

**READY REFERENCE TABLES. VOLUME I
- CONVERSION FACTORS OF EVERY
UNIT OR MEASURE IN USE. BASED ON
THE ACCURATE LEGAL STANDARD
VALUES OF THE UNITED STATES**

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Ready reference tables. Volume I - Conversion factors of every unit or measure in use. Based on the accurate legal standard values of the United States by Carl Hering

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CARL HERING

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VALUES OF THE UNITED STATES**

READY-REFERENCE TABLES

VOL. I



Physics
H

READY REFERENCE TABLES.

VOLUME I.

CONVERSION FACTORS

OF EVERY UNIT OR MEASURE IN USE, INCLUDING THOSE OF
LENGTH, SURFACE, VOLUME, CAPACITY, WEIGHT, WEIGHT AND LENGTH,
PRESSURE, WEIGHT AND VOLUME, WEIGHT OF WATER, ENERGY, HEAT,
POWER, FORCE, INERTIA, MOMENTS, VELOCITY, ACCELERATION,
ANGLES, GRADES, TIME, ELECTRICITY, MAGNETISM, ELEC-
TROCHEMISTRY, LIGHT, TEMPERATURE, MONEY, MONEY
AND LENGTH, MONEY AND WEIGHT, NUMEROUS COM-
POUND UNITS, USEFUL FUNCTIONS AND NUMBERS,
ETC., ETC. WITH THEIR ACCURATE AND
THEIR APPROXIMATE VALUES, THEIR
LOGARITHMS, RELATIONS, DIGIT
CONVERSION TABLES, EXPLA-
NATIONS OF CALCULA-
TIONS, ETC., ETC.

BASED ON THE ACCURATE LEGAL STANDARD VALUES OF THE
UNITED STATES.

CONVENIENTLY ARRANGED FOR
ENGINEERS, PHYSICISTS, STUDENTS, MERCHANTS, ETC.

BY

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President Engineers' Club of Philadelphia;
Delegate to International Congresses; etc.*

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"I look upon our English system as a wickedly brain-destroying piece of bondage under which we suffer. I say this seriously. I do not think any one knows how seriously I speak of it."—SIR WILLIAM THOMSON (now Lord Kelvin), Philadelphia, Sept. 24, 1884.

PREFACE.

THE present is the first of several volumes in preparation by the author, which are intended to contain collections of data conveniently arranged for ready reference. In this first volume, all the various measures used in practice, more especially by engineers and physicists, are given with their values in terms of as many of the others as they are likely to be converted into in practice; the reciprocals of these are also given, thus enabling every calculation involving the conversion of one measure into another to be reduced to a single, simple multiplication. Moreover, they are stated in such a form that errors due to dividing instead of multiplying are entirely avoided. It has been the intention to include every unit or measure used in practice, besides many that are now obsolete but are occasionally met with. The more usual foreign units or measures have also been added.

These conversion factors are not compiled, but have all been especially recalculated for this volume, under the direction of the author, from the exact legal values as far as such values existed, and from the very best, most standard, and most authoritative values obtainable, when no legal values existed. The greatest possible care was taken in selecting these fundamental values. They were obtained from the National Bureau of Standards, the Director of the Nautical Almanac, the International Geodetic Association, the U. S. Coast and Geodetic Survey, the U. S. Treasury Department, the adoptions and recommendations of international congresses and national societies, standard works of reference, and personal authorities, preference in the few cases of disagreement being generally given in the order named. The authority for each fundamental value is given. As all the conversion factors were calculated from the same set of fundamental values, they are all consistent with each other, forming a single, interconvertible, uniform system. It is believed that this is the first time such a complete set of conversion factors of all measures has been published, based on the accurate legal standard values. It is also believed to be the first complete collection of all the electric, magnetic, and photometric units, together with their interrelations, that has been published in convenient tabular form for ready reference.

Accuracy, completeness, and convenience for ready reference were the chief aims in the preparation of these tables. The calculations were very carefully made, in many cases by two entirely different methods, and the resulting values were checked and cross-checked, often several times. For most of the values a final comparison was made between the electrotyped plates and the original calculation sheets. All values marked with asterisks were checked by the original authorities after the pages were electrotyped. It is therefore believed that there are no errors, but should any errors or omissions be found, the author would greatly appreciate being notified of them, as it is the intention to have the values correct and the collection complete, so as to serve as a reliable standard of reference.

A new feature has been added in the form of convenient approximate values consisting often of only one and generally of only two digits. These digits have been so chosen that they reduce the calculation to the simplest possible; they will be found to suffice for most of the ordinary computations, being always correct within 2%. The correct logarithms have also been given for nearly all of the conversion factors.

Another new feature not generally found in tables of conversion factors, is that the values of most of the compound units are given. This saves double, triple, or even more lengthy calculations, in which errors are likely to be made, as they often involve both multiplications and divisions.

A table of physical quantities has been added giving the derivation, symbols, dimensional formula, etc., of each; the table is similar to the one approved by the International Congress at Chicago, but includes many more quantities.

The usual method of giving tables of "Weights and Measures" has been entirely abandoned here as too cumbersome, inadequate, and entirely impracticable for giving numerous values each with its reciprocals; such tables are moreover quite unsuited for ready reference. The author has, instead, adopted a system in which all interconvertible units (like the mechanical, heat, and electrical units of energy, for instance) are given together in one table, and are there placed in the order of their size. This system is not only a more condensed and practical one, but is also far more convenient for ready reference.

The present tables are an extension and entire recalculation of the very much smaller ones published by the author about twenty years ago under the title of "Equivalents of Units of Measurement."

Unusual, foreign, and obsolete units, or those used for special trades, have been added as far as they were obtainable, and in every case their values are given in terms of the usual, legal, or modern units.

For some units, more particularly the electric, magnetic, photometric, etc., explanations have been added of the meaning, derivation, and proper use of the units, which are often incorrectly understood or applied. Some explanatory notes on the usual methods and accuracies of calculations are also given in the introduction.

The index has been made very complete, and in addition to this, attention is called to the Condensed List beginning on the inside cover-page, which contains the most frequently used values with page references to the others.

A comparison with other tables will show that many of the latter are not based on the legal standards of the country. It is not generally known, for instance, that the legal foot is derived from the meter and not from a standard yard. Many of these other tables are based on an unauthorized value of the meter in inches.

Although the accuracy adopted throughout, namely, six places of figures and seven of logarithms, may not always be warranted by the accuracy of some of the fundamental figures, yet it has been maintained uniform throughout these tables in order to enable changes to be made by mere proportion, when more accurate fundamental values become obtainable in the future.

The author takes pleasure in expressing his appreciation of the valuable assistance contributed by others, which has added greatly to the completeness and reliability of the information and makes much of it authoritative. He desires to express his obligations to the following: To the National Bureau of Standards, and in particular to its Director, Prof. S. W. Stratton, for very full and complete published and unpublished data concerning the values of the legal standards of this and other countries; also for his consent to allow the name of that Bureau to be added to these data, and for much other valuable information and assistance. To L. A. Fischer, Assistant Physicist of that Bureau for the laborious work of checking the correctness of many values of the conversion factors of the fundamental mechanical units. To Dr. F. A. Wolff, Assistant Physicist of that Bureau, for similar service in connection with the standard values of some of the electrical units. To Prof. Walter S. Harshman, Director of the Nautical Almanac, for his revision of the table of units of time. To Prof. Thomas Gray, author of the Smithsonian Physical Tables, for suggestions and recommendations concerning some of the derivational and dimensional formulas in the table of Physical Quantities. To Prof. W. S. Franklin for recommendations, suggestions, and a revision of those relations between the electrical and magnetic units which apply to varying currents. To Dr. Ed. L. Nichols for information concerning some of the standards of candle-power. To Dr. A. E. Kennelly for a revision of parts of the table of physical quantities. To the author's former assistant, Dr. E. F. Roeber, for his able work in mathematical physics and his reliable calculations of many of the values in the tables.

CARL HERING.

PHILADELPHIA, April, 1904.

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