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Petroleum Measurement Tables

石油计量表

[Including No.1 Amendment]

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Table of Contents

Foreword	3
No.1 Amendment	5
ISO Foreword	6
1 Scope	7
2 Normative References	7
3 Definitions	7
4 Compositions of Petroleum Measurement Tables	8
5 Application and Example of Petroleum Measurement Table	9
Appendix A (Prompted) Examples of Petroleum Measurement Tables	13
Appendix B (Prompted) Calculation Flowchart of the Petroleum Measurement Tables	21

Petroleum Measurement Tables

1 Scope

This Standard specifies methods for converting glass petroleum densitometer readings (observed density) obtained at non-standard temperatures into density at standard temperatures (standard density) and volume correction factor.

This Standard applies to crude oil, lubricants and other liquid petroleum products.

The standard temperature specified in this Standard is 20°C.

The thermal expansion data of the oil used in the preparation of petroleum measurement tables in this standard is consistent with ISO 91-1.

NOTE: When compiling the petroleum measurement tables, the thermal expansion of glass used to correct the density meter reading is consistent with ISO 91-1, which is also $23 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$, which is slightly lower than the conventional value quoted in ISO 1768 ($25 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$), but under the actual maximum temperature difference, the difference between these two has little effect on the correction result. If both parties to the trade agree that the impact of this error shall be considered, $0.000002\rho_t'(t-20)$ can be subtracted from the density meter reading before checking the standard density meter, where ρ_t' is the glass density meter reading and t is the test temperature.

2 Normative References

The following standards contain provisions that form part of this Standard by reference. Unless otherwise expressly stated in the standard, the following referenced standards shall be currently valid standards.

GB/T 1884 Crude Petroleum and Liquid Petroleum Products - Laboratory Determination of Density - Hydrometer Method

ISO 91-1 Petroleum Measurement Tables – Part 1: Tables Based on Reference Temperatures of 15°C and 60°F

ISO 1768 Glass hydrometers – Conventional value for the thermal cubic expansion (for used in the preparation of measurement tables for liquids)

3 Definitions

For the purposes of this Standard, the following definitions apply.

3.1 Test temperature (t')

The temperature of the liquid specimen at which the density meter reading is taken, in °C.

3.2 Observed density (ρ_t)

The reading of the glass density meter in the liquid specimen at the test temperature, in kg/m³ or g/cm³.

3.3 Density at 20°C (ρ_{20})

The density at the standard temperature of 20°C, in kg/m³.

3.4 Temperature of measurement (t)

The temperature of the oil in the oil storage container or pipeline at the time of measurement, in °C.

3.5 Volume at 20°C (V_{20})

The volume at the standard temperature of 20°C, in m³.

3.6 Volume correction factor (VCF)

The ratio of the volume of oil at standard temperatures to its volume at non-standard temperatures.

4 Compositions of Petroleum Measurement Tables

In the calculation of oil volume, it is recommended to use the following petroleum measurement tables or calculation programs (see Appendix A for examples).

4.1 Standard density tables

Table 59A – Standard Density Table of the Crude Oil

Table 59B – Standard Density Table of the Product

Table 59D – Standard Density Table of the Lubricant

NOTE: If the density entered in the above table is not the observed density measured by a glass densitometer, the above standard density table must not be used directly. Generally, the density value must be converted into the observed density in this Document and then the table is looked up or calculate according to the calculation program corrected by the glass density meter is omitted.

4.2 Volume correction factor tables

Table 60A – Volume Correction Factor Table of the Crude Oil

Table 60B – Volume Correction Factor Table of the Product

by a glass petroleum density meter at 40°C is 753.0 kg/m³. Find the standard density of the petroleum product.

- a) The product shall check Table 59B -- Standard Density Table of the Product;
- b) The observed density range where the observed density of 753.0 kg/m³ located is 733.0~753.0 kg/m³;
- c) Find 753.0 kg/m³ in the observed density column and 40°C in the temperature column. The intersection number between the two is 770.0 kg/m³, which means the standard density of the crude oil is 770.0 kg/m³.

EXAMPLE 2: It is known that the observed density of a certain crude oil measured by a glass petroleum density meter at 40°C is 805.7 kg/m³. Find the standard density of the crude oil.

- a) Crude oil shall check Table 59A -- Standard Density Table of the Crude Oil;
- b) The density range where the observed density of 805.7 kg/m³ located is 790.0~810.0 kg/m³;
- c) If there is no observed density value corresponding to 805.7 kg/m³ in the observed density column, and it is between 804.0~806.0 kg/m³, the interpolation method shall be used. Look up the table and find that at a temperature of 40°C, the observed density is 804.0 kg/m³ and its corresponding standard density is 818.7 kg/m³; at the same temperature, the observed density is 806.0 kg/m³ and its corresponding standard density is 820.6 kg/m³, using the interpolation method to obtain a change in standard density of $(820.6 \text{ kg/m}^3 - 818.7 \text{ kg/m}^3) / (806.0 \text{ kg/m}^3 - 804.0 \text{ kg/m}^3) = 0.95$ corresponding to a change in observed density of 1.0 kg/m³, from which the standard density of such crude oil is $818.7 \text{ kg/m}^3 + (805.7 \text{ kg/m}^3 - 804.0 \text{ kg/m}^3) \times 0.95 = 820.3 \text{ kg/m}^3$.

EXAMPLE 3: It is known that the observed density of a certain lubricant measured with a glass petroleum density meter at 32°C is 986.0 kg/m³. Find the standard density of the lubricant.

- a) Lubricant shall check Table 59D - Standard Density Table of the Lubricant;
- b) The density range where the observed density of 986.0 kg/m³ located is 980.0~1000.0 kg/m³;
- c) Find 986.0 kg/m³ in the observed density column and 32°C in the temperature column. The intersection number between the two is 993.3 kg/m³, which means the standard density of the oil is 993.3 kg/m³.

5.2 Application of volume correction factor table

5.2.1 Application procedures

Given the standard density of an oil product, the procedures to convert the volume of the oil product at measurement temperature corrected to volume correction factor of the standard

volume are as follows:

- a) Select the volume correction factor table of the corresponding oil product according to the oil product type;
- b) Determine the density range of the standard density in the volume correction factor table;
- c) Find the known standard density value in the standard density column, and find the measurement temperature value of the oil product in the temperature column. The intersection number between the two is the volume correction factor for the oil product to be corrected from the measurement temperature to the standard temperature.

If the known standard density is between two adjacent standard densities in the standard density row, there is no need to use interpolation; and only the volume correction factor corresponding to the closer standard density value shall prevail. The temperature value does not need to be interpolated, only the closer temperature value is used to look up the table.

5.2.2 Example

EXAMPLE 1: It is known that the standard density of a certain petroleum product is 762.0 kg/m^3 . Find the volume correction factor to correct the volume of the oil product at 40°C to the standard volume.

- a) The product shall check Table 60B - Volume Correction Factor Table of the Product;
- b) The density range where the standard density of 762.0 kg/m^3 located is $750.0\sim 770.0 \text{ kg/m}^3$,
- c) Find 762.0 kg/m^3 in the standard density column and 40°C in the temperature column. The intersection number between the two is 0.9764, which is the volume correction factor to correct the oil volume at 40°C to the standard volume.

EXAMPLE 2: It is known that the standard density of a certain crude oil is 824.5 kg/m^3 . Find the volume correction factor to correct the volume of the oil product at 40°C to the standard volume.

- a) The crude oil shall check Table 60A - Volume Correction Factor Table of the Crude Oil;
- b) The density range where the standard density of 824.5 kg/m^3 located is $810.0\sim 830.0 \text{ kg/m}^3$;
- c) If there is no standard density value corresponding to 824.5 kg/m^3 in the standard density column, and it is between 824.0 kg/m^3 and 826.0 kg/m^3 , the closest standard density value 824.0 kg/m^3 shall prevail. Check The intersection number at the temperature of 40°C is 0.9819. This value is the volume correction factor of the crude oil to correct the volume at 40°C to the standard volume.

EXAMPLE 3: It is known that the standard density of a certain lubricant is 892.0 kg/m^3 . Find

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