



Standard Test Method for Estimation of Molecular Weight (Relative Molecular Mass) of Petroleum Oils From Viscosity Measurements¹

This standard is issued under the fixed designation D 2502; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the estimation of the mean molecular weight (relative molecular mass) of petroleum oils from kinematic viscosity measurements at 100 and 210°F (37.78 and 98.89°C).² It is applicable to samples with molecular weights in the range from 250 to 700 and is intended for use with average petroleum fractions. It should not be applied indiscriminately to oils that represent extremes of composition or possess an exceptionally narrow molecular weight (relative molecular mass) range.

1.2 Values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information purposes only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)³

2.2 ASTM Adjuncts:

Molecular Weight of Petroleum Oils from Viscosity Measurements (D 2502)⁴

3. Summary of Test Method

3.1 The kinematic viscosity of the oil is determined at 100 and 210°F (37.78 and 98.89°C). A function “ H ” of the 100°F

viscosity is established by reference to a tabulation of H function versus 100°F viscosity. The H value and the 210°F viscosity are then used to estimate the molecular weight from a correlation chart.

4. Significance and Use

4.1 This test method provides a means of calculating the mean molecular weight (relative molecular mass) of petroleum oils from another physical measurement.

4.2 Molecular weight (relative molecular mass) is a fundamental physical constant that can be used in conjunction with other physical properties to characterize hydrocarbon mixtures.

5. Procedure

5.1 Determine the kinematic viscosity of the oil at 100 and 210°F (37.78 and 98.89°C) as described in Test Method D 445.

5.2 Look in Table 1 for 100°F (37.78°C) viscosity and read the value of H that corresponds to the measured viscosity. Linear interpolation between adjacent columns may be required.

5.3 Read the viscosity - molecular weight chart for H and 210°F (98.89°C) viscosity. A simplified version of this chart is shown in Fig. 1 for illustration purposes only (Note 1). Interpolate where necessary between adjacent lines of 210°F viscosity. After locating the point corresponding to the value of H (ordinate) and the 210°F viscosity (superimposed lines), read the molecular weight along the abscissa.

Example:

Measured viscosity, cSt:

100°F (37.78°C) = 179

210°F (98.89°C) = 9.72

Look in Table 1 for 179 and read the corresponding value $H = 461$.

Using $H = 461$ and 210°F viscosity = 9.72 in conjunction with chart gives molecular weight (relative molecular mass) = 360 (see Fig. 1).

NOTE 1—A 22 by 28-in. (559 by 711-mm) chart available as an adjunct to this test method was used in cooperative testing of the method. If other charts are used, the precision statements given in the Precision Section will not apply.

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.04 on Hydrocarbon Analysis.

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² Hirschler, A. E., *Journal of the Institute of Petroleum*, JIPEA, Vol 32, 1946, p. 133.

³ *Annual Book of ASTM Standards*, Vol 05.01.

⁴ Available from ASTM Headquarters. Order ADJD2502

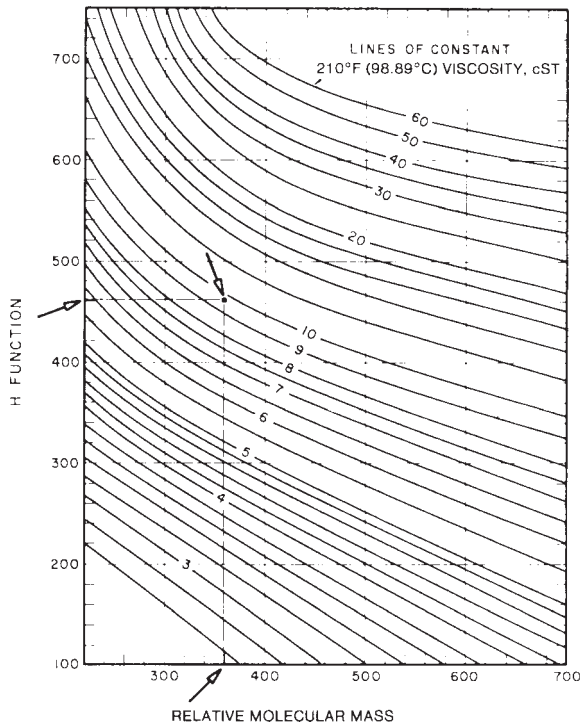


FIG. 1 Viscosity-Molecular Weight Chart

6. Precision and Bias

6.1 The precision of this test method as obtained by statistical examination of interlaboratory test results is as follows:

6.1.1 *Repeatability*—The difference between successive test results obtained by the same operator with the same apparatus under constant operating conditions on identical test material, would in the long run, in the normal and correct operation of the test method, exceed the value 3 g/mol only in one case in twenty.

6.1.2 *Reproducibility*—The difference between two single and independent results, obtained by different operators, working in different laboratories on identical test material, would in the long run, in the normal and correct operation of the test method, exceed the value 25 g/mol only in one case in twenty.

6.2 *Bias*—Since there is no accepted reference material suitable for determining bias for this test method, no statement of bias can be made.

6.3 The precision for this test method was not obtained in accordance with RR:D02-1007, “Manual on Determining Precision Data for ASTM Methods on Petroleum Products and Lubricants.”⁵

7. Keywords

7.1 kinematic viscosity; molecular weight; petroleum oils; relative molecular mass

5.4 Report the molecular weight to the nearest whole number.

⁵ Annual Book of ASTM Standards, Vol 05.03.

TABLE 1 Tabulation of H Function

Kinematic Viscosity, cSt at 100°F (37.78°C)	H				
	0	0.2	0.4	0.6	0.8
2	-178	-151	-126	-104	-85
3	-67	-52	-38	-25	-13
4	-1	9	19	28	36
5	44	52	59	66	73
6	79	85	90	96	101
7	106	111	116	120	124
8	128	132	136	140	144
9	147	151	154	157	160
10	163	166	169	172	175
11	178	180	183	185	188
12	190	192	195	197	199
13	201	203	206	208	210
14	211	213	215	217	219
15	221	222	224	226	227
16	229	231	232	234	235
17	237	238	240	241	243
18	244	245	247	248	249
19	251	252	253	255	256
20	257	258	259	261	262
21	263	264	265	266	267
22	269	270	271	272	273
23	274	275	276	277	278
24	279	280	281	281	282
25	283	284	285	286	287
26	288	289	289	290	291
27	292	293	294	294	295
28	296	297	298	298	299
29	300	301	301	302	303
30	304	304	305	306	306
31	307	308	308	309	310
32	310	311	312	312	313