THERMINOL® LT

Heat Transfer Fluids By SOLUTIA™

Applied Chemistry, Creative Solutions

LT

Combined Heating & Cooling Liquid and Vapour Phase Heat Transfer Fluid

-73°C to 315°C

+400°C
+350°C
+300°C
+250°C
+200°C
+150°C
+100°C
+50°C
+0°C
-50°C
-100°C

TM

Properties of Therminol® LT vs Temperatures - Liquid Phase

Temperature	Density	Thermal Conductivity	Heat Capacity	Viscosity		Vapour pressure (absolute)	Enthalpy	Latent Heat vap.
				Dynamic	Kinematic			
°C	kg/m³	W/m.K	kJ/kg.K	mPa.s	mm²/s**	kPa*	kJ/kg	kJ/kg
-75	939	0.1429	1.432	11.02	11.73	-	-118.5	493.8
-70	936	0.1420	1.452	8.53	9.12	-	-111.3	490.4
-60	928	0.1401	1.492	5.51	5.94	-	-96.5	483.7
-50	920	0.1382	1.532	3.84	4.17	-	-81.4	477.0
-40	913	0.1362	1.571	2.84	3.11	-	-65.9	470.4
-30	905	0.1343	1.610	2.19	2.42	-	-50.0	463.8
-20	897	0.1324	1.649	1.74	1.95	-	-33.7	457.2
-10	889	0.1305	1.687	1.43	1.61	-	-17.0	450.7
0	882	0.1285	1.725	1.20	1.37	-	0.0	444.1
10	874	0.1266	1.763	1.02	1.18	-	17.5	437.7
20	866	0.1246	1.801	0.88	1.03	0.1	35.3	431.3
30	858	0.1227	1.838	0.77	0.91	0.2	53.5	424.9
40	850	0.1207	1.875	0.69	0.81	0.4	72.1	418.5
50	842	0.1188	1.912	0.61	0.73	0.7	91.0	412.2
60	833	0.1168	1.949	0.55	0.67	1.2	110.3	405.9
70	825	0.1148	1.985	0.50	0.61	1.9	130.0	399.7
80	817	0.1129	2.022	0.45	0.56	3.1	150.0	393.5
90	808	0.1109	2.058	0.41	0.52	4.7	170.4	387.3
100	800	0.1089	2.093	0.38	0.48	7.1	191.2	381.1
110	791	0.1069	2.129	0.35	0.45	10.5	212.3	375.0
120	782	0.1049	2.164	0.32	0.42	15.3	233.7	368.8
130	773	0.1029	2.200	0.30	0.39	21.7	255.6	362.7
140	764	0.1009	2.235	0.28	0.37	30.3	277.7	356.5
150	755	0.0989	2.270	0.26	0.35	41.5	300.2	350.4
160	746	0.0968	2.305	0.24	0.33	56.1	323.1	344.1
170	736	0.0948	2.340	0.23	0.31	74.8	346.3	337.9
180	727	0.0928	2.375	0.21	0.30	98.4	369.9	331.6
190	717	0.0908	2.410	0.20	0.28	128	393.8	325.1
200	707	0.0887	2.445	0.19	0.27	164	418.1	318.6
210	696	0.0867	2.481	0.18	0.26	209	442.7	312.0
220	685	0.0846	2.517	0.17	0.25	262	467.7	305.1
230	674	0.0826	2.554	0.16	0.24	327	493.1	298.1
240	663	0.0805	2.592	0.15	0.23	404	518.8	290.9
250	651	0.0784	2.631	0.14	0.22	495	544.9	283.4
260	639	0.0763	2.673	0.14	0.22	601	571.5	275.6
270	626	0.0742	2.717	0.13	0.21	725	598.4	267.4
280	613	0.0722	2.765	0.13	0.20	869	625.8	258.7
290	598	0.0701	2.818	0.12	0.20	1030	653.7	249.4
300	583	0.0688	2.881	0.11	0.20	1220	682.2	239.4
310	567	0.0658	2.957	0.11	0.19	1440	711.4	228.5
320	550	0.0637	3.056	0.10	0.19	1680	741.4	216.2
330	531	0.0616	3.196	0.10	0.19	1950	772.6	202.2
340	509	0.0595	3.415	0.10	0.19	2260	805.6	185.3

* 1 bar = 100 kPa - ** 1 mm²/s = 1 cSt

Note: Values quoted are typical values obtained in the laboratory from production samples. Other samples might exhibit slightly different data. Specifications are subject to change. Write to Solutia for current sales specifications.

Physical Property Formulae of Liquid

Density (kg/m³) = $882.19 - 0.8019 * T(°C) - 0.00045187 * T^2(°C) + 2.73 * 10^{-6} * T^3(°C) - 1.143 * 10^{-8} * T^4(°C)$

Heat Capacity (kJ/kg.K) = $1.71231 + 0.00414607 * T(°C) + 3.39821 * 10^{-6} * T^2(°C) - 6.97152 * 10^{-8} * T^3(°C) + 1.90546 * 10^{-10} * T^4(°C)$

Thermal Conductivity (W/m.K) = $0.128527 - 1.93753 * 10^{-4} * T(°C) - 2.36955 * 10^{-8} * T^2(°C) - 1.52223 * 10^{-11} * T^3(°C)$

Kinematic Viscosity (mm²/s) = $e^{\left(\frac{575.118}{T(°C)+185} - 2.79221\right)}$

Vapour pressure (kPa) = $e^{\left(\frac{-4934.56}{T(°C)+250} + 16.0724\right)}$

Enthalpy (kJ/kg) = $1.714 * T(°C) + 0.00188 * T^2(°C) + 0.25383$

Latent Heat Vaporisation (kJ/kg) = $441.122 - 0.496361 * T(°C) - 0.00197371 * T^2(°C) + 1.17517 * 10^{-5} * T^3(°C) - 2.38633 * 10^{-8} * T^4(°C)$

Properties of Therminol® LT vs Temperatures - Vapour Phase

Temperature °C	Density kg/m³	Heat Capacity kJ/kg.K	Enthalpy kJ/kg	Viscosity Dynamic mPa.s	Thermal Conductivity W/m.K
-75	-	0.759	-68.9	-	-
-70	-	0.780	-65.0	-	-
-60	-	0.823	-57.0	-	-
-50	-	0.865	-48.6	-	-
-40	-	0.908	-39.7	-	-
-30	0.0001	0.950	-30.4	0.00527	0.0075
-20	0.0003	0.992	-20.7	0.00549	0.0080
-10	0.0007	1.035	-10.6	0.00571	0.0086
0	0.0016	1.077	0.0	0.00593	0.0092
10	0.0032	1.119	11.0	0.00615	0.0098
20	0.0062	1.160	22.4	0.00638	0.0104
30	0.0115	1.202	34.2	0.00660	0.0110
40	0.0203	1.243	46.4	0.00682	0.0117
50	0.0345	1.284	59.0	0.00705	0.0123
60	0.0566	1.325	72.0	0.00727	0.0130
70	0.0901	1.366	85.5	0.00750	0.0136
80	0.140	1.406	99.3	0.00772	0.0143
90	0.210	1.446	113.5	0.00795	0.0150
100	0.310	1.486	128.1	0.00818	0.0157
110	0.446	1.525	143.0	0.00840	0.0164
120	0.631	1.564	158.4	0.00863	0.0171
130	0.875	1.603	174.0	0.00885	0.0178
140	1.19	1.642	190.1	0.00908	0.0185
150	1.61	1.680	206.4	0.00930	0.0193
160	2.13	1.719	223.1	0.00952	0.0200
170	2.79	1.757	240.2	0.00975	0.0208
180	3.60	1.794	257.3	0.00997	0.0216
190	4.61	1.832	274.8	0.01020	0.0223
200	5.84	1.870	292.5	0.01040	0.0231
210	7.33	1.907	310.5	0.01060	0.0239
220	9.13	1.945	328.7	0.01080	0.0248
230	11.3	1.983	347.0	0.01110	0.0256
240	13.9	2.021	365.5	0.01130	0.0264
250	16.9	2.059	384.1	0.01150	0.0273
260	20.6	2.099	402.8	0.01170	0.0281
270	24.9	2.139	421.6	0.01190	0.0290
280	30.0	2.181	440.3	0.01220	0.0299
290	36.0	2.226	458.9	0.01240	0.0308
300	43.3	2.274	477.4	0.01260	0.0316
310	52.0	2.328	495.6	0.01280	0.0326
320	62.6	2.392	513.4	0.01300	0.0335
330	75.9	2.473	530.6	0.01320	0.0344
340	92.9	2.591	546.7	0.01340	0.0354

Note: Values quoted are typical values obtained in the laboratory from production samples. Other samples might exhibit slightly different data. Specifications are subject to change. Write to Solutia for current sales specifications.

Physical Property Formulae of Vapour

Density (kg/m^3) = $-0.197869 + 0.00708193 * T(°C) + 3.47386 * 10^{-4} * T^2(°C) - 1.03253 * 10^{-5} * T^3(°C) + 9.43717 * 10^{-8} * T^4(°C) - 3.34431 * 10^{-10} * T^5(°C) + 4.62282 * 10^{-13} * T^6(°C)$

Heat Capacity (kJ/kg.K) = $1.07153 + 0.0039614 * T(°C) + 7.46674 * 10^{-6} * T^2(°C) - 6.40207 * 10^{-8} * T^3(°C) + 1.33709 * 10^{-10} * T^4(°C)$

Enthalpy (kJ/kg) = $0,21193 + 1.08534 * T(°C) + 0.00175373 * T^2(°C) + 2.49012 * 10^{-6} T^3(°C) - 9.1283 * 10^{-9} * T^4(°C)$

Dynamic Viscosity (mPa.s) = $0.005932 + 2.2339 * 10^{-5} * T(°C) + 2.6967 * 10^{-9} * T^2 - 9.941 * 10^{-12} * T^3(°C)$

Thermal Conductivity (W/m.K) = $0.00920674 + 5.94023 * 10^{-5} * T(°C) + 5.14857 * 10^{-8} * T^2(°C)$

«Single Fluid» Combined Cycle Heating and Cooling Systems

Cycling temperatures through a wide temperature range in batch reaction processes, for example in small industrial or pilot scale production units, requires a heat transfer fluid with unique characteristics.

Until recently, the solution to these problems in combined heating and cooling systems operating over a wide temperature range has been relied on «twin loop» systems, with two independent fluids - usually high pressure steam for the heating, and brine for the cooling loop.

Therminol LT offers design and production engineers an unrivalled choice, meeting their demands for efficiency and providing significant overall cost benefits when batch processing fine chemicals and pharmaceutical multi-purpose plants.

Therminol LT has a number of practical advantages when used as a single fluid in dual-purpose heat transfer systems :

Closed loop systems with wide temperature range

Therminol LT can be used in combined closed loop systems, to provide full heating and cooling capacity with the single fluid. This is a major advantage when compared with the «twin-fluid/twin-loop» concept, such as with steam/brine or steam/water-glycol, where flushing is required between cycles.

Reliable low temperature pumpability

Thermal degradation under operating conditions will not significantly alter the viscosity and pour point of the used fluid. The selection of -73°C for Therminol LT minimum use temperature ensures that low temperature pumpability should always remain satisfactory in a well designed and maintained system.

Corrosion inhibitors not needed

Therminol LT heat transfer fluid is non corrosive to carbon steel and common alloys of construction. The need for the addition of costly and sometimes troublesome corrosion inhibitors, and in-service monitoring of inhibitors level is therefore avoided.

Typical Design - Heating and Cooling of Single User with one Fluid

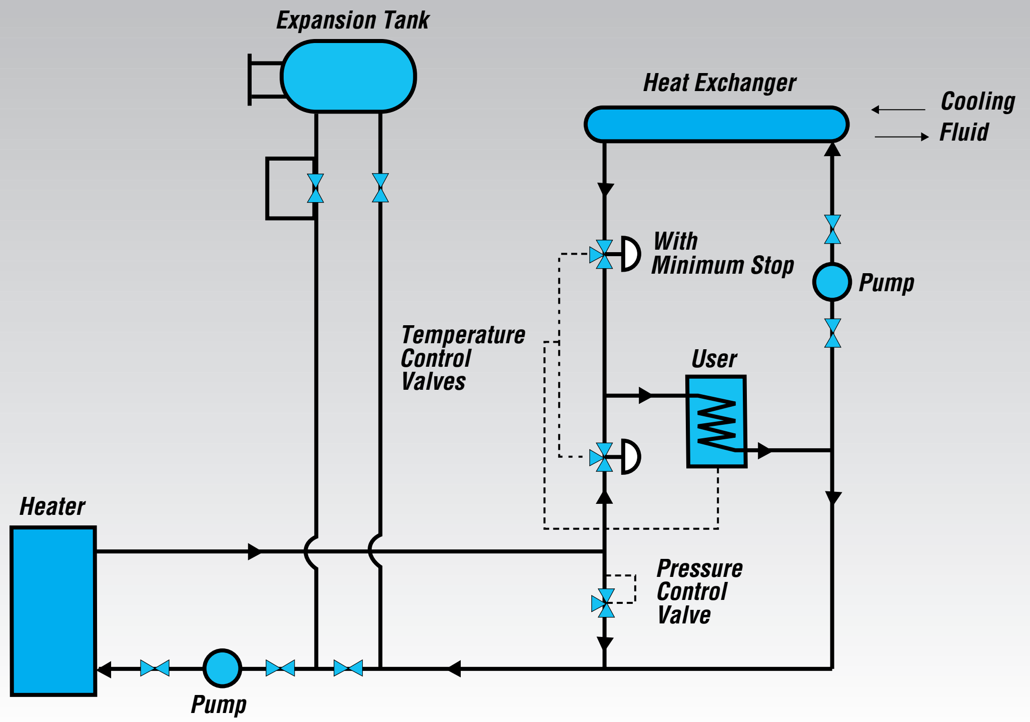
The figure 1 shows a dual system for heating and cooling, using two separate circulating systems for a common user.

The temperature controller output is connected in a split range manner to the cold heat transfer fluid control valve. As the output increases from 0-55%, the cold fluid valve closes (with a minimum stop to prevent deadheading the cooling zone pump).

As the output increases from 45-100%, the hot fluid valve opens. The pressure control valve maintains a minimum flow through the heater in all conditions.

Even with the slight overlap in the cold and hot fluid valve ranges, this design operates with a minimum of interchange between the two circulating systems.

Fig. 1



Therminol LT is a synthetic organic heat transfer fluid for combined heating/cooling use in the liquid phase from -73°C up to 180°C and up to 315°C in vapour phase with pressurisation.

Therminol LT offers designers and users of liquid phase heat transfer systems a fluid with excellent thermal stability, freedom from coking and sludging problems, and low maintenance cost over extended periods of operation.

Therminol LT also has outstanding low temperature viscosity characteristics ensuring excellent pumpability and easy system start-up at temperatures down to -73°C, without the need for electrical tracing.

This fluid is suited for processes involving endothermic and exothermic reactions with combined heating and cooling cycles in the same reactor, e.g. in fine chemicals.

Thermal Stability

The thermal stability of a heat transfer fluid is one of the most important considerations in the selection of a fluid for operation under specific heat transfer conditions.

Fluids such as Therminol LT developed for use in single fluid combined heating and cooling systems, are generally selected with a good balance between low temperature pumpability and heat transfer properties and the ability to provide adequate heat input to the process.

Nevertheless proper design of fired or electrical heaters and of heat exchangers is an important aspect for the achievement of fluid performance and extended life, and bearing this in mind, the maximum bulk and film temperatures recommended for Therminol LT are based on a combination of industrial experience and specific thermal studies with the aim of providing long fluid life and trouble free systems operation, without the risk of fouling or deposits.

Therminol LT remains liquid and can, due to the excellent viscosity, be easily pumped at temperatures down to -75°C.

Typical Physical, Chemical and Thermal Properties of Therminol LT

Composition		Alkyl substituted aromatic
Appearance		Clear light yellow liquid
Max. bulk temperature		315°C
Max. film temperature		340°C
Kinematic viscosity @ 40°C	DIN 51562 - 1	0.81 mm^2/s (cSt)
Density @ 15°C	DIN 51757	870 kg/m^3
Flash point	DIN EN 22719	58°C
Fire point	ISO 2592	66°C
Autoignition temperature	DIN 51794	429°C
Pour point	ISO 3016	-75°C
Boiling point @ 1013 mbar		181°C
Coefficient of thermal expansion		0.00108/°C
Moisture content	DIN 51777 - 1	< 80 ppm
Total acidity	DIN 51558 - 1	< 0.2 mg KOH/g
Chlorine content	DIN 51577 - 3	< 10 ppm
Copper corrosion	EN ISO 2160	<< 1a
Average molecular weight		134

Note: Values quoted are typical values obtained in the laboratory from production samples. Other samples might exhibit slightly different data. Specifications are subject to change. Write to Solutia for current sales specifications.

Moisture Removal from Therminol® LT Cooling Systems

For heat transfer fluids used in cooling systems, it is important to prevent the chiller heat exchanger surface from being coated by ice. This icing will reduce the efficiency of the chiller and can occasionally cause blockage in the system piping.

Various methods of moisture removal are presented in the following sections.

Free water removal

If moisture is present in the system after the Therminol LT is charged to the system, the moisture is often above the saturation level. This free water can be removed by opening the system low-point drains periodically after brief system circulation. The water should be allowed to settle for at least one hour before the low-point drains are checked for moisture.

Once the system is in operation, low levels of free water can be removed by filtration of ice particles in 100 mesh strainers.

After the free water is removed, the moisture level is at the saturation level (see figure 2). Sometimes also, the soluble moisture may cause icing problems in the cooling system.

Saturated water removal

The saturated moisture drying of Therminol LT in the system can be accomplished by molecular sieves.

The molecular sieves are placed in a side stream for bypass flow control.

Free water will saturate the molecular sieves, which will require frequent molecular sieve replacement or regeneration.

System Design

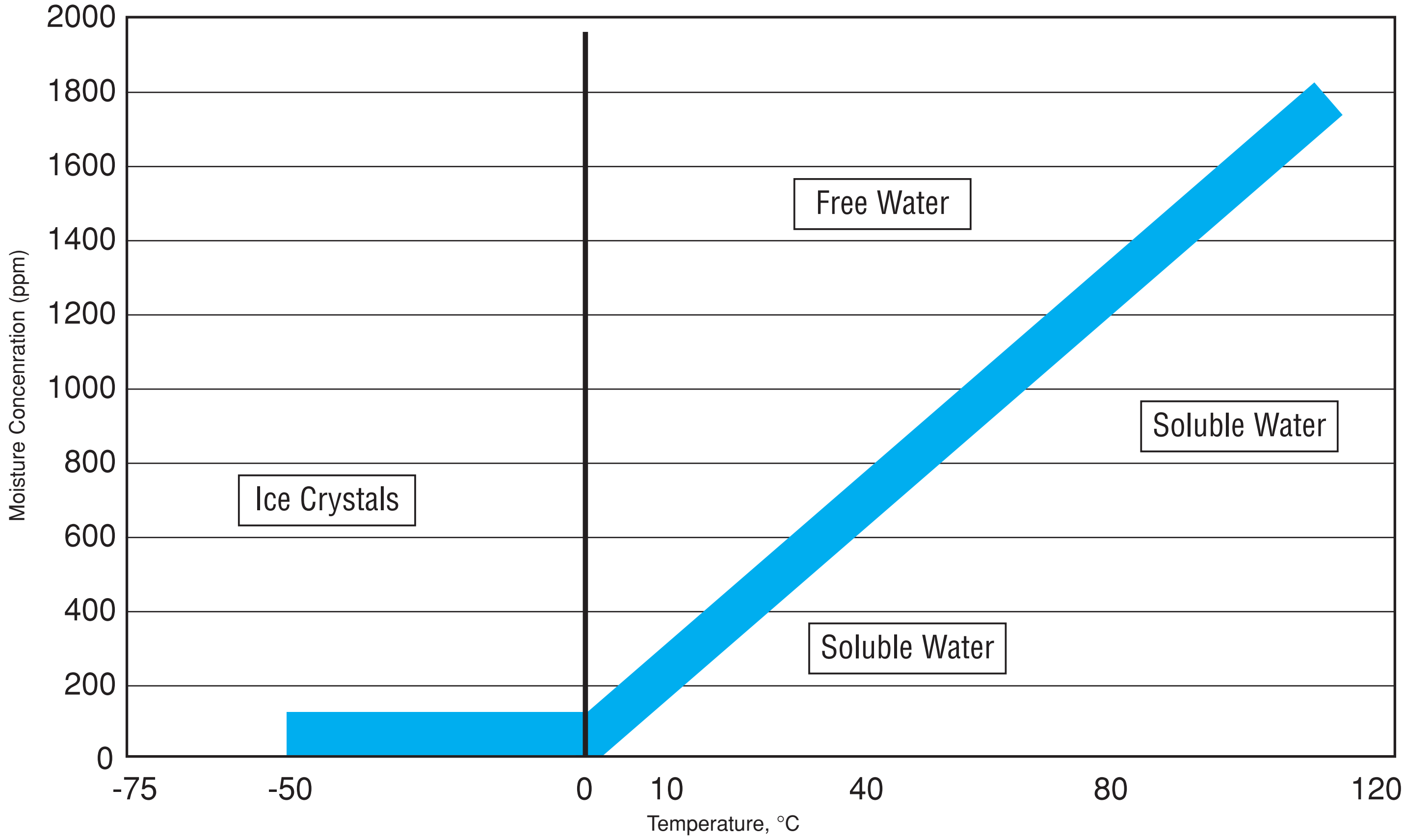
For operation in the typical unpressurised bulk fluid temperature range from -73°C to 180°C, standard reactor and heat exchanger designs together with pipework, valves, gaskets and seals specification appropriate to both heating and cooling give satisfactory service.

For pressurised operation up to 315°C, general system design and reactor/heat exchanger specifications should comply with pressure vessel regulations meeting 20 bar certification requirements.

Equipment design should take into account the low flash point of this product.

Therminol® LT Water Solubility

Fig. 2



The Therminol® Range

Therminol LT is one of the Solutia synthetic heat transfer fluids covering an operating range from -85°C to +400°C, suitable for most process heating or waste heat recovery applications, and capable of operation at or near atmospheric pressure within their recommended operating temperature range.

As a user's process temperature demands change there is always a Therminol fluid capable of meeting the new requirements. In addition, Therminol fluids are often interchangeable allowing conversion by a simple top-up procedure where this is preferred.

Solutia also has a standard DP-DPO eutectic, Therminol VP-1.

Quality Management

All our manufacturing units have obtained ISO 9002 quality control certification. This registration means that plant procedures, quality control systems, material sampling, product storage, handling, packaging, shipping, product literature and characteristic data, record keeping and other company procedures are in line with the quality requirements of the ISO 9002 standards and its other national equivalents.

This is your quality assurance.

Health, Safety and Environmental Information

Please contact the Solutia Europe/Africa HQ for the Material Safety Data Sheet, or if any other information concerning health, safety and environmental issues is required during filling or operation of your heat transfer system with this product.

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