

## **Viscosity Types**

Viscosity, commonly known as thickness, is a measure of how much a liquid resists deformation when a force is applied. There are four types of liquid behavior relating to viscosity.

**Newtonian** - The viscosity of Newtonian liquids remains constant regardless of the force applied to it. Water is a Newtonian liquid.

**Non-Newtonian** - The viscosity of non-Newtonian fluids drops as the force applied and the resulting velocity both increase. Ketchup is an example of a non-Newtonian fluid. Ketchup's high viscosity prevents it from flowing very fast at first, but as its flow rate increases, it becomes much thinner and flows even faster.

**Plastic** - Plastic liquids have a high static or rest viscosity, but once in motion the viscosity drops to a lower value and remains constant. Some latex adhesives and caulking com-pounds exhibit plastic behavior.

**Thixotropic** - Like plastic liquids, thixotropic liquids have a very high static (rest) viscosity that becomes much thinner once they are in motion. However, the viscosity continues to change as the flow rate increases. Most thixotropic liquids contain solids that contribute to its changing viscosity.

## Viscosity units

The English units of viscosity is 1 pound-second per square-foot or 1 slug per foot-second. The SI units of viscosity are the kilogram per meter second and the most common unit is called the poise (P) which is equal to 1 gram per centimeter-second. The SI unit is 10-times greater than the poise. More often we see viscosity described in centipoise (cP) which is one-hundredth of a poise. In any case, the viscosity in these units is the absolute or dynamic viscosity.

There are a variety of other units of viscosity measurement that have been developed over the years. Most of these units are based on some dynamic test on the liquid using a specific test apparatus. These units include Shell cup, Ford cup, Redwood, Zahn, Engler and Kreb Stormer to name a few.

Viscosity is also commonly given as centistokes (cstks) and Saybold Universal Seconds (SSU or SUS). These two units describe the kinematic viscosity, which is the ratio of viscosity to mass density. For the centistoke the relationship is:

$cP = cSt \times SG$	cP = centipoise
	SG = Specific Gravity
$cP = (0.22 \times SSU \times SG) - (180 \times SG)$	SSU = Saybolt second units (also SUS)
SSU	cSt = centistokes



	Specific	cific Viscosity, Saybolt Second Units						
Liquid	Gravity	40 °F	60 °F	80 °F	100 °F	120 °F	140 °F	160 °F
			Miscellaneo	ous Liquids				
Water	1.0	31.5	31.5	31.5	31.5	31.5	31.5	31.5
Gasoline	.6874	30	30	30	30	30	30	30
Jet Fuel	.7485	35	35	35	35	35	35	35
Kerosene	.78-72	42	38	34	33	31	30	30
Turpentine	.8687	34	33	32.8	32.6	32.4	32	32
Varnish Spar	.9	3500	1600	1000	650	530	250	230
		Fuel Oil	& Diesel Oil	(Not for Lul	brication)			
No. 1 Fuel Oil	.8295	40	38	35	33	31	30	30
No. 2 Fuel Oil	.8295	70	50	45	40	-	-	-
No. 3 Fuel Oil	.8295	90	68	53	45	40	-	-
No. 5A Fuel Oil	.8295	1000	400	200	100	75	60	40
No. 4B Fuel Oil	.8295	1300	600	490	400	330	290	240
No. 6 Fuel Oil	.8295	-	70000	20000	9000	1900	900	500
No. 2D Diesel	.8295	100	68	53	45	40	36	35
No. 3D Diesel	.8295	200	120	80	60	50	44	40
No. 4D Diesel	.8295	1600	600	280	140	90	68	54
No. 5D Diesel	.8295	15000	5000	2000	900	400	260	160
		Crar	kcase Oils –	Lubricating	g Oils			
SAE 10	.88935	1500-2400	600-900	300-400	170-220	110-130	75-90	60-65
SAE 20	.88935	2400-9000	900-3000	400-1100	220-550	130-280	90-170	65-110
SAE 30	.88935	9000-14000	3000-4400	1100-1800	550-800	280-400	170-240	110-150
SAE 40	.88935	14000-19000	4400-6000	1800-2400	800-1100	400-550	240-320	150-200
SAE 50	.88935	19000-45000	6000-10000	2400-4000	1100-1800	550-850	320-480	200-280
SAE 60	.88935	45000-60000	10000-17000	4000-6000	1800-2500	850-1200	480-580	280-380
SAE 70	.88935	60000-120000	17000-45000	6000-10000	2500-4000	1200-1800	580-900	380-500
		Transmissior	n Oils – Trans	smission G	ear Lubrica	ants		
SAE 90	.88935	14000	5500	2200	1100	650	380	240
SAE 90 SAE 140	.88935 .88935	14000 35000	5500 12000	2200 5000	1100 2200	650 1200	380 650	240 400
SAE 140	.88935	35000	12000	5000 18000	2200	1200	650	400
SAE 140	.88935	35000	12000 50000	5000 18000	2200	1200	650	400
SAE 140 SAE 250	.88935 .88935 .96	35000 160000 36000	12000 50000 Other	5000 18000 r Oils	2200 7000 14000	1200 3300	650 1700	400 1000 300
SAE 140 SAE 250 Castor Oil	.88935 .88935	35000 160000	12000 50000 Other 9000	5000 18000 r Oils 3000	2200 7000	1200 3300 900	650 1700 400	400 1000
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut	.88935 .88935 .96 .943	35000 160000 36000 4000 1500	12000 50000 Other 9000 1800 500	5000 18000 r Oils 3000 1000 250	2200 7000 14000 580 140	1200 3300 900 400 100	650 1700 400 300	400 1000 300 200 60
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod	.88935 .88935 .88935 .943 .925 .928	35000 160000 36000 4000 1500 1800	12000 50000 Other 9000 1800 500 600	5000 18000 r Oils 3000 1000 250 300	2200 7000 14000 580 140 175	1200 3300 900 400 100 110	650 1700 400 300 70 80	400 1000 300 200 60 70
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corn	.88935 .88935 .88935 .943 .943 .925 .928 .924	35000 160000 36000 4000 1500 1800 1600	12000 50000 Other 9000 1800 500 600 700	5000 18000 <b>r Oils</b> 3000 1000 250 300 400	2200 7000 14000 580 140 175 250	1200 3300 900 400 100 110 175	650 1700 400 300 70 80 100	400 1000 300 200 60 70 80
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Com Cotm Cotton Seed	.88935 .88935 .88935 .943 .925 .928 .924 .88925	35000 160000 36000 4000 1500 1800 1600 1500	12000 50000 0the 9000 1800 500 600 700 600	5000 18000 <b>r Oils</b> 3000 1000 250 300 400 300	2200 7000 580 140 175 250 175	1200 3300 900 400 100 110 175 125	650 1700 400 300 70 80 100 80	400 1000 300 200 60 70 80 70
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corn Cotton Seed Cylinder	.88935 .88935 .88935 .943 .925 .928 .924 .88925 .8295	35000 160000 36000 4000 1500 1800 1600	12000 50000 Other 9000 1800 500 600 700	5000 18000 <b>r Oils</b> 3000 1000 250 300 400	2200 7000 14000 580 140 175 250	1200 3300 900 400 100 110 175	650 1700 400 300 70 80 100	400 1000 300 200 60 70 80
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corn Cotton Seed Cylinder Navy #1 Fuel Oil	.88935 .88935 .88935 .943 .925 .928 .924 .88925 .8295 .989	35000 160000 36000 4000 1500 1800 1600 1500 60000	12000 50000 0thei 9000 1800 500 600 700 600 14000 1100	5000 18000 r Oils 3000 1000 250 300 400 300 6000 600	2200 7000 580 140 175 250 175 2700 380	1200 3300 900 400 100 110 175 125 14000 200	650 1700 300 70 80 100 80 1000 170	400 1000 200 60 70 80 70 70 400 90
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corn Cotton Seed Cylinder Navy #1 Fuel Oil Navy #2 Fuel Oil	.88935 .88935 .88935 .943 .925 .928 .924 .88925 .8295 .989 1.0	35000 160000 36000 4000 1500 1800 1600 1500 60000 4000 -	12000 50000 0thei 9000 1800 500 600 700 600 14000 1100 24000	5000 18000 r Oils 3000 250 300 400 300 6000 600 8700	2200 7000 580 140 175 250 175 2700 380 3500	1200 3300 900 400 100 110 175 125 14000 200 1500	650 1700 300 70 80 100 80 1000	400 1000 300 200 60 70 80 70 400
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corn Cotton Seed Cylinder Navy #1 Fuel Oil Navy #2 Fuel Oil Gas	.88935 .88935 .88935 .943 .925 .928 .924 .88925 .8295 .989	35000 160000 36000 4000 1500 1800 1600 1500 60000 4000 - 180	12000 50000 000 1800 500 600 700 600 14000 1100 24000 90	5000 18000 r Oils 3000 1000 250 300 400 300 6000 600 8700 60	2200 7000 580 140 175 250 175 2700 380 3500 50	1200 3300 900 400 100 110 175 125 14000 200 1500 45	650 1700 300 70 80 100 80 1000 170 900 -	400 1000 200 60 70 80 70 400 90 480
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corn Cotton Seed Cylinder Navy #1 Fuel Oil Navy #2 Fuel Oil Gas Insulating	.88935 .88935 .88935 .943 .925 .928 .924 .88925 .8295 .989 1.0 .887	35000 160000 36000 4000 1500 1800 1600 1500 60000 4000 - 180 350	12000 50000 <b>Othe</b> 9000 1800 500 600 14000 1100 24000 90 150	5000 18000 r Oils 3000 1000 250 300 400 300 6000 600 8700 60 90	2200 7000 580 140 175 250 175 2700 380 3500 50 65	1200 3300 900 400 100 110 175 125 14000 200 1500 45 50	650 1700 300 70 80 100 80 1000 170 900 - 45	400 1000 200 60 70 80 70 400 90 480 - 40
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corn Cotton Seed Cylinder Navy #1 Fuel Oil Navy #2 Fuel Oil Gas Insulating Lard	.88935 .88935 .88935 .943 .925 .928 .924 .88925 .8295 .989 1.0 .887 .912925	35000 160000 36000 4000 1500 1800 1600 1500 60000 - 180 350 1100	12000 50000 0the 9000 1800 500 600 14000 1100 24000 90 150 600	5000 18000 <b>r Oils</b> 3000 1000 250 300 400 300 6000 600 8700 60 90 380	2200 7000 580 140 175 250 175 2700 380 3500 50 65 287	1200 3300 900 400 100 110 175 125 14000 200 1500 45 50 180	650 1700 300 70 80 100 80 1000 170 900 - 45 140	400 1000 200 60 70 80 70 400 90 90 480 - 40 90
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corn Cotton Seed Cylinder Navy #1 Fuel Oil Navy #2 Fuel Oil Gas Insulating Lard Linseed	.88935 .88935 .943 .925 .928 .924 .88925 .8295 .8295 .989 1.0 .887 .925 .925939	35000 160000 36000 4000 1500 1800 1600 1500 60000 4000 - 180 350 1100 1500	12000 50000 Other 9000 1800 500 600 14000 14000 1100 24000 90 150 600 500	5000 18000 <b>Oils</b> 3000 1000 250 300 400 300 6000 600 8700 60 90 380 250	2200 7000 580 140 175 250 175 2700 380 3500 50 65 287 143	1200 3300 900 400 100 110 175 125 14000 200 1500 45 50 180 180 110	650 1700 300 70 80 1000 170 900 - 45 140 85	400 1000 200 60 70 80 70 400 90 480 - 400 90 70 70
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corm Cotton Seed Cylinder Navy #1 Fuel Oil Navy #2 Fuel Oil Gas Insulating Lard Linseed Raw Menhadden	.88935 .88935 .88935 .925 .928 .924 .88925 .8295 .989 1.0 .887 .912925 .925939 .933	35000 160000 36000 4000 1500 1800 1500 60000 4000 - - 180 350 1100 1500 1500	12000 50000 Other 9000 1800 500 600 700 600 14000 1100 24000 90 150 600 500 550	5000 18000 <b>r Oils</b> 3000 1000 250 300 400 300 6000 600 8700 60 90 380 250 250	2200 7000 580 140 175 250 175 2700 380 3500 50 65 287 143 140	1200 3300 900 400 100 110 175 125 14000 200 1500 45 50 180 110 110	650 1700 300 70 80 1000 170 900 - 45 140 85 80	400 1000 200 60 70 80 70 400 90 480 - - 40 90 70 70 70 70
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corn Cotton Seed Cylinder Navy #1 Fuel Oil Navy #2 Fuel Oil Gas Insulating Lard Linseed Raw Menhadden Neats Foot	.88935 .88935 .88935 .943 .925 .928 .924 .88925 .8295 .989 1.0 .887 .912925 .925939 .933 .917	35000 160000 36000 4000 1500 1800 1600 1500 60000 4000 - - 180 350 1100 1500 - -	12000 50000 <b>Othe</b> 9000 1800 500 600 700 600 14000 1100 24000 90 150 600 500 550 1000	5000 18000 <b>r Oils</b> 3000 1000 250 300 400 300 6000 600 8700 60 90 380 250 250 430	2200 7000 580 140 175 250 175 2700 380 3500 50 65 65 287 143 140 230	1200 3300 900 400 100 110 175 125 14000 200 1500 45 50 180 110 110 110	650 1700 300 70 80 1000 170 900 - 45 140 85 80 100	400 1000 200 60 70 80 70 400 90 480 - 40 90 70 70 70 70 80
SAE 140 SAE 250 Castor Oil Chinawood Cocoanut Cod Corm Cotton Seed Cylinder Navy #1 Fuel Oil Navy #2 Fuel Oil Gas Insulating Lard Linseed Raw Menhadden	.88935 .88935 .88935 .925 .928 .924 .88925 .8295 .989 1.0 .887 .912925 .925939 .933	35000 160000 36000 4000 1500 1800 1500 60000 4000 - - 180 350 1100 1500 1500	12000 50000 Other 9000 1800 500 600 700 600 14000 1100 24000 90 150 600 500 550	5000 18000 <b>r Oils</b> 3000 1000 250 300 400 300 6000 600 8700 60 90 380 250 250	2200 7000 580 140 175 250 175 2700 380 3500 50 65 287 143 140	1200 3300 900 400 100 110 175 125 14000 200 1500 45 50 180 110 110	650 1700 300 70 80 1000 170 900 - 45 140 85 80	400 1000 200 60 70 80 70 400 90 480 - - 40 90 70 70 70 70

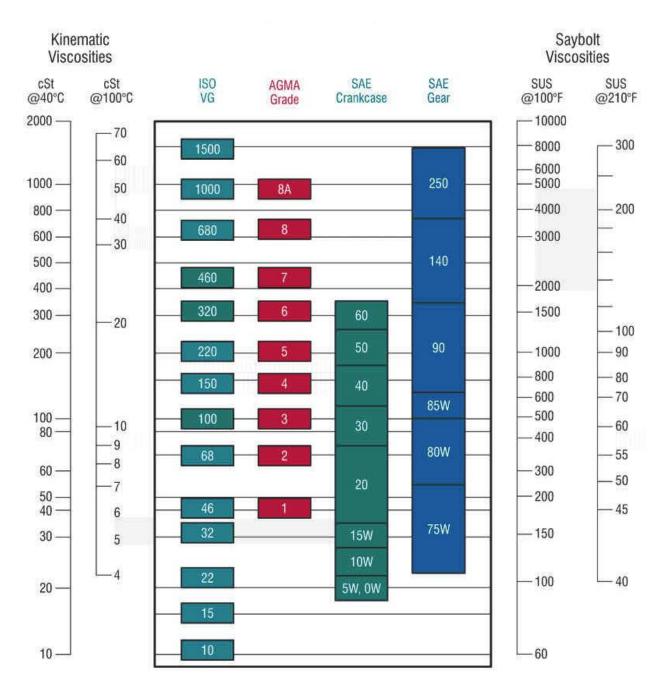


Liquid Specific Gravity	Specific	Viscosity, Saybolt Second Units						
	40 °F	60 °F	80 °F	100 °F	120 °F	140 °F	160 °F	
Other Oils (continued)								
Quenching	-	2400	900	450	250	180	130	90
Rape Seed	.919	2400	900	450	250	180	130	90
Rosin	.980	28000	7800	3200	1500	900	500	300
Rosin (Wood)	Rosin (Wood) 1.09 Extremely Viscose							
Sesame	.923	1100 500 290 184 130 90 60						
Soya Bean	.92798	1200	475	270	165	120	80	70
Sperm	.883	360	250	170	110	90	70	60
Turbine (Light)	.91	500	350	230	150	-	-	-
Trubine (Heavy)	.91	3000	1400	700	330	200	150	100
Whale	.925	900	450	275	170	140	100	80

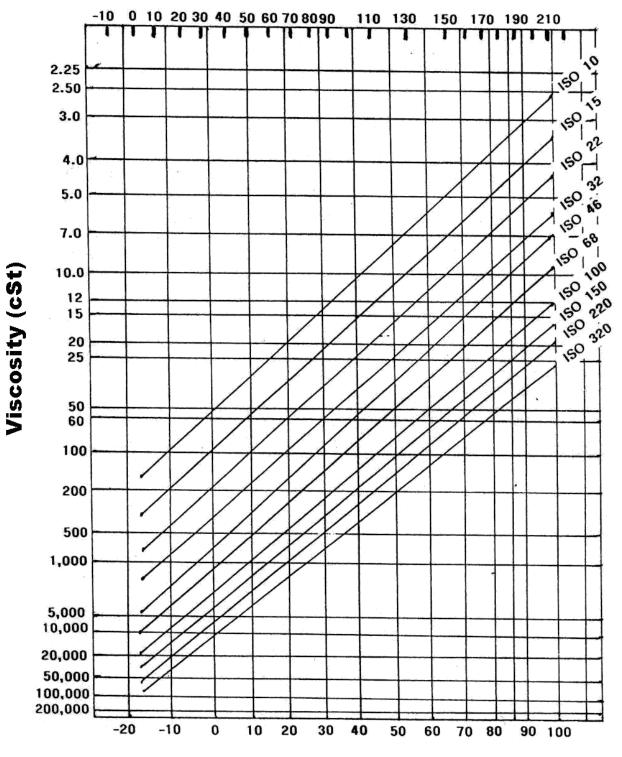
	Specific	Viscosity, Saybolt Second Units				
Liquid	Gravity	70 °F	100 °F	130 °F		
		Sugar, Syrups, Mola	asses, etc.			
Corn Syrups	1.4-1.47	-	5,000-500,000	1,500-60,000		
Glucose	1.35-1.44	-	35,000-100,000	10,000-13,000		
Honey (Raw)	-	-	340	-		
Molasses	1.40-1.49	-	1,300-250,000	700-75,0001		
Sugar Syrup 60 Brix	1.29	230	92	-		
Sugar Syrup 62 Brix	1.30	310	111	-		
Sugar Syrup 64 Brix	1.31	440	148	-		
Sugar Syrup 66 Brix	1.33	650	195	-		
Sugar Syrup 68 Brix	1.34	1,000	275	-		
Sugar Syrup 70 Brix	1.35	1,650	400	-		
Sugar Syrup 72 Brix	1.36	2,700	640	-		
Sugar Syrup 74 Brix	1.38	5,500	1,100	-		
Sugar Syrup 76 Brix	1.39	10,000	2,000	-		
Corn Starch 22 Baume	1.18	150	130	-		
Corn Starch 24 Baume	1.20	600	440	-		
Corn Starch 25 Baume	1.21	1,400	800	-		
Ink – Printers	1.0-1.38	-	2,500-10,000	1,100-3,000		
Ink - Newspaper	-	-	5,500-8,000	2,400		
Tallow	.918		56 S.S.U. @ 212 °F	_,		
		Tars				
Coke Oven – Tar	1.12+	3,000-8,000	650-1,400	-		
Gas House – Tar	1.16-1.3	15,000-300,000	2,000-20,000	-		
		Crude Oils	5			
Texas, Oklahoma	.81916	100-700	34-210	-		
Wyoming, Montana	.8688	100-1,000	46-320	-		
California	.7892	100-4,500	34-700	-		
Pennsylvania	.885	100-200	38-86	-		
		Glycols				
Propylene	1.038	240.6	-	-		
Trietheylene	1.125	185.7	-	-		
Diethylene	1.12	149.7	-	-		
Ethylene	1.125	88.4	-	-		
Glycerine (100%)	1.26	2,900	813	-		
Phenol (Carbolic Acid)	.95-1.00	60	-	-		
Silicate of Soda	-	-	365-640	-		
Sulfuric Acid (100%)	1.83	75	-	-		



## **Comparative Viscosity Classifications**







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