relays of horses must be used to keep the work going continuously; such an engine, then, he called a 10-horsepower engine.

James Watt, who is generally known as the inventor of the modern steam engine, adopted [6] the term "horsepower" as a unit for expressing the power of his steam engines and defined its value in gravitational units, viz, foot-pounds per minute. The magnitude of Watt's horsepower was, however, six or eight times as great as Savery's. The value [7] was derived from experiments made under the direction of Watt and Boulton, his business partner, about the year 1775.

Some heavy horses of Barclay & Perkins's brewery, London, were caused to raise a weight from the bottom of a deep well by pulling horizontally on a rope passing over a pulley. It was found that a horse could raise a weight of 100 pounds while walking at the rate of 2.5 miles per hour. This is equivalent to 22 000 foot-pounds per minute. Watt added 50 per cent to this value, giving 33 000 foot-pounds per minute, or 550 foot-pounds per second. The addition of 50 per cent was an allowance made for friction, so that a purchaser of one of his engines might have no ground for complaint. The figure thus arrived at by Watt is admitted to be in excess of the power of an average horse for continuous work, and is probably at least twice the power of the average horse working six hours per day.

Since the time of Watt his value has been in general use in England and the United States, and 550 foot-pounds per second is known as the English horsepower. As the use of the steam engine spread from England into other countries the value of the horsepower was translated into the units of the various countries; that is, since the foot and pound had different values in the different countries, the number of foot-pounds in a horsepower necessarily varied. These values were given to the nearest round number, and hence the equivalence to the English horsepower was only approximate, the value averaging about 1 per cent smaller. Hence arose the discrepancies shown in Table 1.

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[5] The Life of James Watt, by J. P. Muirhead (London, 1858), p. 153.

[6] John Robinson, Mechanical Philosophy, Vol. II (Edinburgh, 1822).

[7] I. P. Church, Statics and Dynamics (New York, 1886), p. 136. Encyclopedia Britannica, 4th edition, article on "Steam and steam engines," written by John Robison, with footnotes by James Watt, jr. T. W. Wright, Elements of Mechanics (New York, 1896), p. 251.

TABLE 1

Various Values Adopted For The Horsepower

[Foot-Pounds Given in Terms of the Local Foot and Pound]

	Foot-pounds per second	English horse-power	Kilogram-meters per second	Authority [8]
England and United States	550.	1.0000	76.041	V
Austria (old)	430.	1.0010	76.119	H
Switzerland	500.	0.9863	75.000	A
Sweden	600.	0.9856	74.943	N
Russia	550.	1.0000	76.041	N
Prussia	480.	0.9906	75.325	H
Saxony	530.	0.9869	75.045	H
Baden	500.	0.9863	75.000	H
Würtemburg	525.	0.9890	75.204	H
Bavaria	460.	0.9888	75.190	K
Modern Germany, Austria, France, Italy, etc	....	0.9863	75.000	V

[8] V=various. H=Des Ingenieurs Taschenbuch-Hütte II (Berlin, 1902). A=F. Autenheimer, Mechanische Arbeit (Stuttgart, 1871), p. 15. N=J. W. Nystrom, Elements of Mechanics (Philadelphia, 1875), p. 63. K=Karmarsch und Heeren's Technisches Wörterbuch VI (1883), p. 637; and Alexander's Weights and Measures (Baltimore, 1850).

After the metric system had come into use in France, Germany, and Austria the values of the horsepower in the various countries were reduced to kilogram-meters per second, with the results shown in the table. The values range from 75 to 76 kilogram-meters per second, averaging only a little more than 75. Hence, this round value, 75, has been adopted generally on the Continent as the value of the horsepower.

The English value, 550 foot-pounds per second, is, however, equivalent to 76.041 kilogram-meters per second, and hence it is that there is a difference of nearly 1.5 per cent between the value generally used in English and American practice and that used in continental practice. Reduced to watts, the English horsepower is generally taken as 746 watts, although the precise equivalent, in watts, of 550 foot-pounds per second depends on the acceleration of gravity, and hence on the latitude and altitude. This is discussed fully below.

It is unfortunate that the value of the horsepower on the Continent of Europe was not taken as 76 kilogram-meters per second instead of 75, in order that it might agree with the English value, as was originally intended. It is perhaps unlikely that a change to 76 could now be made, or that an agreement could be reached by which the continental and the

English horsepower would correspond to the same number of watts. It is to some extent customary for continental writers to distinguish the two horsepowers by the words "English" and "metric." We shall call the latter the "continental horsepower." Thus, German writers speak of the "Englische Pferdestärke" and the "metrische Pferdestärke." The term "Pferdestärke" is now the preferred name for the horsepower in Germany, the old term "Pferdekraft" being unsuitable because "Kraft" means "force." Similarly, in France, the old term "force-de-cheval" has been given up for "cheval-vapeur." There is another unit of power which has been used in Europe, the "poncelet," or 100 kilogram-meters per second. This unit was named in honor of Jean Victor Poncelet, who introduced the teaching of kinematics at the Sorbonne in 1838. This unit was adopted in France shortly before 1846, according to C. F. Peschel.[9] It was adopted as a unit of power in 1889 by the "Congrés international de mécanique appliquée." Its use is still permitted in the electrical regulations issued by the "Association alsacienne des Propriétaires d'Appareils à Vapeur." It has not, however, been much used in practice.[10] This is probably due in part to the fact that the horsepower had so firm a hold as the unit of power, and in part to the very near equivalence of the poncelet to the kilowatt. The poncelet is open to the same objection as the horsepower when the latter is rigidly defined as a certain number of foot-pounds or kilogram-meters per second, viz, that the power it represents varies from place to place.

VI. EQUIVALENTS OF THE ENGLISH AND AMERICAN HORSEPOWER

It is possible to define the horsepower in such a way that the value determined by James Watt will be continued and yet the unit will represent *the same rate of work at all places*. The convenient and frequently used equivalent, 746 watts, happens to be equal to the rate of work expressed by 550 local foot-pounds per second *at 50° latitude and sea level*, nearly the latitude of London, where Watt's original experiments to determine the horsepower were made. The horsepower is therefore taken to be equal to the definite amount of power, 746 watts, and in consequence the number of foot-pounds per second corresponding to 1 horsepower varies with the value of g. The number of standard [11] foot-pounds per second in a horsepower = 550.22. The same rate of work is expressed by a larger number of foot-pounds per second in lower latitudes and higher altitudes,

[9] Peschel's Elements of Physics, Vol. II, p. 250 (London, 1846).

[10] Olof Linders, Physikalischen Grössen.

[11] As explained in Sec. II, the standard foot-pound is that corresponding to $g=980.665$.

where the force of gravity is less, and by a smaller number of foot-pounds per second in higher latitudes where the force of gravity is greater. Table 2 gives the number of foot-pounds per second in a horsepower at various latitudes and altitudes. The value of g at sea level is obtained from the formula given in Section III. The change with altitude is calculated from the correction to the value of g, viz, -0.000192 per meter elevation. The number given in the table for 45° and sea level is 550.24; the fact that it differs from the number of "standard" foot-pounds per second, above, emphasizes again the fact that the standard value of g does not correspond quite exactly to 45° and sea level.

TABLE 2

Value of the English and American Horsepower (746 Watts) in Local Foot-Pounds per Second at Various Latitudes and Altitudes

Altitude	Latitude				
	0° (equator)	30°	45°	60°	90° (pole)
Sea level	551.70	550.97	550.24	549.52	548.79
5000 feet	551.86	551.13	550.41	549.68	548.95
10 000 feet	552.03	551.30	550.57	549.85	549.12

The foregoing table may be put in the following approximate form for ease of remembering:

TABLE 3

English and American Horsepower (746 Watts) at Various Latitudes

Latitude	Local foot-pounds per second (approx.)
90°, pole	549
50°, London	550
(39°, Washington)	(550.5)
30°, New Orleans	551
0°, equator	552

The value of the English horsepower may also be given in metric units for various latitudes and altitudes, as follows:

TABLE 4

Value of the English and American Horsepower (746 Watts) in Local Kilogram-Meters per Second at Various Latitudes and Altitudes

Altitude	Latitude				
	0° (equator)	30°	45°	60°	90° (pole)
Sea level	76.275	76.175	76.074	75.973	75.873
1500 meters (=5000 feet approximately)	76.297	76.197	76.096	75.995	75.895
3000 meters (=10000 feet approximately)	76.320	76.220	76.119	76.018	75.918

By interpolation one can take out of these tables the proper value of the horsepower in gravitation measure (either foot-pounds or kilogram-meters per second) for any latitude and altitude.

VII. EQUIVALENTS OF THE CONTINENTAL HORSEPOWER

The continental horsepower is generally given either as 75 kilogram-meters per second or as 736 watts. These two equivalents are independent definitions and are likely to cause confusion *unless* one of them is assigned to some definite place on the earth's surface. As pointed out in the preceding sections of this circular, the unit, to be definite, should represent the same rate of work at all places. The continental horsepower, then, should be taken as 736 watts, which is equivalent to 75 local kilogram-meters per second at latitude 52° 30′, or Berlin. The number of kilogram-meters per second expressing this amount of power will be smaller than 75 at more northern latitudes and larger at lower latitudes. The values at various latitudes at sea level are given in Table 5:

TABLE 5

Continental Horsepower (736 Watts) in Local Kilogram-Meters per Second

Altitude	Latitude				
	0° (equator)	30°	45°	60°	90° (pole)
Sea level	75.253	75.153	75.054	74.955	74.856
1500 meters	75.275	75.175	75.076	74.977	74.878
3000 meters	75.297	75.197	75.098	74.999	74.900

VIII. CONCLUSIONS

It is considered desirable that the watt and kilowatt be used as the units of power, whenever possible, for all kinds of scientific, engineering, and other work. It is not unlikely that the unit of horsepower will ultimately go out of use. In the meantime, however, it is desirable that its definition be uniform. This circular has been written to point out that if the horsepower is to represent *the same amount of power at different places* its relation to the watt must be a constant number, and the number of local foot-pounds or kilogram-meters per second which it represents must vary from place to place. Table 2 and others of this circular show clearly this variation with locality.

It might be feared that some confusion could arise because of the independent definitions of the mechanical watt and the "international" electrical watt. The watt and kilowatt are defined primarily in purely mechanical terms, and not electrically at all. That they have been used mainly in electrotechnical work is merely accidental and is due to the fact that they are metric units and so fit in naturally with the metric units in which all electrical quantities are universally expressed. Any kind of power may properly be measured in kilowatts. For example, in the case of the hydraulic power furnished by a flowing stream, the total power is given in kilowatts by multiplying 0.163 into the product of the head in meters by the flow in cubic meters per minute; the total power is likewise given in kilowatts by multiplying 0.00141 into the product of the head in feet by the flow in cubic feet per minute. The watt is defined directly in terms of the fundamental units of mass, length, and time, in the "meter-kilogram-second" system, thus: "The watt is the power developed by the action, with a velocity of 1 meter per second, of a force capable of giving to a mass of 1 kilogram in one second a velocity of 1 meter per second." The "international watt," however, is defined in terms of concrete electrical standards, which electrical standards represent practically, as nearly as the limitations of experiment allow, the absolute electrical quantities in terms of their theoretical relations to length, mass, and time. The international watt thus defined is the closest concrete realization of the theoretical absolute or mechanical watt which we have. Measurements have indicated that the international watt is not more than 3 parts in 10 000 greater than the absolute watt. Consequently, there is in reality no confusion between the mechanical watt and the international electrical watt.

It is recommended that engineering societies and other interests concerned recognize the value of the "English and American horsepower" as 746 watts (or 550 foot-pounds per second at 50° latitude and sea level, approximately the latitude of London), employing Table 2 to obtain the value in foot-pounds per second at other places. It is likewise recommended that the value of the "continental horsepower" be taken uniformly as 736 watts (or 75 kilogram-meters per second at latitude 52° 30′, the latitude of Berlin), and that the value in kilogram-meters per second at other places be obtained from such a table as Table 5 of this circular.

These values were adopted by a committee of the British Association for the Advancement of Science in 1873. This was the committee which recommended the cgs system, and on it were Sir W. Thomson, Carey Foster, Clerk Maxwell, J. D. Everett, and others (B. A. Report 1873, p. 222). The committee in its report said: "One horsepower is about three-fourths of an erg-ten per second. More nearly, it is 7.46 erg-nines per second; and one force-de-cheval is 7.36 erg-nines per second." (One erg-nine = 100 watts.)

The Standards Committee of the American Institute of Electrical Engineers adopted, on May 16, 1911, the following rule, which was inserted in the Standardization Rules of the Institute:

> In view of the fact that a horsepower defined as 550 foot-pounds per second represents a power which varies slightly with the latitude and altitude (from 743.3 to 747.6 watts), and also in view of the fact that different authorities differ as to the precise value of the horsepower in watts, the standards committee has adopted 746 watts as the value of the horsepower. The number of foot-pounds per second to be taken as 1 horsepower is therefore such a value at any given place as is equivalent to 746 watts; the number varies from 552 to 549 foot-pounds per second, being 550 at 50° latitude (London), and 550.5 at Washington. The Standards Committee, however, recommends that the kilowatt instead of the horsepower be used generally as the unit of power.

The same value, 746 watts, is used by the Bureau of Standards as the exact equivalent of the English and American horsepower. The Bureau recommends the use, whenever possible, of the kilowatt instead of the horsepower.