

In view of these facts, and the absence of any material normal standards of customary weights and measures, the Office of Weights and Measures, with the approval of the Secretary of the Treasury, will in the future regard the International Prototype Metre and Kilogramme as fundamental standards, and the customary units—the yard and the pound—will be derived therefrom in accordance with the Act of July 28, 1866. Indeed, this course has been practically forced upon this Office for several years, but it is considered desirable to make this formal announcement for the information of all interested in the science of metrology or in measurements of precision.

T. C. MENDENHALL,
Superintendent of Standard Weights and Measures.

Approved:
J. G. CARLBLE,
Secretary of the Treasury.
APRIL 5, 1893.

[United States Coast and Geodetic Survey.—Office of Standard Weights and Measures—T. C. Mendenhall, Superintendent.]

TABLES FOR CONVERTING CUSTOMARY AND METRIC WEIGHTS AND MEASURES.

OFFICE OF STANDARD WEIGHTS AND MEASURES,
Washington, D.C., March 21, 1894.

The yard in use in the United States is equal to $\frac{3}{4} \frac{6}{10} \frac{0}{10} \frac{0}{10}$ of the metre. The troy pound of the mint is the United States standard weight for coinage. It is of brass of unknown density, and therefore not suitable for a standard of mass. It was derived from the British standard troy pound of 1758 by direct comparison. The British avoirdupois pound was also derived from the latter and contains 7,000 grains troy. The grain troy is therefore the same as the grain avoirdupois, and the pound avoirdupois in use in the United States is equal to the British pound.

2·20462234 pounds avoirdupois = 1 kilogramme.

In Great Britain the legal metric equivalent of the imperial gallon is 4·54346 litres, and of the imperial bushel 36·3477 litres.

The length of a nautical mile, as given below, is that adopted by the United States Coast Survey many years ago, and defined as the length of a minute of arc of a great circle of a sphere whose surface is equal to the surface of the earth (the Clarke spheroid of 1866).

1 foot	=	0·304801 metre, 9·4840158 log.
1 fathom	=	1·829 metres.
1 Gunter's chain	=	20·1168 metres.
1 square statute mile	=	259·000 hectares.
1 nautical mile	=	1853·25 metres.
1 avoirdupois pound	=	453·5924277 grammes.
15432·35639 grains	=	1 kilogramme.

* * * * *

By the concurrent action of the principal Governments of the world, an International Bureau of Weights and Measures has been established near Paris. Under the direction of the International Committee, two ingots were cast of pure platinum-iridium in the proportion of 9 parts of the former to 1 of the latter metal. From one of these a certain number of kilogrammes were prepared; from the other a definite number of metre bars. These standards of

weight and length were intercompared without preference, and certain ones were selected as international prototype standards. The others were distributed by lot, in September, 1889, to the different Governments, and are called national prototype standards. Those apportioned to the United States were received in 1890 and are in the keeping of this office.

The metric system was legalized in the United States in 1866.

The International Standard Metre is derived from the Metre des Archives, and its length is defined by the distance between two lines at 0° centigrade on a platinum-iridium bar deposited at the International Bureau of Weights and Measures.

The International Standard Kilogramme is a mass of platinum-iridium deposited at the same place, and its weight in vacuo is the same as that of the Kilogramme des Archives.

The litre is equal to a cubic decimetre, and it is measured by the quantity of distilled water which, at its maximum density, will counterpoise the standard kilogramme in a vacuum, the volume of such a quantity of water being, as nearly as has been ascertained, equal to a cubic decimetre.

Appendix 4. The International Nautical Mile

The following announcement is quoted from the National Bureau of Standards Technical News Bulletin of August 1954.

Adoption of International Nautical Mile

Beginning on July 1, 1954, the National Bureau of Standards will use the International Nautical Mile in lieu of the U.S. Nautical Mile. This decision, replacing the U.S. Nautical Mile of 1,853,248 meters (6,080.20 feet) by the International Nautical Mile of 1,852 meters (6,076.10333 . . . feet), confirms an official agreement between the Secretary of Commerce and the Secretary of Defense to use the International Nautical Mile within their respective departments.

The use of a mile derived from the length of a degree of the earth's meridian is very old. It is believed that the Chaldean astronomers determined the length of such a unit. Miles of this sort have been variously called meridian miles, geographical miles, sea miles, and nautical miles, and they have differed greatly in magnitude, some of the values providing 10, 12, 15, and 60 miles to a degree. The British and the U.S. nautical miles were each derived by taking 60 nautical miles per degree, but the values adopted were not the same. The nautical mile adopted by the British Admiralty equals 6,080 British feet, while the U.S. nautical mile has had the adopted value of 1,853,248 meters, from which the equivalent 6,080.20 U.S. feet has been derived. The British foot is shorter than the U.S. foot by 1 part in 400,000, an amount which is of no importance in the ordinary transactions of everyday life but which is very important in precise measurements.

In 1929 the International Hydrographic Bureau obtained an agreement from a large number of countries to adopt a value of 1,852 meters for the nautical mile, the unit thus defined to be called the International Nautical Mile. However, at the same time Great Britain, the U.S.S.R., and the United States did not accept this value, each country preferring to retain the nautical mile to which it had been accustomed.

Finally, in 1953 an informal group from the Department of Defense and the Department of Commerce considered a proposal for international standardization of abbreviations for the knot and the mile. At this meeting the general situation regarding the nautical mile

was discussed, and the belief was expressed that a change from 1,853.248 meters to 1,852 meters would not affect nautical charts, the calibration of navigational instruments, or navigation. Because there seemed to be no sound reason why the International Nautical Mile should not be adopted in this country, the Departments of Commerce and Defense agreed to accept this value as of July 1, 1954, the announcement to be made by the National Bureau of Standards.

Identical directives, in the names of the two departments, have been mutually adopted. The Department of Commerce directive is as follows:

Adoption of International Nautical Mile

I. Purpose

To adopt the International Nautical Mile for use as a standard value within the Department of Commerce.

II. Implementation

After the effective date of this directive, the International Nautical Mile (1,852 meters, 6,076.10333 . . . feet), shall be used within the Department of Commerce as the standard length of the nautical mile.

III. Effective date

This directive is effective 1 July 1954.

It will be noted that in the forgoing announcement one of the equivalents of the international nautical mile is stated as 6,076.10333 . . . feet. The three dots following the last digit indicate a continuing repetition of the digit 3.

By reference to appendix 5, it will be found that the equivalent of the international nautical mile in feet is stated as approximately 6,076.11549 international feet; this latest value represents no change in the length of the nautical mile—1852 meters—but is merely a restatement of the equivalent in terms of the international foot which is shorter than the former United States foot by two parts in a million.

Appendix 5. The United States Yard and Pound

The following statement of the Department of Commerce concerning a refinement of values for the yard and the avoirdupois pound, approved June 25, 1959, is quoted from the Federal Register of July 1, 1959:

Refinement of Values for the Yard and the Pound

Background. The National Bureau of Standards, founded in 1901, is authorized by statute (U.S. Code, Title 15, Ch. 7, sec. 272) to undertake "The custody, maintenance, and development of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards.

* * * Under this authority the National Bureau of Standards has sought to refine and extend the standards to meet the continuing requirements of science and industry for increased accuracy and uniformity of measurement.

Since 1893 the National Bureau of Standards and its predecessor agency, the Office of Standard Weights and Measures of the Treasury Department, have derived the yard and the pound and the multiples

and submultiples of these units from metric standards, namely the international meter and the international kilogram. The original announcement of this derivation, together with the numerical ratios upon which the derivations were based, is given in Bulletin 26, "Fundamental Standards of Length and Mass", of the U.S. Coast and Geodetic Survey, approved for publication April 5, 1893, by the Secretary of the Treasury. An amendment to the 1893 Bulletin was made in 1894 in which there was a small adjustment in the pound-kilogram ratio to bring it into closer agreement with the British Imperial pound.

In the latter half of the period since 1893 minor but troublesome discrepancies have developed among various groups, both in this country and abroad, that are concerned with very accurate measurements involving yard and pound units or their customary multiples and submultiples. As a result of study and negotiation, it has developed that most of the discrepancies can be resolved and a high degree of measurement uniformity obtained by small refinements of the ratios defined in the 1893-94 bulletins relating the yard and pound to the meter and kilogram. Accordingly, the following announcement is made:

Announcement. Effective July 1, 1959, all calibrations in the U.S. customary system of weights and measures carried out by the National Bureau of Standards will continue to be based upon metric measurement standards and except those for the U.S. Coast and Geodetic Survey as noted below, will be made in terms of the following exact equivalents and appropriate multiples and submultiples:

$$1 \text{ yard} = 0.9144 \text{ meter}$$

$$1 \text{ pound (avoirdupois)} = 0.45359237 \text{ kilogram}$$

Currently, the units defined by these same equivalents, which have been designated as the International Yard and the International Pound, respectively, will be used by the National Standards Laboratories of Australia, Canada, New Zealand, South Africa, and United Kingdom; thus there will be brought about international accord on the yard and pound by the English-speaking nations of the world, in precise measurements involving these basic units.

Any data expressed in feet derived from and published as a result of geodetic surveys within the United States will continue to bear the following relationship as defined in 1893:

$$1 \text{ foot} = \frac{1200}{3937} \text{ meter}$$

The foot unit defined by this equation shall be referred to as the U.S. Survey Foot and it shall continue to be used, for the purpose given herein, until such a time as it becomes desirable and expedient to readjust the basic geodetic survey networks in the United States, after which the ratio of a yard, equal to 0.9144 meter shall apply.

RELATION TO PREVIOUSLY DEFINED STANDARDS

In 1866 (U.S. Code 1952 Ed., Titles 15, Ch. 6, secs. 204 and 205) the Congress legalized the use of the metric system within the United States. The law also established approximate equivalents between customary and metric measures. The above ratios between the yard and pound and metric measures as well as those defined in the 1893-94 bulletins are consistent with the ratios established by Congress in 1866 within the limits of accuracy by which the latter are expressed.

Yard. In the 1893 Bulletin the yard was defined as:

$$1 \text{ yard} = \frac{3600}{3937} \text{ meter}$$

which results in the approximate relation:

$$1 \text{ yard} = 0.91440183 \text{ meter}$$