VISCOSITY INDEX TABLES FOR CELSIUS TEMPERATURES

DS 39B

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Foreword

These tables were prepared to provide a convenient means of obtaining the viscosity index of petroleum products and lubricants without the necessity of calculation. They have been prepared under the sponsorship of Research and Development Division VII on Flow Properties of ASTM Committee D-2.

This publication is intended to replace the previous Viscosity Index Tables: DS 39a. Those were based on 100 and 210°F as reference temperatures. These new tables are based on ASTM Method D 2270-74 for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C. Method D 2270-74 was prepared in compliance with worldwide agreements reached within the International Standards Organization to adopt 40 and 100° Celsius as the primary reference temperatures for the viscosity determinations of petroleum lubricants and related products. Research and Development Division VII of ASTM Committee D-2 was requested by Technical Committee 28 of the International Standards Organization to prepare a new standard for calculating viscosity index. This was to be based on kinematic viscosities determined at 40 and 100°C, and to be in agreement with the prior Method D 2270-64 using 100 and 210°F. It was also requested that new Viscosity Index Tables be prepared which would obviate the necessity for detailed calculations. This publication fulfills that request.

During the interim period in which the use of 100 and 210°F as reference temperatures is being phased out, either DS 39a or this new publication can be used interchangeably.

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Past Chairman
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Acknowledgment of Work

Introduction

The tables in this publication permit direct reading of the viscosity index of a petroleum product or lubricant if its kinematic viscosities at 40 and 100°C are known. Use of these tables eliminates the calculations which would be required to determine the viscosity index.

Definition

The viscosity index is an arbitrary number indicating the effect of change of temperature on the kinematic viscosity of an oil. A high viscosity index signifies a relatively small change of kinematic viscosity with temperature.

Calculation of Viscosity Index

The viscosity index of an oil is calculated from its viscosities at 40 and 100°C. The procedure for the calculation is given in ASTM Method D 2270-74 for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C. Table 1 of the Method lists the basic viscosity values of the reference series used in the calculation. The accuracy of the calculated viscosity index obtained by the use of Method D 2270 or the tables presented here is dependent on the accuracy of the viscosity determinations. It is recommended that the viscosity index be reported only to whole numbers and that the use of decimal values be avoided.

Structure and Use of the Tables

The tables are arranged according to the kinematic viscosity at 100°C. The viscosity at 100°C is given at the top of each column. The intervals for these viscosity values were selected on the basis of the importance of the size of the interval in a given viscosity range; ease of interpolation; and the size of the resulting publication. The viscosity index values are given in increments of one unit and are listed in the extreme left column. The upper limit of viscosity index decreases with increasing viscosity on the

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basis of practicality. The viscosities at 40°C are listed in the body of the table. The use of the tables is illustrated by the following examples:

Example 1

What is the viscosity index of an oil for which the observed kinematic viscosities are 79.61 cSt at 40°C and 9.12 cSt at 100°C?

Enter the table in the column headed 9.12 under "Kinematic Viscosity at 100°C." Go down this column to the value 79.61.

The left hand column on the same line gives the value 87. This is the viscosity index of the oil.

Example 2

What is the kinematic viscosity of an oil at 40°C which is required for an oil of 13.60 cSt at 100°C and 125 viscosity index?

Enter the column headed 13.60 cSt at 100°C and proceed down the column to the line at which 125 appears in the left hand column.

The value found is 107.7 cSt, which is the required kinematic viscosity at 40°C.

If the exact viscosities of an oil are not found in the table, the information desired can be obtained by linear interpolation between the proper tabulated values. The viscosity index should be reported only to the nearest whole number.

Method of Calculating Tabular Data and Publication

It is considered desirable to record the procedures by which this edition of the ASTM Viscosity Index Tables were prepared. A computer was programmed to perform the necessary calculations; type selection; and arrangement in the desired format. The mathematical equations given in ASTM Method D 2270-74 were rearranged so that the required kinematic viscosities at 40°C in the body of the table were determined for the specified values of the kinematic viscosity at 100°C and viscosity index. The equations used were as follows:

For Oils of 0 to 100 VI
$$U = L - [(VI/100)\ (L - H)]$$

For Oils of 100 VI and greater
$$U = \text{antilog}\ [\log H - N \log Y]$$

where

$Y =$ kinematic viscosity of oil in centistokes at 100°C.

$L =$ kinematic viscosity in centistokes at 40°C of an oil of 0 viscosity index and having the same kinematic viscosity at 100°C as the oil whose viscosity index is to be calculated.

H = kinematic viscosity in centistokes at 40°C of an oil of 100 viscosity index, and having the same kinematic viscosity at 100°C as the oil whose viscosity index is to be calculated.

U = kinematic viscosity in centistokes at 40°C to be listed in the body of the table. When the tables are being used in the normal manner, this is also the kinematic viscosity at 40°C of the oil whose viscosity index is being determined.

$N = \log [0.00715 \ (VI - 100) + 1]$

The kinematic viscosities at 40°C in the table were tabulated to four significant figures. This represents an accuracy better than that normally obtained in the laboratory and of the order of magnitude approached in precise standardization studies. Independent recalculation of the tabulated data given here might result in a possible deviation of one unit in the fourth digit. This deviation can arise from the rounding procedure used by the computer when producing the tables. Normal laboratory practices should not be expected to provide significantly better viscosity or viscosity index accuracy than provided for in the tables.

References

The following references do not constitute a complete coverage of the literature, but will be helpful in following the history and development of the viscosity index.

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