International Standard ISO 91/1

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Petroleum measurement tables — Part 1 : Tables based on reference temperatures of 15 °C and 60 °F

Tables de mesure du pétrole — Partie 1 : Tables basées sur les températures de référence de 15 °C et 60 °F

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 91/1 was developed by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, and was circulated to the member bodies in November 1980.

It has been approved by the member bodies of the following countries :

Australia	Germany, F. R.	Poland
Austria	Hungary	Portugal
Belgium	India	Romania
Brazil	Iran	South Africa, Rep. of
Bulgaria	Israel	Sweden
Canada	Italy	Switzerland
Chile	Japan	United Kingdom
China	Netherlands	USA
Egypt, Arab Rep. of	Norway	USSR
France	Peru	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Czechoslovakia
Venezuela

This International Standard cancels and replaces ISO Recommendation R 91-1970 and its Addendum 1-1975, of which it constitutes a technical revision.

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Petroleum measurements tables — Part 1 : Tables based on reference temperatures of 15 °C and 60 °F

0 Introduction

The tables referred to in the previous edition of ISO/R 91 were developed during the late 1940's and were based on data for crude petroleum and petroleum fractions published in 1916. Some later data on natural gasolines reported in 1942 were also used. The revised tables referred to in the present revision were prepared by the American Petroleum Institute following the development of a new data base by the National Bureau of Standards (USA). This study included the examination of 463 samples of crude oil and refined products. The samples represented 67 % of world crude petroleum production and 68 % of the estimated reserves in 1974.

1 Scope and field of application

This part of ISO 91 refers to petroleum measurement tables based on reference temperatures of 15 °C and 60 °F.[1)]

The standard reference temperature for petroleum measurement adopted in ISO 5024 is 15 °C, and should be used for international trade. However, it is recognized that its use is not yet universally accepted and references to tables based on 60 °F have therefore been included in this part of ISO 91 and tables based on 20 °C are covered in ISO 91/2.

2 References

ISO 649/1, *Density hydrometers for general purposes — Part 1 : Specification.*

ISO 1768, *Glass hydrometers — Conventional value for the thermal cubic expansion coefficient (for use in the preparation of measurement tables for liquids).*

3 Sources of tables

3.1 For the purposes of international trade, it is recommended that use be made of the *API-ASTM-IP Petroleum Measurement Tables*, which were developed jointly by

a) the American Petroleum Institute (API) — USA,

b) the American Society for Testing and Materials (ASTM) — USA, and

c) the Institute of Petroleum (IP) — United Kingdom,

and have been adopted by these organizations under the following designations :

ANSI/ASTM D 1250-80

API 2540-1980

IP 200/80

3.2 The tables have been published by the American Petroleum Institute[2)] under the title *Manual of petroleum measurement standards, chapter 11.1 — Volume correction factors*. The complete set of tables consists of 12 volumes and the table numbers and titles are related to the corresponding volume numbers in the annex[2)]. Such publications are reprinted from time to time. If corrections are included in such reprints, the API has agreed to advise ISO of them and an amendment will be issued to this International Standard referring to the corrections and to the date of the reprint. Users should then ensure that they have the most recent reprint.

3.3 Of the tables referred to in the annex, the series of tables 5A, 5B, 6A, 6B, 6C — 23A, 23B, 24A, 24B, 24C — 53A, 53B, 54A, 54B, 54C, are of primary use. They shall be used to convert from hydrometer readings of API gravity or relative density or density and volume measurements, first to obtain API

1) Part 2 of this International Standard, which refers to petroleum measurement tables based on the reference temperature of 20 °C, is in preparation. (Revision of ISO/R 91, Addendum 1-1975.)

2) All volumes may be purchased from the publishers, the American Petroleum Institute, c/o Publication and Distribution Section, 2101 L Street NW, Washington, DC, 20037, USA, or from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa 19103, USA. Other suppliers include American Technical Publishers Ltd., 68a Wilbury Way, Hitchin, Herts SG4 OTP, England. The tables are also available on microfiche and the computer sub-routine as magnetic tape or as FORTRAN card decks.

gravity at 60 °F, or relative density 60/60 °F, or densities at 15 °C respectively and then to find the volume corrected to the corresponding reference temperature. The other tables, which are reproduced in volumes XI and XII[1], permit accurate conversion of measurements from one system of units to another and conversions between mass and volume. Hence, there are some tables common to both of these volumes.

3.4 The tables referred to in the annex relate to the following ranges of density and relative density :

Tables 5A and 6A	— 100° to 0° API
Tables 5B and 6B	— 85° to 0°API
Tables 23A and 24A	— 0,612 to 1,076 (60 °F/60 °F)
Tables 23B and 24B	— 0,654 to 1,075 (60 °F/60 °F)
Tables 53A and 54A	— 612 to 1 074 kg/m³ at 15 °C
Tables 53B and 54B	— 654 to 1 075 kg/m³ at 15 °C

and for values below these ranges and down to the equivalent of 500 kg/m³ (0,500 kg/l) at 15 °C, reference should be made to the corresponding tables in the 1952 edition of API 2540, ASTM D 1250 and IP 200[2], and to tables 33 and 34 of ASTM D 1250.

3.5 Computer sub-routines in ANSI FORTRAN and the required program documentation are available for each of the tables in volumes I to IX. This documentation and information on the background and development of the tables have been published in volume X entitled "*Background, development and program documentation*" (see notes 1 and 2).

NOTES

1 The computer sub-routines for tables 5, 23 and 53 contain an optional provision to bypass the hydrometer correction so that the values for density may be introduced directly.

2 In tables relating to the conversion of hydrometer readings, the coefficient of thermal cubic expansion for glass of $23 \times 10^{-6}\ °C^{-1}$ has been used. This value is marginally below the conventional value quoted in ISO 1768, i.e. $25 \times 10^{-6}\ °C^{-1}$. This difference in coefficient is not significant for most temperature differences found in practice. It may be corrected for by subtracting 0,000 002 R' $(\theta - 15)$ from the hydrometer reading, before entering tables 53A and 53B with readings made using hydrometers complying with ISO 649, where R' is the hydrometer reading and θ the observed temperature, if it is agreed between the interested parties that the temperature difference $(\theta - 15)$ is sufficient for the error to be otherwise significant.

1) Volumes XI and XII are at present in course of preparation based on the same expansion data as the tables in the volumes I to X. It is expected that these volumes will also have been published prior to the publication of ISO 91.

2) Consideration is being given by the organizations concerned to the republication of these portions of the 1952 edition and, if they are published, this International Standard will be amended accordingly.