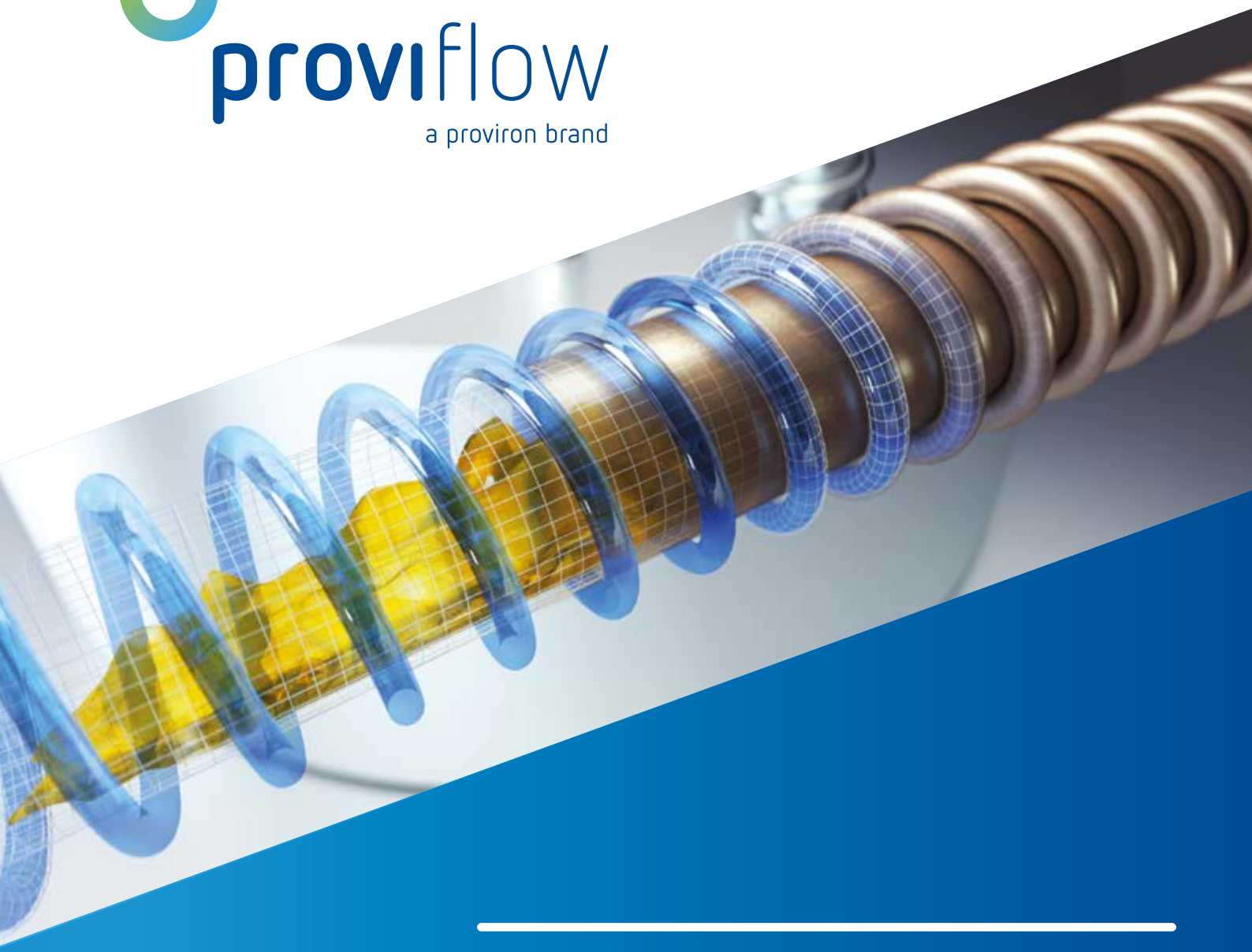
proviflow
a proviron brand



Product Guide
Heat Transfer Fluids

Proviflow® N
Proviflow® L
Proviflow® FG

Contents

Proviflow® Range

Proviflow® L and **Proviflow® N** are formulated using **OAT (Organic Acid Technology) inhibitors** and have been designed to cope with the most demanding of conditions. They can be used in a wide variety of applications and offer excellent freeze point suppression as well as enhanced protection against corrosion, hard water scaling and bacterial growth. Also, Proviflow® L and Proviflow® N are free from Phosphates, Nitrites, primary/secondary Amines, Silicates and Borates.

Proviflow® FG is an MPG based heat transfer fluid with a specially formulated inhibitor package for use in food and drink applications, containing exclusively FDA approved components. Proviflow® FG has been registered by US NSF and classified as a HT1 heat transfer fluid for potential incidental food contact. Due to its low acute oral toxicity, Proviflow® FG can be used in a wide range of food and beverage cooling applications where safety and certainty matter.

All **Proviflow®** fluids are tested to and exceed the **ASTM D1384-05** corrosion test standard. The range also contains a highly advanced reserve alkalinity additive. This ensures a longer and more efficient working life, limited disruption to processes, reduced maintenance costs and ultimately an improved return on capital employed.

PRODUCT APPLICATION TABLE

Product	Base Chemistry	Ground/Air Source	Solar Thermal	Industrial Cooling	Process Cooling	Refrigeration	HVAC
Proviflow® N	Monoethylene Glycol	○		○	○	○	○
Proviflow® L	Monopropylene Glycol	○	○	○	○	○	○
Proviflow® FG	Monopropylene Glycol	○		○	○	○	○

In Solar Thermal applications, Proviflow® L has demonstrated excellent, long-term thermal stability at temperatures of up to 160˚C / 320˚F. It can also withstand degradation at stagnation temperatures approaching 200˚C / 392˚F for short periods of time.

The longevity of a solar thermal heat transfer fluid is dependent on numerous variables, some of which are not fluid related. In order to ensure that you obtain the maximum possible lifespan from your fluid, you must ensure that stagnation events are kept to a minimum. Any excessive and unnecessary periods of fluid stagnation will lead to the degradation of any glycol based heat transfer fluid.

Food and drink refrigeration

Best Practice

All Proviflow® products are designed and manufactured to the highest standards to give the end-user greater peace of mind in the knowledge that every product offers a long and efficient working life. In order to ensure this, we recommend our best practice advice.

Storage

Proviflow® fluids are available in bulk and in IBC 200 L/ 55 gal or 25 L/ 5 gal containers. Other container size requirements can be discussed further. All fluids have a shelf life of two years provided that they are kept in their sealed original containers and are stored indoors at ambient temperatures and away from direct sunlight.

Handling

For information on exposure and recommended personal protective equipment (PPE), please refer to the specific Safety Data Sheet of your fluid.

Commissioning

Before filling a system with your Proviflow® fluid, please make sure that it is cleaned and flushed in order to ensure that any contaminants or deposits are removed.

In the first instance, it is recommended that de-ionised water is used for diluting. If local potable water is to be used, we recommend a maximum of 100ppm chloride content.

The dilution rate required varies between applications and the freeze protection desired. Please consult the applicable hardware manufacturer's instructions.

Once the dilution rate is established, please refer to our dilution table on page 9. Please note that the minimum volume of concentrate should be 20%. Any level of concentrate below 20% significantly reduces the inhibitor level within your fluid and will lead to the fluid breaking down.

Please note that Proviflow® products must not be used in hardware or equipment containing galvanised materials.

All heat transfer fluids must be disposed of in accordance with applicable local and national regulations, whether this be excess virgin fluid on commissioning or existing system fluid which is to be replaced.

Renewable energy heat pumps

Miscibility with other fluids

All Proviflow® fluids should be miscible with other manufacturers' fluids which have the same base of freeze suppressant. However, undesired reactions can occur and easily result in the breakdown of the fluid and reduce the working life, especially when different kinds of inhibitor packages are mixed. Indeed even usually compatible fluids may not be miscible if the existing fluid has already broken down before adding your Proviflow® product. If in doubt, please contact us and a fluid compatibility test can be carried out.

After Care

All Proviflow® fluids are produced to the highest standards with particular importance placed on efficiency, ease of service and a long working life. As well as best practice on mixing and installation, it is also essential to take care of your fluid post commissioning.

Proviron recommends that all in situ fluids are dosed and tested every six months to check for visible signs of degradation, change in pH and fluid concentration. As a rule and depending on product concentration, a fluid should have a pH between 7 and 10. For the fluid concentration, please refer to the product dilution table in this guide for the Refractive Index reading corresponding to the % volume.

Data centre cooling

Disclaimer

Information contained in this publication is accurate to the best of the knowledge and the belief of the company. It is expressly provided that the information relating to the use of the products is given for information purposes only. No guarantee is provided to the client that the product is adapted to the specific use for which the client intends it. The client should perform his own tests to determine the suitability for a particular purpose. Our only intention is to rapidly provide the user with information on the technical properties of our products, it being understood that the client should adapt the information to the specific conditions of their use. It should be consulted together with the instructions from the applicable hardware manufacturer and in accordance with local and/or national laws and regulations.

Non-Metallic Components

Proviflow® fluids are compatible with the following non-metallic materials.

Butyl Rubber	IIR
Ethylene/propylene/diene Rubber	EPDM
Fluorocarbon Rubber	FPM
Hydrogenated Nitrile Rubber	H-NBR
Natural Rubber (max +80˚C)	NR
Nitrile Butadiene Rubber (max +40˚C)	NBR
Polyamides	PA
Polychlorobutadiene	CR
Polyester Cross Linked	UP
Polyethylene (soft/hard)	LDPE/HDPE
Polypropylene	PP
Polytetrafluoroethylene	PTFE
Polyvinylchloride	PVC
Silicone Rubber	NIVQ
Styrene Butadiene Rubber (max 100˚C)	SBR

The above list is intended as a guide and compatibility is also dependent on the quality of these materials. The use of inferior products could result in the breakdown of the fluid and/or the materials.

ASTM D1384-05 Corrosion Standard

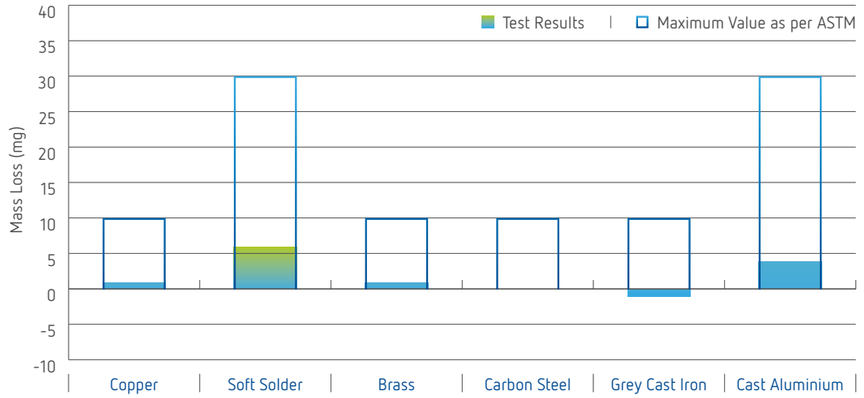
In order to back-up the efficiency of its comprehensive additive pack, all Proviflow® fluids have been tested independently to the ASTM D1384-05 corrosion standard.

The test comprises of a range of metals commonly used in heat transfer applications and these are immersed in a diluted solution of Proviflow® fluid using corrosive water. The metals are then tested over 336 hours at a temperature of 88˚C / 190˚F with the solution being constantly aerated to simulate in situ conditions. The metals are weighed before and after the test in order to measure any signs of corrosion that may have occurred during the test. In order to pass the test, the weights measured for each metal must stay within the tolerances stipulated in the test.

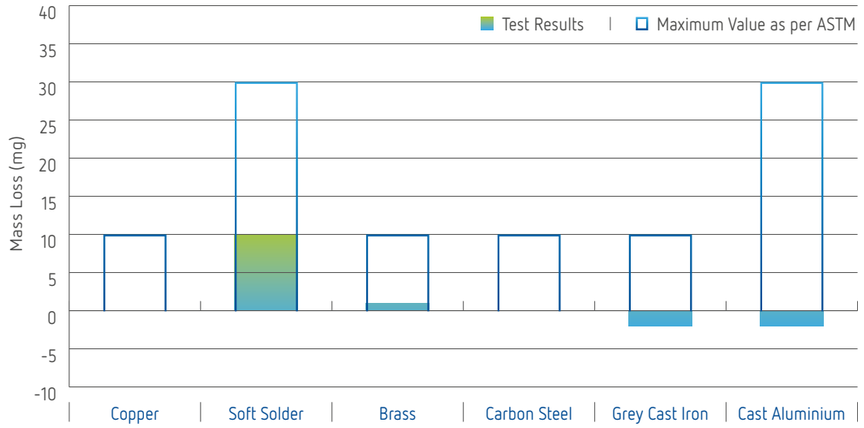
All Proviflow® fluids pass the ASTM D1384-05 and indeed far exceed its expectations on weight loss tolerance. Please see the results below.

Food and drink process cooling

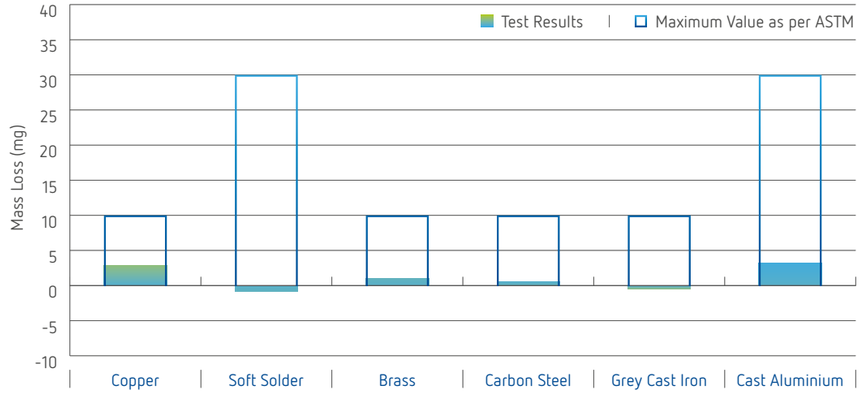
PROVIFLOW N RESULTS



PROVIFLOW L RESULTS



PROVIFLOW FG RESULTS



Specifications & Physical Properties

SPECIFICATIONS

	Unit	Proviflow® N	Proviflow® L	Proviflow® FG	Test Method
Refractive Index	N/A	1.429 - 1.433	1.430 - 1.435	1.430 – 1.435	ASTM D1747-09
Density	g/ml	1.105 - 1.115	1.040 - 1.050	1.048 – 1.058	ASTM D7042-11
	lb/gal	9.222 - 9.305	8.679 - 8.763	8.746 - 8.829	ASTM D7042-11
pH Range @ 50% v/v	N/A	7.5 - 10.0	7.5 - 10.0	7.5 - 10.0	ASTM E70-07

**All properties measured at 20˚C / 68˚F and in concentrate form unless otherwise stated*

PHYSICAL PROPERTIES

	Unit	Proviflow® N	Proviflow® L	Proviflow® FG	Test Method
Base Chemistry	N/A	MEG	MPG	MPG	N/A
Colour	N/A	On request	On request	On request	N/A
Temperature Range	˚C	-50 to +170	-45 to +160	-40 to +120	N/A
	˚F	-58 to +338	-54.4 to +320	-40 to +248	N/A
Boiling Point	˚C	ca. 174	ca. 160	ca. 160	ASTM D1120-11
	˚F				
Flash Point	˚C	124	115	110	ASTM D92
	˚F	255.2	239	230	
Kinematic Viscosity	mm^2/s	ca. 18	ca. 41	ca. 43	ASTM D7042-11
Reserve Alkalinity	ml	>10	>10	> 10	ASTM D1121

**All properties measured at 20˚C / 68˚F and in concentrate form unless otherwise stated*

Dilution

All Proviflow® products are concentrated fluids and must be diluted before use. The values in the table below are the freeze points for varying levels of dilution of Proviflow® products. Please refer to the level of freeze protection and freeze point required as indicated by the system manufacturer. Freeze points are determined based on the ASTM D1177 standard.

For an additional margin of protection, we kindly advise you to select a temperature in this table that is at least **3°C / 37.4°F lower** than the freeze point of the system. Contact us for more information.

Proviflow® N (based on mono ethylene glycol)					
Vol%	Wt%		Density @ 20°C	Density @ 68°F	R.I. @ 20°C/ 68°F
		°F	g/ml	lb/gal	
20	21.8	16.1	1.027	8.568	1.3540
21	22.8	15.1	1.028	8.580	1.3550
22	23.9	14.1	1.030	8.592	1.3561
23	25.0	13.1	1.031	8.604	1.3572
24	26.0	11.9	1.033	8.616	1.3583
25	27.1	10.8	1.034	8.628	1.3593
26	28.1	9.6	1.035	8.640	1.3604
27	29.2	8.3	1.037	8.652	1.3615
28	30.2	7.0	1.038	8.664	1.3625
29	31.3	5.6	1.040	8.676	1.3636
30	32.3	4.2	1.041	8.688	1.3647
31	33.4	2.7	1.042	8.699	1.3657
32	34.4	1.2	1.044	8.711	1.3668
33	35.4	-0.4	1.045	8.722	1.3678
34	36.5	-2.0	1.047	8.734	1.3689
35	37.5	-3.7	1.048	8.745	1.3699
36	38.5	-5.4	1.049	8.756	1.3710
37	39.5	-7.2	1.051	8.767	1.3720
38	40.6	-9.0	1.052	8.778	1.3731
39	41.6	-10.9	1.053	8.789	1.3741
40	42.6	-12.8	1.055	8.800	1.3752
41	43.6	-14.8	1.056	8.811	1.3762
42	44.6	-16.9	1.057	8.822	1.3772
43	45.7	-18.9	1.058	8.833	1.3783
44	46.7	-21.1	1.060	8.843	1.3793
45	47.7	-23.3	1.061	8.854	1.3803
46	48.7	-25.5	1.062	8.865	1.3814
47	49.7	-27.8	1.064	8.875	1.3824
48	50.7	-30.1	1.065	8.885	1.3834
49	51.7	-32.5	1.066	8.896	1.3844
50	52.7	-35.0	1.067	8.906	1.3854
51	53.7	-37.5	1.068	8.916	1.3865
52	54.7	-40.0	1.070	8.926	1.3875
53	55.7	-42.6	1.071	8.936	1.3885
54	56.7	-45.2	1.072	8.946	1.3895
55	57.7	-47.9	1.073	8.956	1.3905
56	58.6	-50.7	1.074	8.966	1.3915
57	59.6	-53.5	1.076	8.976	1.3925
58	60.6	-56.3	1.077	8.985	1.3935
59	61.6	-59.2	1.078	8.995	1.3945
60	62.6	-62.2	1.079	9.004	1.3955

Proviflow® L (based on mono propylene glycol)						
Vol%	Wt%	Freezing point		Density @ 20°C	Density @ 68°F	R.I. @ 20°C/ 68°F
		°C	°F	g/ml	lb/gal	
20	20.7	-6.9	19.5	1.016	8.474	1.3552
21	21.7	-7.4	18.7	1.017	8.483	1.3564
22	22.7	-7.8	17.9	1.018	8.491	1.3576
23	23.8	-8.3	17.0	1.019	8.500	1.3588
24	24.8	-8.8	16.1	1.020	8.508	1.3600
25	25.8	-9.4	15.1	1.020	8.516	1.3611
26	26.8	-9.9	14.1	1.021	8.524	1.3623
27	27.8	-10.6	13.0	1.022	8.531	1.3635
28	28.9	-11.2	11.9	1.023	8.539	1.3646
29	29.9	-11.9	10.6	1.024	8.546	1.3658
30	30.9	-12.6	9.4	1.025	8.554	1.3669
31	31.9	-13.3	8.1	1.026	8.561	1.3681
32	32.9	-14.1	6.7	1.027	8.568	1.3692
33	33.9	-14.8	5.3	1.028	8.575	1.3704
34	34.9	-15.7	3.8	1.028	8.582	1.3715
35	36.0	-16.5	2.3	1.029	8.589	1.3726
36	37.0	-17.4	0.7	1.030	8.595	1.3737
37	38.0	-18.3	-1.0	1.031	8.602	1.3749
38	39.0	-19.3	-2.7	1.031	8.608	1.3760
39	40.0	-20.2	-4.4	1.032	8.614	1.3771
40	41.0	-21.3	-6.3	1.033	8.620	1.3782
41	42.0	-22.3	-8.1	1.034	8.626	1.3793
42	43.0	-23.4	-10.0	1.034	8.632	1.3804
43	44.0	-24.5	-12.0	1.035	8.637	1.3815
44	45.0	-25.6	-14.1	1.036	8.643	1.3825
45	46.0	-26.8	-16.2	1.036	8.648	1.3836
46	47.0	-27.9	-18.3	1.037	8.653	1.3847
47	48.0	-29.2	-20.5	1.038	8.659	1.3858
48	49.0	-30.4	-22.8	1.038	8.664	1.3868
49	50.0	-31.7	-25.1	1.039	8.668	1.3879
50	51.0	-33.0	-27.4	1.039	8.673	1.3890
51	52.0	-34.4	-29.9	1.040	8.678	1.3900
52	53.0	-35.7	-32.3	1.040	8.682	1.3911
53	54.0	-37.2	-34.9	1.041	8.687	1.3921
54	55.0	-38.6	-37.5	1.041	8.691	1.3932
55	56.0	-40.1	-40.1	1.042	8.695	1.3942
56	57.0	-41.6	-42.8	1.042	8.699	1.3952
57	58.0	-43.1	-45.6	1.043	8.703	1.3962
58	59.0	-44.7	-48.4	1.043	8.706	1.3973
59	60.0	-46.2	-51.2	1.044	8.710	1.3983
60	61.0	-47.9	-54.2	1.044	8.713	1.3993

Proviflow® FG (based on mono propylene glycol)						
Vol%	Wt%	Freezing point		Density @ 20°C	Density @ 68°F	R.I. @ 20°C/ 68°F
		°C	°F	g/ml	lb/gal	
20.0	20.9	-7.3	18.9	1.018	8.499	1.3556
21.0	21.9	-7.7	18.1	1.020	8.508	1.3568
22.0	22.9	-8.2	17.3	1.021	8.518	1.3580
23.0	24.0	-8.7	16.4	1.022	8.527	1.3591
24.0	25.0	-9.2	15.5	1.023	8.537	1.3603
25.0	26.0	-9.7	14.5	1.024	8.546	1.3615
26.0	27.0	-10.3	13.4	1.025	8.555	1.3627
27.0	28.1	-11.0	12.3	1.026	8.564	1.3639
28.0	29.1	-11.6	11.1	1.027	8.572	1.3650
29.0	30.1	-12.3	9.8	1.028	8.581	1.3662
30.0	31.1	-13.0	8.5	1.029	8.589	1.3674
31.0	32.1	-13.8	7.2	1.030	8.598	1.3685
32.0	33.2	-14.6	5.7	1.031	8.606	1.3697
33.0	34.2	-15.4	4.3	1.032	8.614	1.3708
34.0	35.2	-16.3	2.7	1.033	8.622	1.3719
35.0	36.2	-17.2	1.1	1.034	8.630	1.3731
36.0	37.2	-18.1	-0.6	1.035	8.637	1.3742
37.0	38.2	-19.1	-2.3	1.036	8.645	1.3753
38.0	39.3	-20.1	-4.1	1.037	8.652	1.3765
39.0	40.3	-21.1	-6.0	1.038	8.660	1.3776
40.0	41.3	-22.2	-7.9	1.039	8.667	1.3787
41.0	42.3	-23.3	-9.9	1.039	8.674	1.3798
42.0	43.3	-24.4	-11.9	1.040	8.680	1.3809
43.0	44.3	-25.6	-14.0	1.041	8.687	1.3820
44.0	45.3	-26.8	-16.2	1.042	8.694	1.3831
45.0	46.3	-28.0	-18.4	1.043	8.700	1.3842
46.0	47.3	-29.3	-20.7	1.043	8.707	1.3852
47.0	48.3	-30.6	-23.0	1.044	8.713	1.3863
48.0	49.3	-31.9	-25.4	1.045	8.719	1.3874
49.0	50.3	-33.3	-27.9	1.046	8.725	1.3885
50.0	51.3	-34.7	-30.4	1.046	8.731	1.3895
51.0	52.3	-36.1	-33.0	1.047	8.736	1.3906
52.0	53.3	-37.6	-35.6	1.048	8.742	1.3916
53.0	54.3	-39.1	-38.3	1.048	8.747	1.3927
54.0	55.3	-40.6	-41.1	1.049	8.752	1.3937
55.0	56.3	-42.2	-43.9	1.049	8.757	1.3948
56.0	57.3	-43.8	-46.8	1.050	8.762	1.3958
57,0	58.3	-45.4	-49.8	1.051	8.767	1.3968
58,0	59.3	-47.1	-52.8	1.051	8.772	1.3978
59.0	60.3	-48.8	-55.9	1.052	8.777	1.3989
60.0	61.3	-50.6	-59.0	1.052	8.781	1.3999

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
60	-30	-22	1.119	0.401	2.933	65.9	58.9	313
	-20	-4	1.115	0.396	2.978	34.3	30.8	400
	-10	14	1.110	0.391	3.025	19.5	17.6	466
	0	32	1.105	0.385	3.073	12.0	10.8	516
	10	50	1.099	0.380	3.122	7.8	7.1	553
	20	68	1.093	0.374	3.17	5.4	4.9	581
	30	86	1.086	0.368	3.218	3.9	3.6	601
	40	104	1.080	0.362	3.265	2.9	2.7	615
	50	122	1.073	0.357	3.311	2.3	2.1	623
	60	140	1.066	0.351	3.357	1.8	1.7	628
	70	158	1.060	0.346	3.401	1.5	1.4	629
	80	176	1.053	0.340	3.445	1.2	1.2	628
	90	194	1.047	0.335	3.488	1.1	1.0	625
	100	212	1.040	0.330	3.529	0.9	0.9	620
	110	230	1.034	0.325	3.569	0.8	0.8	614
55	-30	-22	1.110	0.408	3.039	54.9	49.5	271
	-20	-4	1.106	0.406	3.079	28.9	26.1	361
	-10	14	1.102	0.403	3.121	16.6	15.1	431
	0	32	1.097	0.399	3.164	10.3	9.4	483
	10	50	1.091	0.395	3.207	6.8	6.2	523
	20	68	1.085	0.391	3.251	4.7	4.3	553
	30	86	1.079	0.387	3.295	3.4	3.2	575
	40	104	1.073	0.383	3.339	2.6	2.4	590
	50	122	1.067	0.378	3.382	2.0	1.9	600
	60	140	1.060	0.374	3.424	1.6	1.5	606
	70	158	1.054	0.370	3.466	1.3	1.3	609
	80	176	1.047	0.366	3.507	1.1	1.1	609
	90	194	1.041	0.361	3.546	1.0	0.9	607
	100	212	1.035	0.357	3.585	0.9	0.8	603
	110	230	1.028	0.353	3.623	0.8	0.7	598

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
50	-30	-22	1.100	0.416	3.145	45.7	41.6	228
	-20	-4	1.097	0.416	3.179	24.4	22.2	322
	-10	14	1.093	0.414	3.216	14.1	12.9	395
	0	32	1.088	0.413	3.254	8.8	8.1	451
	10	50	1.083	0.411	3.293	5.9	5.4	493
	20	68	1.078	0.408	3.333	4.1	3.8	525
	30	86	1.072	0.406	3.373	3.0	2.8	549
	40	104	1.066	0.403	3.413	2.3	2.2	566
	50	122	1.060	0.400	3.453	1.8	1.7	577
	60	140	1.054	0.397	3.492	1.5	1.4	585
	70	158	1.048	0.394	3.53	1.2	1.2	589
	80	176	1.041	0.391	3.568	1.0	1.0	590
	90	194	1.035	0.388	3.605	0.9	0.9	588
	100	212	1.029	0.385	3.642	0.8	0.8	585
	110	230	1.023	0.382	3.677	0.7	0.7	581
45	-20	-4	1.090	0.424	3.26	21.2	19.5	282
	-10	14	1.086	0.424	3.292	12.4	11.4	359
	0	32	1.082	0.424	3.326	7.8	7.2	417
	10	50	1.077	0.423	3.362	5.2	4.9	463
	20	68	1.072	0.422	3.399	3.7	3.4	497
	30	86	1.066	0.421	3.435	2.7	2.6	522
	40	104	1.061	0.419	3.472	2.1	2.0	541
	50	122	1.055	0.417	3.509	1.6	1.6	554
	60	140	1.049	0.415	3.546	1.3	1.3	563
	70	158	1.043	0.413	3.582	1.1	1.1	568
	80	176	1.037	0.411	3.618	1.0	0.9	570
	90	194	1.031	0.409	3.652	0.8	0.8	570
	100	212	1.025	0.407	3.687	0.7	0.7	568
	110	230	1.019	0.404	3.72	0.7	0.6	564

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
40	-20	-4	1.079	0.435	3.38	17.3	16.0	242
	-10	14	1.076	0.438	3.406	10.2	9.5	322
	0	32	1.072	0.441	3.435	6.5	6.1	384
	10	50	1.067	0.442	3.465	4.4	4.1	431
	20	68	1.063	0.443	3.497	3.1	3.0	468
	30	86	1.058	0.443	3.529	2.3	2.2	495
	40	104	1.052	0.444	3.561	1.8	1.7	516
	50	122	1.047	0.443	3.594	1.4	1.4	531
	60	140	1.041	0.443	3.627	1.2	1.1	541
	70	158	1.035	0.442	3.659	1.0	1.0	547
	80	176	1.030	0.441	3.691	0.9	0.8	550
	90	194	1.024	0.440	3.723	0.7	0.7	551
	100	212	1.019	0.439	3.754	0.7	0.7	550
	110	230	1.013	0.438	3.785	0.6	0.6	547
35	-10	14	1.069	0.448	3.483	9.0	8.4	284
	0	32	1.065	0.452	3.507	5.8	5.4	349
	10	50	1.061	0.455	3.534	3.9	3.7	400
	20	68	1.057	0.457	3.562	2.8	2.7	439
	30	86	1.052	0.459	3.591	2.1	2.0	468
	40	104	1.047	0.460	3.621	1.6	1.6	490
	50	122	1.041	0.461	3.651	1.3	1.3	507
	60	140	1.036	0.461	3.681	1.1	1.0	518
	70	158	1.031	0.462	3.711	0.9	0.9	526
	80	176	1.025	0.462	3.741	0.8	0.8	530
	90	194	1.020	0.461	3.77	0.7	0.7	532
	100	212	1.014	0.461	3.799	0.6	0.6	532
	110	230	1.009	0.461	3.828	0.6	0.6	530

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
33	-10	14	1.063	0.455	3.54	8.2	7.7	269
	0	32	1.060	0.460	3.561	5.3	5.0	335
	10	50	1.056	0.464	3.585	3.6	3.4	387
	20	68	1.052	0.467	3.611	2.6	2.5	427
	30	86	1.047	0.470	3.638	2.0	1.9	457
	40	104	1.043	0.472	3.665	1.5	1.5	480
	50	122	1.037	0.474	3.693	1.2	1.2	497
	60	140	1.032	0.475	3.721	1.0	1.0	509
	70	158	1.027	0.476	3.75	0.9	0.8	517
	80	176	1.022	0.477	3.778	0.7	0.7	522
	90	194	1.016	0.477	3.806	0.7	0.7	524
	100	212	1.011	0.478	3.833	0.6	0.6	525
	110	230	1.006	0.478	3.86	0.5	0.5	523
30	-10	14	1.058	0.462	3.597	7.4	7.0	246
	0	32	1.055	0.468	3.616	4.8	4.6	315
	10	50	1.052	0.473	3.637	3.3	3.2	368
	20	68	1.048	0.478	3.66	2.4	2.3	409
	30	86	1.043	0.481	3.684	1.8	1.7	441
	40	104	1.038	0.484	3.71	1.4	1.4	465
	50	122	1.034	0.487	3.736	1.2	1.1	483
	60	140	1.028	0.489	3.762	1.0	0.9	496
	70	158	1.023	0.490	3.788	0.8	0.8	504
	80	176	1.018	0.492	3.815	0.7	0.7	510
	90	194	1.013	0.493	3.841	0.6	0.6	513
	100	212	1.008	0.494	3.867	0.6	0.6	514
	110	230	1.003	0.495	3.893	0.5	0.5	513

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
25	-10	14	1.050	0.474	3.692	6.3	6.0	208
	0	32	1.047	0.482	3.706	4.1	4.0	279
	10	50	1.044	0.489	3.723	2.9	2.8	335
	20	68	1.040	0.495	3.742	2.1	2.0	379
	30	86	1.036	0.500	3.762	1.6	1.5	413
	40	104	1.032	0.504	3.784	1.3	1.2	439
	50	122	1.027	0.508	3.806	1.0	1.0	458
	60	140	1.022	0.512	3.829	0.9	0.8	472
	70	158	1.017	0.515	3.853	0.7	0.7	483
	80	176	1.012	0.517	3.876	0.6	0.6	489
	90	194	1.007	0.519	3.9	0.6	0.6	493
	100	212	1.002	0.521	3.923	0.5	0.5	495
	110	230	0.997	0.523	3.947	0.5	0.5	495
20	0	32	1.039	0.496	3.796	3.6	3.4	236
	10	50	1.036	0.505	3.809	2.5	2.4	295
	20	68	1.033	0.512	3.823	1.8	1.8	342
	30	86	1.029	0.519	3.84	1.4	1.4	378
	40	104	1.025	0.525	3.858	1.1	1.1	407
	50	122	1.020	0.530	3.877	0.9	0.9	428
	60	140	1.016	0.535	3.897	0.8	0.8	444
	70	158	1.011	0.539	3.917	0.7	0.7	456
	80	176	1.007	0.542	3.938	0.6	0.6	465
	90	194	1.002	0.546	3.959	0.5	0.5	470
	100	212	0.997	0.549	3.98	0.5	0.5	473
	110	230	0.992	0.551	4.001	0.4	0.4	474

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
60	-30	-22	1.073	0.369	3.387	270.6	252.3	272
	-20	-4	1.069	0.365	3.42	108.3	101.4	420
	-10	14	1.064	0.361	3.453	49.0	46.0	534
	0	32	1.058	0.358	3.485	24.5	23.2	623
	10	50	1.051	0.355	3.516	13.4	12.7	692
	20	68	1.043	0.353	3.546	7.9	7.5	745
	30	86	1.035	0.350	3.575	4.9	4.8	786
	40	104	1.027	0.348	3.603	3.3	3.2	816
	50	122	1.018	0.347	3.629	2.3	2.2	838
	60	140	1.010	0.345	3.655	1.6	1.6	854
	70	158	1.001	0.344	3.68	1.2	1.2	864
	80	176	0.993	0.343	3.704	1.0	1.0	870
	90	194	0.984	0.342	3.727	0.8	0.8	872
	100	212	0.975	0.341	3.75	0.6	0.6	872
	110	230	0.967	0.340	3.771	0.5	0.5	869
55	-30	-22	1.066	0.379	3.46	200.5	188.0	217
	-20	-4	1.063	0.377	3.489	82.8	77.8	370
	-10	14	1.059	0.376	3.519	38.5	36.3	488
	0	32	1.053	0.374	3.547	19.8	18.8	580
	10	50	1.047	0.373	3.575	11.0	10.6	652
	20	68	1.039	0.373	3.602	6.6	6.4	708
	30	86	1.032	0.372	3.628	4.3	4.1	751
	40	104	1.024	0.372	3.653	2.9	2.8	783
	50	122	1.016	0.371	3.677	2.0	2.0	807
	60	140	1.008	0.371	3.701	1.5	1.5	824
	70	158	0.999	0.371	3.724	1.1	1.1	836
	80	176	0.991	0.371	3.746	0.9	0.9	843
	90	194	0.983	0.371	3.767	0.7	0.7	846
	100	212	0.974	0.371	3.787	0.6	0.6	847
	110	230	0.966	0.372	3.807	0.5	0.5	845

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
50	-20	-4	1.058	0.389	3.559	63.2	59.8	319
	-10	14	1.054	0.390	3.584	30.2	28.7	442
	0	32	1.049	0.391	3.609	15.9	15.2	537
	10	50	1.042	0.392	3.634	9.1	8.8	612
	20	68	1.036	0.393	3.657	5.6	5.4	670
	30	86	1.029	0.394	3.681	3.7	3.6	715
	40	104	1.021	0.395	3.703	2.5	2.5	750
	50	122	1.013	0.396	3.725	1.8	1.8	775
	60	140	1.005	0.397	3.747	1.4	1.4	794
	70	158	0.997	0.398	3.767	1.1	1.1	807
	80	176	0.989	0.400	3.787	0.8	0.9	815
	90	194	0.981	0.401	3.806	0.7	0.7	820
	100	212	0.973	0.402	3.825	0.6	0.6	821
	110	230	0.965	0.403	3.843	0.5	0.5	820
45	-20	-4	1.052	0.402	3.628	48.3	45.9	268
	-10	14	1.049	0.404	3.649	23.7	22.6	395
	0	32	1.044	0.407	3.671	12.8	12.3	494
	10	50	1.038	0.410	3.692	7.5	7.3	572
	20	68	1.032	0.413	3.713	4.7	4.6	633
	30	86	1.025	0.416	3.734	3.2	3.1	680
	40	104	1.018	0.418	3.754	2.2	2.2	716
	50	122	1.011	0.421	3.773	1.6	1.6	743
	60	140	1.003	0.423	3.792	1.2	1.2	764
	70	158	0.996	0.426	3.811	1.0	1.0	778
	80	176	0.988	0.428	3.828	0.8	0.8	788
	90	194	0.980	0.430	3.846	0.7	0.7	793
	100	212	0.972	0.433	3.863	0.6	0.6	796
	110	230	0.965	0.435	3.879	0.5	0.5	796

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
40	-10	14	1.044	0.419	3.715	18.6	17.9	347
	0	32	1.039	0.424	3.733	10.4	10.0	450
	10	50	1.034	0.428	3.751	6.2	6.0	531
	20	68	1.028	0.433	3.769	4.0	3.9	595
	30	86	1.022	0.437	3.787	2.7	2.7	644
	40	104	1.015	0.441	3.804	2.0	1.9	682
	50	122	1.008	0.445	3.821	1.5	1.4	711
	60	140	1.001	0.449	3.838	1.1	1.1	733
	70	158	0.994	0.453	3.854	0.9	0.9	749
	80	176	0.986	0.457	3.87	0.7	0.8	760
	90	194	0.979	0.460	3.885	0.6	0.6	767
	100	212	0.971	0.463	3.9	0.5	0.6	770
	110	230	0.964	0.466	3.915	0.5	0.5	771
35	-10	14	1.039	0.433	3.78	14.6	14.1	299
	0	32	1.035	0.440	3.795	8.3	8.1	406
	10	50	1.030	0.447	3.81	5.1	5.0	490
	20	68	1.025	0.453	3.825	3.4	3.3	556
	30	86	1.019	0.459	3.84	2.4	2.3	608
	40	104	1.012	0.465	3.854	1.7	1.7	648
	50	122	1.006	0.470	3.869	1.3	1.3	679
	60	140	0.999	0.475	3.883	1.0	1.0	703
	70	158	0.992	0.480	3.898	0.8	0.8	720
	80	176	0.985	0.485	3.911	0.7	0.7	732
	90	194	0.977	0.490	3.925	0.6	0.6	740
	100	212	0.970	0.494	3.938	0.5	0.5	745
	110	230	0.963	0.498	3.951	0.5	0.5	747

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
33	-10	14	1.036	0.439	3.806	26.7	25.8	280
	0	32	1.033	0.447	3.819	14.0	13.5	388
	10	50	1.029	0.454	3.833	8.0	7.8	474
	20	68	1.023	0.461	3.847	4.9	4.8	541
	30	86	1.018	0.468	3.861	3.3	3.2	594
	40	104	1.011	0.474	3.875	2.3	2.3	635
	50	122	1.005	0.480	3.888	1.7	1.7	666
	60	140	0.998	0.486	3.902	1.3	1.3	690
	70	158	0.991	0.491	3.915	1.0	1.0	708
	80	176	0.984	0.496	3.928	0.8	0.8	721
	90	194	0.977	0.501	3.941	0.7	0.7	729
	100	212	0.970	0.506	3.953	0.6	0.6	735
	110	230	0.963	0.511	3.965	0.5	0.5	737
30	-10	-14	1.033	0.448	3.845	11.5	11.1	251
	0	32	1.030	0.457	3.857	6.7	6.5	361
	10	50	1.026	0.465	3.868	4.2	4.1	449
	20	68	1.021	0.473	3.88	2.9	2.8	518
	30	86	1.016	0.481	3.893	2.0	2.0	572
	40	104	1.010	0.488	3.905	1.5	1.5	614
	50	122	1.003	0.495	3.917	1.2	1.2	647
	60	140	0.997	0.501	3.929	0.9	0.9	672
	70	158	0.990	0.507	3.941	0.8	0.8	691
	80	176	0.983	0.513	3.953	0.7	0.7	704
	90	194	0.976	0.519	3.964	0.6	0.6	713
	100	212	0.969	0.525	3.976	0.5	0.5	719
	110	230	0.962	0.530	3.987	0.5	0.5	722

Concentrate % v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/m K)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K⁻¹ (10⁻⁶/°C)
25	0	32	1.026	0.473	3.918	5.4	5.3	316
	10	50	1.022	0.483	3.927	3.5	3.4	407
	20	68	1.017	0.493	3.936	2.4	2.4	479
	30	86	1.012	0.502	3.946	1.8	1.7	535
	40	104	1.007	0.511	3.955	1.3	1.3	580
	50	122	1.001	0.519	3.965	1.1	1.0	614
	60	140	0.994	0.527	3.975	0.9	0.9	641
	70	158	0.988	0.535	3.985	0.7	0.7	661
	80	176	0.981	0.542	3.994	0.6	0.6	676
	90	194	0.975	0.549	4.004	0.5	0.6	687
	100	212	0.968	0.555	4.013	0.5	0.5	694
	110	230	0.961	0.561	4.023	0.5	0.5	697
20	0	14	1.021	0.490	3.98	4.4	4.3	271
	10	32	1.018	0.502	3.986	2.9	2.8	365
	20	50	1.014	0.513	3.992	2.0	2.0	440
	30	68	1.009	0.524	3.999	1.5	1.5	499
	40	104	1.004	0.534	4.006	1.2	1.2	545
	50	122	0.998	0.544	4.013	0.9	0.9	582
	60	140	0.992	0.553	4.02	0.8	0.8	610
	70	158	0.986	0.562	4.028	0.7	0.7	632
	80	176	0.980	0.570	4.036	0.6	0.6	648
	90	194	0.973	0.578	4.043	0.5	0.5	660
	100	212	0.967	0.586	4.051	0.5	0.5	668
	110	230	0.960	0.593	4.059	0.4	0.5	673

Concentrate %v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/mK)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K-1 (10-6/°C)
60	-30	-22	1.075	0.366	3.364	296.9	276.3	289
	-20	-4	1.071	0.361	3.399	117.8	110.0	435
	-10	14	1.065	0.357	3.433	52.8	49.5	548
	0	32	1.059	0.353	3.466	26.2	24.7	636
	10	50	1.052	0.349	3.498	14.2	13.5	704
	20	68	1.044	0.346	3.529	8.3	7.9	757
	30	86	1.036	0.344	3.558	5.2	5.0	797
	40	104	1.028	0.341	3.587	3.4	3.3	826
	50	122	1.019	0.339	3.615	2.3	2.3	848
	60	140	1.011	0.337	3.641	1.7	1.7	863
	70	158	1.002	0.336	3.667	1.3	1.3	873
	80	176	0.993	0.334	3.691	1.0	1.0	879
	90	194	0.984	0.333	3.715	0.8	0.8	881
	100	212	0.976	0.331	3.738	0.6	0.6	880
	110	230	0.967	0.330	3.76	0.5	0.5	877
55	-30	-22	1.068	0.376	3.438	219.3	205.2	234
	-20	-4	1.065	0.373	3.469	89.7	84.2	385
	-10	14	1.060	0.371	3.499	41.3	39.0	502
	0	32	1.054	0.369	3.529	21.1	20.0	593
	10	50	1.048	0.368	3.557	11.7	11.2	664
	20	68	1.041	0.367	3.585	7.0	6.7	719
	30	86	1.033	0.366	3.612	4.4	4.3	761
	40	104	1.025	0.365	3.638	3.0	2.9	793
	50	122	1.017	0.364	3.663	2.1	2.1	816
	60	140	1.008	0.364	3.687	1.5	1.5	833
	70	158	1.000	0.363	3.711	1.2	1.2	844
	80	176	0.991	0.363	3.733	0.9	0.9	851
	90	194	0.983	0.363	3.755	0.7	0.7	854
	100	212	0.975	0.362	3.776	0.6	0.6	854
	110	230	0.966	0.362	3.796	0.5	0.5	852

Concentrate %v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/mK)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K-1 (10-6/°C)
50	-20	-4	1.059	0.386	3.539	68.1	64.3	333
	-10	14	1.055	0.386	3.566	32.3	30.6	455
	0	32	1.050	0.386	3.592	16.9	16.1	549
	10	50	1.044	0.387	3.617	9.6	9.2	623
	20	68	1.037	0.387	3.642	5.9	5.7	681
	30	86	1.030	0.388	3.666	3.8	3.7	725
	40	104	1.022	0.388	3.689	2.6	2.6	759
	50	122	1.014	0.389	3.712	1.9	1.8	784
	60	140	1.006	0.390	3.734	1.4	1.4	802
	70	158	0.998	0.391	3.755	1.1	1.1	815
	80	176	0.990	0.392	3.775	0.9	0.9	823
	90	194	0.982	0.393	3.795	0.7	0.7	827
	100	212	0.974	0.393	3.814	0.6	0.6	828
	110	230	0.966	0.394	3.833	0.5	0.5	827
45	-20	-4	1.054	0.399	3.61	51.7	49.1	281
	-10	14	1.050	0.401	3.633	25.2	24.0	407
	0	32	1.045	0.403	3.655	13.6	13.0	505
	10	50	1.039	0.405	3.677	7.9	7.6	582
	20	68	1.033	0.408	3.699	4.9	4.8	642
	30	86	1.026	0.410	3.72	3.3	3.2	689
	40	104	1.019	0.412	3.741	2.3	2.3	725
	50	122	1.011	0.414	3.761	1.7	1.7	751
	60	140	1.004	0.417	3.781	1.3	1.3	771
	70	158	0.996	0.419	3.8	1.0	1.0	785
	80	176	0.988	0.421	3.818	0.8	0.8	795
	90	194	0.980	0.423	3.836	0.7	0.7	800
	100	212	0.973	0.425	3.853	0.6	0.6	802
	110	230	0.965	0.427	3.87	0.5	0.5	802

Concentrate %v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/mK)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K-1 (10-6 /°C)
40	-10	14	1.045	0.416	3.7	19.7	18.9	358
	0	32	1.040	0.420	3.719	10.9	10.4	460
	10	50	1.035	0.424	3.738	6.5	6.3	540
	20	68	1.029	0.428	3.756	4.2	4.0	603
	30	86	1.023	0.432	3.775	2.8	2.8	652
	40	104	1.016	0.436	3.793	2.0	2.0	690
	50	122	1.009	0.440	3.81	1.5	1.5	719
	60	140	1.002	0.443	3.827	1.2	1.2	740
	70	158	0.994	0.447	3.844	0.9	0.9	756
	80	176	0.987	0.450	3.861	0.8	0.8	766
	90	194	0.979	0.453	3.876	0.6	0.7	773
	100	212	0.971	0.456	3.892	0.5	0.6	776
	110	230	0.964	0.459	3.907	0.5	0.5	777
35	-10	14	1.039	0.431	3.767	15.3	14.8	309
	0	32	1.036	0.437	3.783	8.7	8.4	415
	10	50	1.031	0.443	3.798	5.3	5.2	498
	20	68	1.026	0.449	3.814	3.5	3.4	564
	30	86	1.019	0.455	3.829	2.4	2.4	615
	40	104	1.013	0.460	3.845	1.8	1.7	655
	50	122	1.006	0.465	3.86	1.3	1.3	685
	60	140	0.999	0.470	3.875	1.1	1.1	709
	70	158	0.992	0.475	3.889	0.9	0.9	725
	80	176	0.985	0.480	3.903	0.7	0.7	737
	90	194	0.978	0.484	3.917	0.6	0.6	745
	100	212	0.970	0.488	3.931	0.5	0.5	750
	110	230	0.963	0.492	3.944	0.5	0.5	751

Concentrate %v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/mK)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K-1 (10-6 /°C)
33	-10	14	1.037	0.437	3.795	13.9	13.4	289
	0	32	1.034	0.444	3.809	8.0	7.7	396
	10	50	1.029	0.451	3.823	4.9	4.8	481
	20	68	1.024	0.457	3.837	3.3	3.2	548
	30	86	1.018	0.464	3.851	2.3	2.2	600
	40	104	1.012	0.470	3.866	1.7	1.7	641
	50	122	1.005	0.476	3.88	1.3	1.3	672
	60	140	0.998	0.481	3.894	1.0	1.0	696
	70	158	0.991	0.486	3.907	0.8	0.8	713
	80	176	0.984	0.491	3.921	0.7	0.7	726
	90	194	0.977	0.496	3.934	0.6	0.6	734
	100	212	0.970	0.501	3.946	0.5	0.5	739
	110	230	0.963	0.505	3.959	0.5	0.5	741
30	-10	14	1.034	0.446	3.835	11.9	11.5	258
	0	32	1.031	0.454	3.847	7.0	6.7	368
	10	50	1.027	0.462	3.859	4.4	4.3	455
	20	68	1.022	0.470	3.872	2.9	2.9	524
	30	86	1.016	0.477	3.884	2.1	2.0	577
	40	104	1.010	0.484	3.897	1.5	1.5	619
	50	122	1.004	0.491	3.91	1.2	1.2	652
	60	140	0.997	0.497	3.922	1.0	1.0	677
	70	158	0.990	0.503	3.934	0.8	0.8	695
	80	176	0.983	0.509	3.946	0.7	0.7	708
	90	194	0.976	0.515	3.958	0.6	0.6	718
	100	212	0.969	0.520	3.97	0.5	0.5	723
	110	230	0.962	0.525	3.981	0.5	0.5	726

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Concentrate %v/v	Temperature (°C)	Temperature (°F)	Density (g/cm³)	Thermal Conductivity (W/mK)	Specific Heat (kJ/kg J)	Dynamic Viscosity (mPa.s)	Kinematic Viscosity (mm²/s)	Thermal Expansion K-1 (10-6 /°C)
25	0	32	1.026	0.471	3.912	5.6	5.4	321
	10	50	1.022	0.481	3.921	3.6	3.5	412
	20	68	1.018	0.491	3.93	2.5	2.4	483
	30	86	1.013	0.500	3.94	1.8	1.8	539
	40	104	1.007	0.509	3.95	1.3	1.3	584
	50	122	1.001	0.517	3.96	1.1	1.1	618
	60	140	0.995	0.524	3.97	0.9	0.9	645
	70	158	0.988	0.532	3.98	0.7	0.7	665
	80	176	0.982	0.539	3.99	0.6	0.6	679
	90	194	0.975	0.546	4	0.6	0.6	690
	100	212	0.968	0.552	4.009	0.5	0.5	696
	110	230	0.961	0.558	4.019	0.5	0.5	700
20	0	32	1.021	0.489	3.977	4.4	4.3	274
	10	50	1.018	0.501	3.982	2.9	2.9	367
	20	68	1.014	0.512	3.989	2.1	2.0	442
	30	86	1.009	0.523	3.995	1.5	1.5	501
	40	104	1.004	0.533	4.003	1.2	1.2	547
	50	122	0.998	0.543	4.01	0.9	0.9	584
	60	140	0.992	0.552	4.018	0.8	0.8	612
	70	158	0.986	0.560	4.026	0.7	0.7	634
	80	176	0.980	0.569	4.033	0.6	0.6	650
	90	194	0.973	0.577	4.041	0.5	0.5	661
	100	212	0.967	0.584	4.049	0.5	0.5	669
	110	230	0.961	0.591	4.057	0.4	0.5	674

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