ASTM
VISCOSITY INDEX TABLES

Calculated from

KINEMATIC VISCOSITY

ERRATUM

DS 39a, ASTM VISCOSITY INDEX CALCULATED FROM KINEMATIC VISCOSITY

Page 687, 95 V.I.

First three columns to read

229.1
229.5
229.8

Errata

ASTM Viscosity Index Tables Calculated from Kinematic Viscosity, Data Series 39A

Make the following changes:

Page	V.I.	Kinematic Viscosity at 210 F, cs	Kinematic Viscosity at 100 F, cs. Change from
4	167	2.00	5.856 to 5.861
14	50	2.23	8.827 to 8.927
25	0	2.45	115657 to 11.657
318	250	7.28	2.79 to 28.79
411	125	8.82	6306 to 63.06
658	126	17.16	1591 to 159.1
661	0	17.36	48.15 to 428.15
704	150	18.84	1520 to 152.0
832	50	45.50	1602.2 to 1692.2
916	50	66.20	3383.3 to 3338.3

950—The value after V.I. of 158 should read 159

ASTM VISCOSITY INDEX
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ASTM DATA SERIES DS 39a
(Formerly STP 168)

Price $23.00 to Members $16.00

Published by the
AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race Street, Philadelphia

Library of Congress Catalog Card Number: 65-24834

NOTE

The Society is not responsible, as a body,
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Printed in York, Pennsylvania
September, 1965

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 guidance of Research Division VII on Flow Properties, of ASTM Committee D-2 on Petroleum Products and Lubricants.

It should be pointed out that this publication is intended to replace a previous publication: ASTM Viscosity Index Tables, STP No. 168. The adoption of ASTM Method D2270 for Calculating Viscosity Index from Kinematic Viscosity, has changed the viscosity index values above 100 VI as compared to those previously obtained by ASTM Method D567 for Calculating Viscosity Index or STP No. 168. The reader is referred to Method D2270-64 and the Introduction to this publication for details of this change. The studies leading to the change in calculating viscosity index are the result of recommendations by the Third and Fourth World Petroleum Congresses that a method be selected which would avoid the problems which ultimately developed in the use of Method D567-53.

The work leading to the adoption of Method D2270-64, and this volume, began in the year, 1956. An exhaustive study was made of all available proposals. It is difficult to give proper acknowledgment to all of those who contributed over the period of study. A following page does list the Officers of Research Division VII and the members of Section C of Research Division VII at the time at which the work was culminated.

This publication is unique in that it has been produced almost entirely by computer techniques. Brief details of the procedure are given in a later section. In this regard, special acknowledgment should be given to the ASTM staff for their foresighted interest in the computer production technique; their direct assistance has been an important contribution.

W. A. Wright, *Chairman*
Research Division VII
ASTM Committee D-2

September, 1965

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INTRODUCTION

The tables in this publication permit direct reading of the Viscosity Index of a petroleum product or lubricant if its kinematic viscosities at 100 F and 210 F are known. Use of these tables eliminates the calculation required for determining Viscosity Index.

Definition

The Viscosity Index is an empirical number that indicates the effect of change of temperature on the viscosity of an oil. A low Viscosity Index signifies relatively large change of viscosity with temperature.

Calculation of Viscosity Index

The viscosity index of an oil is calculated from its viscosity at 100 F (37.8 C) and at 210 F (98.9 C). The procedure for its calculation is described in ASTM Method D2270 for Calculating Viscosity Index from Kinematic Viscosity. Table I of the Method lists the basic values of the reference series used in the calculation. Viscosity index values from 0 to 100 VI are identical to those used previously in ASTM Method D567. The calculation procedure and the viscosity index values above 100 VI have been changed by the new Method D2270, and result in values which are more representative of the viscosity-temperature characteristics of the oil. The accuracy of the calculated viscosity index value is dependent on the accuracy of the viscosity determinations. It is recommended that these values be reported only to whole numbers and the use of decimal values be avoided.

Scope of Tables

These tables are arranged according to kinematic viscosity at 210 F (98.9 C). The viscosity at 210 F 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 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 given in the extreme left column. The upper limit of viscosity index decreases with increasing viscosity on the basis of practicality. The viscosities at 100 F are listed in the body of the table. The following table gives the viscosity ranges at 210 F and the associated viscosity and viscosity index intervals.

Kinematic Viscosity at 210 F		*Viscosity Index*	
Range	*Interval*	*Range*	*Interval*
2.00- 9.99	0.01	0-300	1
10.00-19.98	0.02	0-250	1
20.00-74.90	0.10	0-200	1
75.00	....	0-200	1

Instructions for Using Tables

Example 1.

What is the viscosity index of an oil for which the observed kinematic viscosities are 80.76 cs at 100 F and 9.10 cs at 210 F?

Enter the table in the column headed 9.10 under "Kinematic Viscosity at 210 F". Go down this column to the value 80.76.

The left hand column on the same line gives the value 95. This is the viscosity index of the oil.

Example 2.

What is the kinematic viscosity of an oil at 100 F which is required for an oil of 14.00 cs at 210 F and 125 viscosity index?

Enter the column headed 14.00 cs at 210 F and proceed down the column to the line at which 125 appears in the left hand column.

The value found is 120.4, which is the required kinematic viscosity at 100 F.

Interpolation

If the exact viscosities of an oil are not shown in the table, the viscosity index can be found by interpolation. The value should be reported to the nearest whole number.

Method of Calculating Tabular Data and Publication

It is considered worthwhile to record the procedure by which the tables were computed and prepared. Method D2270 retains viscosity index values from 0 to 100 VI in agreement with the older Method D567 and the same range of viscosity index given in STP 168. These data were transcribed into the computer program for the production of that portion of this volume.

The data for viscosity indices above 100 VI were obtained as follows:

Method B of D2270 (for oils of 100 or greater viscosity index) gives the relationship:

$$KV_{210}^{N} = \frac{H}{U} \quad \text{.....(1)}$$

where:

KV_{210} = kinematic viscosity of the unknown oil at 210 F

N = $(\log H - \log U) / (\log KV_{210})$

H = kinematic viscosity at 100 F of an oil having 100 viscosity index using Method A of D2270, and having the same viscosity as the unknown at 210 F. This is also equal to H in Table I of D2270.

U = kinematic viscosity at 100 F of the unknown oil. (Note: $H > U$.)

$$VI = \frac{(\text{Antilog } N) - 1}{0.0075} + 100 \quad \text{.....(2)}$$

where:

N = power required to raise the viscosity of the oil at 210 F to equal the ratio of H and U viscosities at 100 F, and

VI = viscosity index (100 or above).

In order to prepare the tabular material, the value of U in cs at 100 F needed to be calculated and tabulated for the specified values of viscosity index and kinematic viscosity at 210 F. The following equation was used:

$$U = \text{antilog } [\log H - \log (0.0075\ VI + 0.25) \log KV_{210}] \ldots \quad (3)$$

The symbols have the same significance as given above.

The computer program was written around Eq (3) with the appropriate values of viscosity at 210 F and the related values of H being a portion of the input. The remaining input value, viscosity index, was programmed to be automatically supplied at unit intervals. The computer program derived the required values of U, and tabulated them in the desired format. The same information, together with programmed instructions as to final page format, type selection, etc., was used to prepare a punched tape for the final master copy of each page. A Photocopy reproduction technique was then used to produce the finished volume. The fact that all values above 100 VI were computer derived made verification of the new data very simple. The data were examined to assure the listing of the correct values and intervals of the viscosity at 210 F and the viscosity index. Relatively few check calculations of the tabular data determined the reliability of the initial computer program.

REFERENCES:

The following references, while not constituting an exhaustive listing, will be found to be helpful in following the history and development of viscosity index.

E. W. Dean and G. H. B. Davis, "Viscosity Variation of Oils and Temperature", *Chem. and Met. Eng.*, Vol. 36, pp 618-619 (1929).

E. W. Dean, A.D. Bauer, and J. H. Bergland, "Viscosity Index of Lubricating Oils", *Ind. and Eng. Chem.*, Vol. 32, pp 102-107 (1940).

J. C. Geniesse, "A Comparison of Viscosity-Index Proposals", ASTM *Bulletin No. 215*, pp 81-84, (1956).

W. A. Wright, "A Proposed Modification of the ASTM Viscosity Index", *Proc. API*, Vol. 44, Sec. 3, (Refining), pp 535-541 (1964).