
Viscosity

SAE J300 Viscosity Grades for Engine Oils

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Axle and Manual Transmission Lubricant Viscosity Classification

- SAE Classification
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SAE J300 Viscosity Grades for Engine Oils - December 1999

SAE Viscosity Grade	Low Temperature (°C) Cranking Viscosity ⁽¹⁾ , cP Max.	Low Temperature (°C) Pumping Viscosity ⁽²⁾ , cP Max. with No Yield Stress	Kinematic Viscosity ⁽³⁾ (cSt) at 100°C Min.	Kinematic Viscosity ⁽³⁾ (cSt) at 100°C Max.	High-Shear Viscosity ⁽⁴⁾ (cP) at 150°C and 10 ⁶ s ⁻¹ Min.
0W	6200 at -35	60 000 at -40	3.8	-	-
5W	6600 at -30	60 000 at -35	3.8	-	-
10W	7000 at -25	60 000 at -30	4.1	-	-
15W	7000 at -20	60 000 at -25	5.6	-	-
20W	9500 at -15	60 000 at -20	5.6	-	-
25W	13000 at -10	60 000 at -15	9.3	-	-
20	-	-	5.6	< 9.3	2.6
30	-	-	9.3	< 12.5	2.9
40	-	-	12.5	< 16.3	2.9 (0W-40, 5W-40, and 10W-40 grades)
40	-	-	12.5	< 16.3	3.7 (15W-40, 20W-40, 25W-40, 40 grades)
50	-	-	16.3	< 21.9	3.7
60	-	-	21.9	< 26.1	3.7

All values are critical specifications as defined by ASTM D 3244.

1 cP=1 mPa·s; 1 cSt=1 mm²s⁻¹

Notes:

(1) ASTM D 5293.

(2) ASTM D 4684. Note that the presence of any yield stress detectable by this method constitutes a failure regardless of viscosity.

(3) ASTM D 445.

(4) ASTM D 4683, CEC L-36-A-90 (ASTM D 4741), or ASTM D 5481.

ISO Viscosity Grade Conversions

ISO Viscosity Grade	Mid-point Kinematic Viscosity	Kinematic Viscosity Limits cSt at 40°C (104°F)		ASTM, Saybolt Viscosity Number	Saybolt Viscosity SUS 100°F (37.8°C)	
		Min.	Max.		Min.	Max.
2	2.2	1.98	2.42	32	34.0	35.5
3	3.2	2.88	3.52	36	36.5	38.2
5	4.6	4.14	5.06	40	39.9	42.7
7	6.8	6.12	7.48	50	45.7	50.3
10	10	9.00	11.0	60	55.5	62.8
15	15	13.5	16.5	75	72	83
22	22	19.8	24.2	105	96	115
32	32	28.8	35.2	150	135	164
46	46	41.4	50.6	215	191	234
68	68	61.2	74.8	315	280	345
100	100	90.0	110	465	410	500
150	150	135	165	700	615	750
220	220	198	242	1000	900	1110
320	320	288	352	1500	1310	1600
460	460	414	506	2150	1880	2300
680	680	612	748	3150	2800	3400
1000	1000	900	1100	4650	4100	5000
1500	1500	1350	1650	7000	6100	7500

Viscosity Ranges for AGMA Lubricant Numbers

Rust and Oxidation Inhibited Gear Oils	Viscosity Range	Equivalent ISO Grade	Extreme Pressure Gear Lubricants
AGMA Lubricant No.	cSt (mm ² /s) at 40°C		AGMA Lubricant No.
1	41.4 to 50.6	46	
2	61.2 to 74.8	68	2 EP
3	90 to 110	100	3 EP
4	135 to 165	150	4 EP
5	198 to 242	220	5 EP
6	288 to 352	320	6 EP
7 Compounded	414 to 506	460	7 EP
8 Compounded	612 to 748	680	8 EP
8A Compounded	900 to 1100	1000	8A EP

Notes:

Viscosity ranges for AGMA Lubricant Numbers will henceforth be identical with those of the ASTM system.
Oils compounded with 3% to 10% fatty or synthetic fatty oils.

SAE J306 Automotive Gear Viscosity Classification

Axle and Manual Transmission Lubricant Viscosity Classification

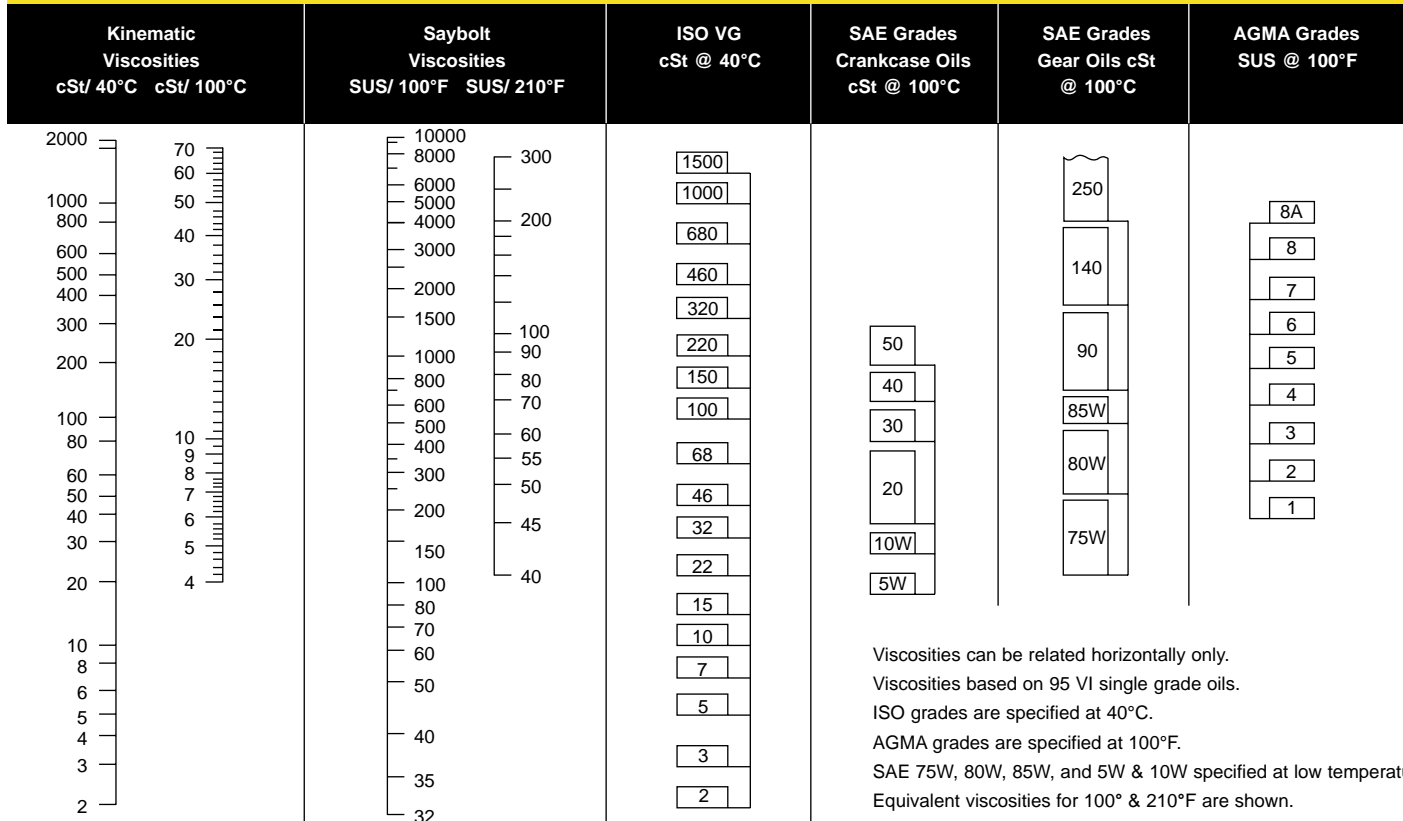
	70W	75W	80W	85W	80	85	90	140	250
Viscosity at 100°C min, mm ² /s	4.1	4.1	7.0	11.0	7.0	11.0	13.5	24.0	41.0
max, mm ² /s	No requirement				11.0	13.5	24.0	41.0	No req.
Viscosity of 150,000 mPa.s, max temp °C	-55	-40	-26	-12	No requirement				
20 hr. KRL Shear (CRC L-45-T-93), KV100 after Shear, mm ² /s	4.1	4.1	7.0	11.0	7.0	11.0	13.5	24.0	41.0

MIL-PRF-2105E Specification

	75W	80W-90	85W-140
Viscosity at 100°C min, mm ² /s	4.1	13.5	24.0
max, mm ² /s	-	24.0	41.0
Viscosity of 150,000 mPa.s, max temp °C	-40	-26	-12
Channel Point, min, °C	-45	-35	-20
Flash Point, min, °C	150	165	180

Comparison of Viscosity Classifications

Approximate Equivalents



Viscosities can be related horizontally only.

Viscosities based on 95 VI single grade oils.

ISO grades are specified at 40°C.

AGMA grades are specified at 100°F.

SAE 75W, 80W, 85W, and 5W & 10W specified at low temperature.

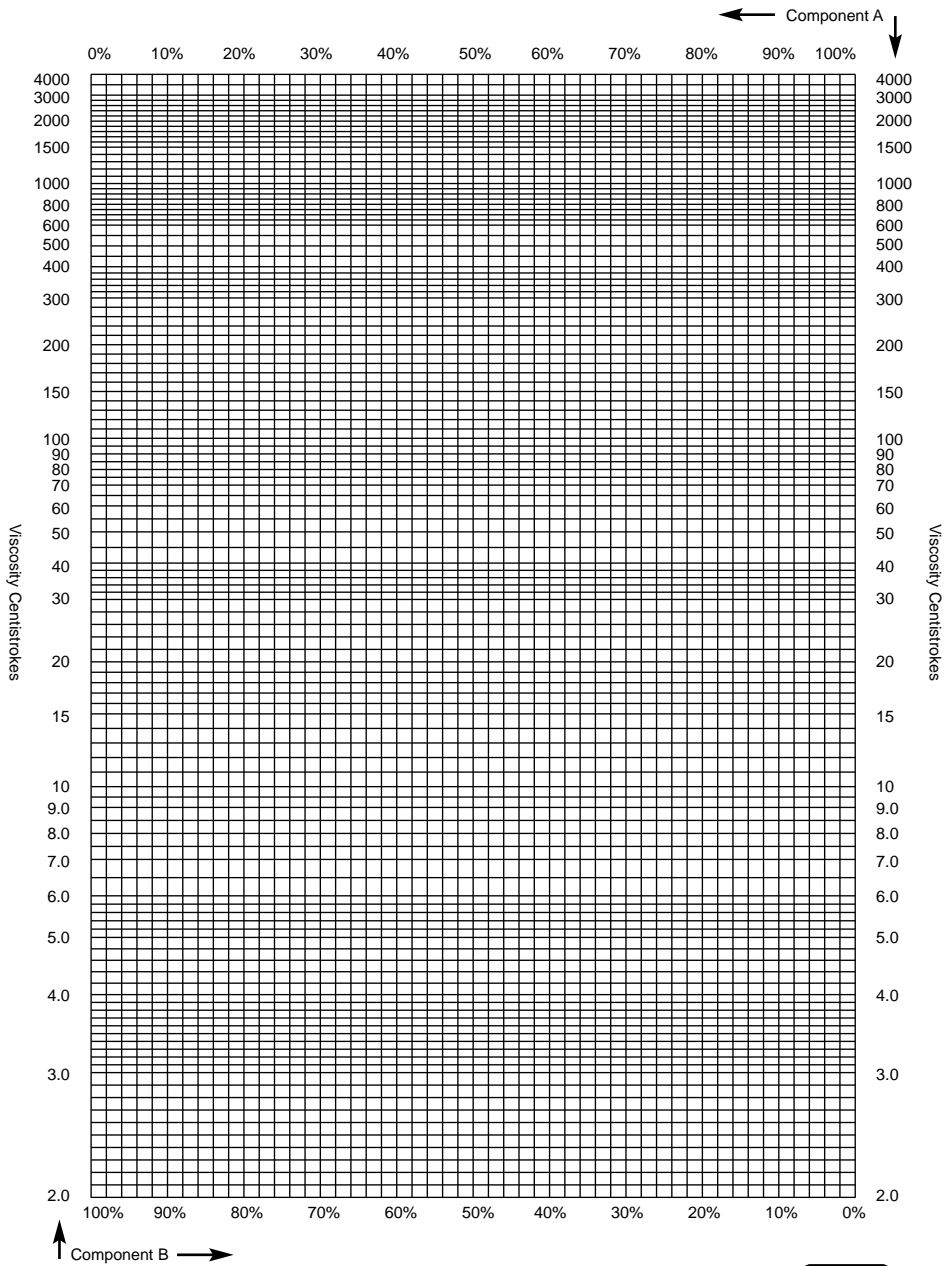
Equivalent viscosities for 100° & 210°F are shown.

Viscosity Equivalents at Same Temperature

Approximate Equivalents

Kinematic (Centistokes)	Saybolt Universal (Seconds)	Redwood No.1 (Seconds)	Engler (Degrees)	Saybolt Furot (Seconds)	Redwood No.2 (Seconds)	Kinematic (Centistokes)	Saybolt Universal (Seconds)	Redwood No.1 (Seconds)	Engler (Degrees)	Saybolt Furot (Seconds)	Redwood No.2 (Seconds)
1.8	32	30.8	1.14	-	-	96.8	450	397	12.8	47.0	-
2.7	35	32.2	1.18	-	-	102.2	475	419	13.5	49	-
4.2	40	36.2	1.32	-	-	107.6	500	441	14.2	51	-
5.8	45	40.6	1.46	-	-	118.4	550	485	15.6	56	-
7.4	50	44.9	1.60	-	-	129.2	600	529	17.0	61	-
8.9	55	49.1	1.75	-	-	140.3	650	573	18.5	66	-
10.3	60	53.5	1.88	-	-	151	700	617	19.8	71	-
11.7	65	57.9	2.02	-	-	162	750	661	21.3	76	-
13.0	70	62.3	2.15	-	-	173	800	705	22.7	81	-
14.3	75	67.6	2.31	-	-	183	850	749	24.2	86	-
15.6	80	71.0	2.42	-	-	194	900	793	25.6	91	-
16.8	85	75.1	2.55	-	-	205	950	837	27.0	96	-
18.1	90	79.6	2.68	-	-	215	1,000	882	28.4	100	-
19.2	95	84.2	2.81	-	-	259	1,200	1,058	34.1	121	104
20.4	100	88.4	2.95	-	-	302	1,400	1,234	39.8	141	122
22.8	110	97.1	3.21	-	-	345	1,600	1,411	45.5	160	138
25.0	120	105.9	3.49	-	-	388	1,800	1,587	51	180	153
27.4	130	114.8	3.77	-	-	432	2,000	1,763	57	200	170
29.6	140	123.6	4.04	-	-	541	2,500	2,204	71	250	215
31.8	150	132.4	4.32	-	-	650	3,000	2,646	85	300	255
34.0	160	141.1	4.59	-	-	758	3,500	3,087	99	350	300
36.0	170	150.0	4.88	-	-	866	4,000	3,526	114	400	345
38.4	180	158.8	5.15	-	-	974	4,500	3,967	128	450	390
40.6	190	167.5	5.44	-	-	1,082	5,000	4,408	142	500	435
42.8	200	176.4	5.72	23.0	-	1,190	5,500	4,849	156	550	475
47.2	220	194.0	6.28	25.3	-	1,300	6,000	5,290	170	600	515
51.8	240	212	6.85	27.0	-	1,405	6,500	5,730	185	650	580
55.9	260	229	7.38	28.7	-	1,515	7,000	6,171	199	700	600
60.2	280	247	7.95	30.5	-	1,625	7,500	6,612	213	750	645
64.5	300	265	8.51	32.5	-	1,730	8,000	7,053	227	800	690
69.9	325	287	9.24	35.0	-	1,840	8,500	7,494	242	850	730
75.3	350	309	9.95	37.2	-	1,950	9,000	7,934	256	900	770
80.7	375	331	10.70	39.5	-	2,055	9,500	8,375	270	950	815
86.1	400	353	11.40	42.0	-	2,165	10,000	8,816	284	1,000	855
91.5	425	375	12.10	44.2	-						

Two Components Viscosity Blending (cSt)



Base Stocks Viscosities

Approximate Equivalents

	Neutrals			
	40°C		100°C	
	cSt	SUS	cSt	SUS
70N	13.3	70.8	3.0	37.0
80N	15.6	80.3	3.35	37.3
90N	18.0	89.0	3.4	37.5
100N	21.5	104.0	4.0	39.0
140N	30.7	144.0	4.5	41.0
150N	31.6	148.0	4.9	42.4
160N	33.7	158.0	5.2	43.3
170N	34.0	159.0	5.4	44.0
180N	38.5	181.0	5.7	44.9
200N	44.5	204.0	6.2	46.0
250N	56.1	257.0	6.5	47.0
300N	61.3	285.0	7.0	49.0
315N	70.0	315.0	7.9	52.0
330N	70.9	328.0	8.4	53.7
350N	76.0	358.0	8.8	55.0
400N	86.0	398.6	9.8	58.0
450N	98.0	454.0	10.5	61.0
500N	107.0	496.0	11.0	64.0
600N	130.4	604.0	12.1	66.0
650N	141.0	665.0	13.8	71.0
700N	151.0	668.0	14.0	73.0

	Brights			
	40°C		100°C	
	cSt	SUS	cSt	SUS
135 Brt	413.2	1875.0	28.6	135.0
145 Brt	523.3	2425.0	30.9	145.0
150 Brt	568.0	2632.0	33.0	155.0
160 Brt	600.0	2800.0	35.2	166.0
175 Brt	616.0	2855.0	36.0	169.7
185 Brt	654.7	3034.0	37.6	177.0
225 Brt	1030.0	4800.0	49.3	229.0

Conversion Factors

Linear Measurement	1 yd	= 0.9144 m
	1 m	= 1.0936 yd
	1 ft	= 0.3048 m
	1 m	= 3.28 ft
	1 in	= 2.54 cm
	1 cm	= 0.3937 in
	1 mile	= 1.6093 km
	1 km	= 0.6214 mile
Area Measurement	1 sq yd	= 0.8361 sq m
	1 sq m	= 1.1960 sq yd
	1 sq in	= 6.452 sq cm
	1 sq cm	= 0.155 sq in
Cubic Measurement	1 cu in	= 16.3872 cc
	1 cc	= 0.0610 cu in
	1 cu ft	= 0.02832 cu m
	1 cu m	= 35.314 cu ft
	1 cu yd	= 0.7646 cu m
	1 cu m	= 1.3079 cu yd
Volumetric Measurement	1 imp gall	= 4.54596 litre
	1 litre	= 0.21998 imp gall
	1 imp gall	= 1.201 US gall
	1 litre	= 1.76 pints
Weight Measurement	1 oz	= 28.3495 g
	1 g	= 0.03527 oz
	1 lb	= 453.59 g
	1 kg	= 2.20462 lbs
Weights per Volume	1 g/litre	= 0.16035 oz/imp gall
	1 oz/imp gall	= 6.236 g/litre
	1 g/litre	= 0.01002 lb/imp gall
	1 lb/imp gall	= 99.8003 g/litre
Temperature Conversions	°C	= (°F - 32) x 5/9
	°F	= (°C x 9/5) + 32
Gravity Conversion	API gravity, deg	= (141.5/sp.gr. @ 60/60°F) - 131.5
Weight/Volume Conversion (for additive blending)	% volume of additive	= $\frac{\% \text{ weight of additive} \times \text{density of finished oil}}{\text{density of additive}}$
		(typical finished oil density = 0.88 g/ml)