Manual of Petroleum Measurement Standards Chapter 15

Guidelines for the Use of Petroleum Industry-specific International System (SI) Units

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Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Washington, DC 20001, standards@api.org.

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Introduction

The general purpose of this publication is to encourage and facilitate uniformity of metric practice within the petroleum industry. The specific purposes are as follows:

— to define metric practice for the petroleum industry;

— to encourage uniformity of metric practice and nomenclature within the petroleum industry; and

— to facilitate the use of SI in all aspects of the petroleum industry.

Use of this publication by the American Petroleum Institute (API), its divisions, and its members implements API's policy and also implements recommendations in International Standard ISO 80000-1, *Quantities and units*, Part 1: General, Annex B, 2009 [1]. Production of the first edition of API's Publication 2564 [2] in 1973 was encouraged by API member companies either operating internationally or participating in the activities of the International Organization for Standardization (ISO). The Institute of Petroleum (IP) in Great Britain (now known as the Energy Institute) and the Canadian Petroleum Association (CPA) both offered their full endorsement and accompanied it with valuable technical support and assistance.

The transition to the International System of Units (SI) advanced considerably since 1973. The Metric Conversion Act of 1975 (Public Law 94-168) was enacted, declaring the coordination and planning of increasing use of the metric system (SI) in the United States to be government policy. A notice by the Assistant Secretary of Commerce for Science and Technology in the Federal Register of October 26, 1977 (Volume 42, Number 206, pages 56513 and 56514) [3] interpreted and modified SI for the United States. The act also provided for establishing a U.S. Metric Board to coordinate voluntary conversion. In 1982, the U.S. Metric Board was disbanded; responsibility for metric coordination was then transferred to the Office of Metric Programs in the Department of Commerce. The Omnibus Trade and Competitiveness Act of 1988 amended the Metric Conversion Act of 1975, designating the SI system as the preferred measurement system for the United States. In 1991, Executive Order 12770 (Metric Usage in Federal Government Programs) directed federal agencies to use the metric system to the extent economically feasible and practicable. In addition to the increased activity of the federal government in this field, the interpretation of SI also has been dealt with extensively in metric practice guides of various standards associations, technical and trade societies, and individual industries. The International System of Units (SI) is the dominant measurement used with the exception of the United States. With the arrival of the global marketplace, it is imperative for the U.S. petroleum industry to extend its use of SI and for personnel in the petroleum industry to gain a working knowledge of SI.

The API Metric Transition Committee was formed in 1976 in order to coordinate internal API metric policy and to formulate API's policy with regard to government and nongovernment bodies. One of the Metric Transition Committee's first actions was the creation of the Subcommittee on Units to review and revise Chapter 15, Sections I and 2, of the *Manual of Petroleum Measurement Standards*. Sections I and 2 had been published as API Publications 2563 *Metric Practice Guide* [4], and 2564 *Conversion of Operational and Process Measurement Units to the Metric (SI) System*.

At the recommendation of the Subcommittee on Units, the Metric Transition Committee discontinued API Publication 2563 and adopted ASTM (American Society for Testing and Materials) E 380-79 [5] and ANSI (American National Standards Institute) Z210.1-1976 [6] as the authoritative metric practice guide. ASTM E 380 has been replaced by IEEE/ASTM SI-10, *American National Standard for Metric Practice* [7]. API now publishes API *MPMS* Chapter 15, 4th edition to include special interpretations and applications of SI by the petroleum industry. API *MPMS* Chapter 15, 4th edition now references IEEE/ASTM SI-10 for universally used SI unit conversions. In preparing API *MPMS* Chapter 15, 4th edition, the working group has tried to keep consistent with metric practice as defined by the General Conference on Weights and Measures (abbreviated "CGPM" from the official French name), the federal government, and significant standards organizations (such as the ASTM, ANSI, and related technical societies). However, even among these sources, agreement is not absolute on all details of metric practice. Where feasible, API *MPMS* Chapter 15, 4th edition has adhered to the policies of the voluntary standards associations ASTM and ANSI on all unresolved issues. Where no clear policy has been evident or where the policy was not acceptable to the petroleum industry, this publication has recognized the particular needs of the petroleum industry. All such cases have been specific interpretations of SI, not repudiation of the system. Emphasis has been placed on the application of SI in practice, which has necessitated some departure from rigorous adherence to the idealized, "pure" SI.

Guidelines for the Use of Petroleum Industry-specific International System (SI) Units

1 Scope and Field of Application

This publication specifies the API-preferred units for quantities involved in petroleum industry measurements, and indicates factors for conversion of quantities expressed in customary units to the API-preferred SI units not covered in ASTM/IEEE SI-10. The quantities that comprise the tables are grouped into convenient categories related to their use. They were chosen to meet the needs of the many and varied aspects of the petroleum industry, but also should be useful in other, similar process industries.

2 References

This publication emphasizes the practical application of SI to the petroleum industry. For a complete, detailed presentation of SI and the metric practice on which this publication is based, the reader should consult ASTM/IEEE SI-10.

3 The International System of Units (SI)

3.1 General

SI is the official abbreviation, in all languages, for the International System of Units (Le Système International d'Units). The International System is not the old centimeter-gram-second (cgs) system of metric units but is based on the meter, kilogram, and second as the fundamental quantities. SI is considered to be an improvement over the centimeter-gram-second metric system and is used currently or is being adopted by most nations of the world.

There are two classes of units in SI. The first consists of base units which, by convention, are dimensionally independent. The second class consists of derived units that are formed by combining base units according to the algebraic relations linking the corresponding quantities. Special names and symbols have been assigned to the commonly used units in this class.

The coherent nature of SI is preserved by defining all derived combinations in terms of unity, thus eliminating conversion factors within the system. As an example, the derived unit of power, with its special name ("watt"), is defined as 1 joule of work completed in 1 second of time.

3.2 Other Allowable Units

Table 1 (see 4.11) lists and defines all "other allowable" units given in Table 2's table of conversion factors (see Section 5).

4 Use of Conversion Tables in Section 5

4.1 Categories

The units and conversion factors in Section 5 (Table 2) have been grouped into the following categories:

1) space, time;

2) mass, amount of substance;

3) heating value, entropy, heat capacity;

4) temperature, pressure, vacuum;