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The Glycol People

TECHNICAL INFORMATION BULLETIN

SOLARMATE

Premixed reversible vaporizable special Propylene Glycol based Heat Transfer Fluid, for solar heating installations.

SOLARMATE: is non-toxic & non-corrosive for Solar systems with an operating temperature range of -15°F to 324°F (-46°C to 163°C)

Chemical Composition:

A blend of virgin (not recycled) Dow Chemical propylene glycol, deionized water and corrosion inhibitor, Defoaming Agent, Yellow Dye.

Physical Properties:

Appearance	clear, yellow coloured liquid
Density 20°C (72°F)	1060.0 kg/m ³ (66.17 lb/ft ³)
Refractive index 22°C(72°F)	1.3903
pH value	9.2-10.7
Reserve Alkalinity (min)	16.0 ml
Viscosity 10°C (50°F)	10.36481 mPa'S (10.65 cps)
Boiling Point °C @ 101kPa	106
(°F @ 760mmHg)	222
Flash Point	none
Water content	46-50%
Frost protection °C/°F	-35/-31

Description:

SOLAR MATE is a clear, yellow coloured, practically odourless liquid, based on virgin (not recycled) propylene glycol, water and specially designed industrial

package of liquid inhibitors. It has been designed specifically for uses as a heat transfer fluid in solar thermal systems operating under elevated thermal conditions (vacuum tube collectors). In case of stagnation those components evaporate together with propylene glycol and water, the collector remains empty, and no damaging insoluble residues will cause any flow obstruction or blocking. The corrosion inhibitors contained in **SOLARMATE** reliably provide protection against acid corrosion, scale and sediment formation in systems with materials normally used in solar thermal installations. The acid neutralizing agent of **SOLARMATE** buffers any acids formed as a result of glycol oxidation. Mineral deposition preventative acts to prevent minerals from depositing on the surface walls of piping systems and heat exchangers. Mineral sediment preventative keeps free-floating minerals in solution from precipitating out. This additive prevents minerals salts, or cluster of minerals salts, from forming large enough particles to precipitate, or drop, out of solution. If the system is prudently engineered, **SOLAR MATE** consistently ensures high thermal efficiency of the solar thermal system.

In order to maintain its specific properties, SOLARMATE must not be mixed with other heat transfer fluids, or diluted by water. If the leakages or other pressure loss happens, the heat transfer fluid in the system must be refilled with SOLARMATE only.

Application:

SOLARMATE is suitable for solar thermal systems with stagnation temperatures up to 425°F (219°C), if subsequent instructions are followed:

The solar heating system must be protected in respect to temperature, pressure and discharge of liquid in accordance with local regulations. **The collector circuit must be protected in such a way that at the highest possible collector temperature (stagnation temperature), no heat transfer medium will escape from the safety valve.** This could be achieved through the appropriate sizing of the expansion tank and matching of the operational system pressure.

For **SOLARMATE** a maximum bulk temperature of 325°F (163°C) is recommended, with film temperatures not to exceed 375°F (191°C), it can tolerate brief temperature excursions up to 100°F (56°C) above the maximum recommended

temperatures. Tests have shown that the heat transfer medium is under less stress during stagnation than when it is just below the steam-building phase.

All of the data sheets of the collector manufacturers list stagnation temperatures above 400°F (200°C). However, extended exposure of the fluids to temperatures in excess of 50°F (28°C) above the maximum recommended temperatures will result in accelerated degradation of the glycol and inhibitor systems.

On the other hand, these temperatures generally only occur during operation with dry steam, i.e. when the heat transfer medium has completely turned to a steam in the collector or the collector has been completely emptied due to steam. The wet steam then dries quickly and is no longer able to conduct heat.

It must be ensured that all of the heat-transfer fluid can escape out of the solar collectors into the – sufficiently dimensioned – expansion tanks when the maximum static temperature is reached, and thus the collectors remain completely empty.

Expansion factor:

Like any fluids, SOLARMATE expands as temperature increases. Therefore, expansion tanks must be sized appropriately. To determine capacity of the expansion tank, use the following formula:

$$V_n = \frac{(V_v + V_{ex} + z \cdot V_c) \cdot (P_e + 12)}{P_e - P_{st} + 7.33}$$

Where:

V_n = nominal capacity of the diaphragm expansion tank in gal.

V_v = min. amount of fluid in the tank, that provide the NPSH
(netpositive suction head) in gal.

$V_v = 0.005 V_A$ in gal, (0.8minium

V_A = fluid capacity of the entire system

P_{st} = tank's diaphragm pre-charge pressure in psig

$$P_{st} = 22 \text{ psig} + 0.45 h$$

h =static head of the system in ft.

z = number of collectors

V_c = single collector volume in gal

V_{ex} = the volume of expansion when the system heats up

$$V_{ex} = \frac{p(T_{LOW}) - P(T_{HIGH})}{P(T_{HIGH})} \times V_A$$

Where:

p(TLOW) = the density at the lowest anticipated Temperature (winter operation mode).

P(THIGH) = the density at the highest anticipated temperature (stagnation).

Density data for **SOLARMATE** are given in Table 1.

Pe = permissible end pressure in psig

Pe = Pprv – 0.1 Pprv

Pprv = safety valve blow off pressure in psig.

Application guidelines:

In view of the specific properties of **SOLARMATE**, the following instructions must be adhered to for ensuring long term protection.

1. Solar heating equipment must be of closed loop design, because entry of atmospheric oxygen leads to premature ageing and consequently reduces the life span of the heat-transfer fluid.
2. Flexible-membrane expansion tanks must have a heavy duty butyl/EPDM diaphragm with code approvals **ANSI/NSF 61**.
3. All joints must be of silver or copper brazing solder. Fluxes used in combination with soft solder usually contain chlorides. Their residues must be removed by thorough flushing of the system; otherwise increased chloride concentration in the heat transfer fluid may lead to corrosion. A solution of 1 to 2 percent of WM8588, neutral pH cleaner can be used with water for flushing the system.
4. The only flexible connections must be of metal, or those that do not permit the diffusion of oxygen.
5. Galvanized steel is not recommended because the zinc will react with the inhibitor in the fluids, causing precipitate formation, depletion of the inhibitor package, and removal of the protective zinc coating, particularly above 100°F (38°C).

6. Chemically speaking, **SOLARMATE** is largely inert, but it is important to ensure that the manufacturer's recommendations state that all the seals and connectors used in solar heating equipment are resistant up to the maximum temperature and pressure of the medium.
7. Scaling on copper or copper alloys must be removed, because it can be detached by hot propylene glycol/water mixtures.
8. To prevent galvanic corrosion, it must be ensured that no external voltages are applied between parts of the equipment that come into contact with **SOLARMATE**.
9. The piping layout design has to prevent the flow disturbance by air pockets or deposits.
10. The operating pressure of the heat-transfer fluid must never be lower than a static pressure of the system.
11. Dirt and water must not be allowed to enter the installation or its components during assembly and before filling. After completion of assembly, the system must be flushed to remove any foreign objects (solder, scale, packaging residues, sawdust, etc).
12. It must be ensured that the air is properly flushed out of the system at the start-up stage.
13. If pressure drop occurs due to leakage or take-out, the heat-transfer fluid in the system must be refilled with **SOLARMATE only. Do not top up with water!!**

Safety, Handling, Storage, and Disposal of SOLARMATE L-HT heat Transfer fluid.

Toxicology

For complete product toxicological information for **SOLAR MATE L-HT** heat transfer fluid, request material Safety Data sheet (MSDS) from HOOD CHEMICAL. The MSDS provides the most up-to-date health and safety considerations related to the use of this product and should be consulted prior to use of the product.

Storage

Storage of **SOLARMATE L-HT** glycol-based heat transfer fluid presents no unusual problems. The materials do not readily solidify, are low in toxicity, have no flash points, and can be handled without posing a hazard to health. As a precaution,

however, sparks or flames should be avoided during transfer or processing operations because undiluted glycols can be ignited. Tank truck shipments can be emptied into storage tanks or clean drums.

Drum/Pail storage

SOLARMATE L-HT fluid may be stored in the drums or plastic pails in which shipment is made. Because glycols are hygroscopic, it is important that the drum cap be replaced tightly after each withdrawal to keep the material in the drum from absorbing water. Drum should be stored inside a heated building when temperatures below 10°F (-12°C) are anticipated. This will assure that the glycol is in a liquid form when needed.

Environmental Considerations

The biochemical oxygen demand (BOD) for propylene glycols approaches the theoretical oxygen demand (ThOD) value in the standard 20-day test period. This indicates that these materials are biodegradable and should not concentrate in common water systems. The possibility of spills in lakes or rivers, however, should be avoided, since rapid oxygen depletion may have harmful effects on aquatic organisms. Extensive testing of the effects of propylene glycol on aquatic organisms has shown the material to be practically non-toxic (LC50>100mg/L) with LC50's & 10,000 mg/L for fathead minnow, rainbow trout and *Daphnia magna*.

Spill, Leak & Disposal Procedures

Using appropriate safety equipment, small spills may be soaked up with common absorbent material. For large spills, the fluid should be pumped into suitable containers located in diked areas. Residual material should be cleaned up with water. Concentrate can be handled according to local, state/provincial, and federal regulations.

Table 1 – Saturation properties of SOLARMATE L-HT heat transfer fluid – English Units

Temp. °F	Specific Heat (Btu/(lb·°F))	Densities (lb/ft ³)	Viscosities (cph)	Thermal Conductivity (Btu/(hr·ft ²)(°F/ft))	Vapour Pressure (psia)
-20	0.758	67.52	172.83	0.175	
-10	0.764	67.40	95.97	0.178	
0	0.770	67.27	61.32	0.181	
10	0.776	67.14	40.62	0.183	
20	0.782	66.99	27.83	0.186	
30	0.788	66.84	19.66	0.188	
40	0.794	66.68	14.28	0.191	
50	0.800	66.51	10.65	0.193	
60	0.806	66.33	8.13	0.195	
70	0.812	66.14	6.34	0.198	
80	0.818	65.94	5.04	0.200	
90	0.824	65.74	4.08	0.202	
100	0.830	65.52	3.35	0.203	
110	0.836	65.30	2.79	0.205	1.1
120	0.842	65.07	2.36	0.206	1.5
130	0.848	64.83	2.02	0.208	1.9
140	0.854	64.58	1.75	0.209	2.5
150	0.860	64.32	1.53	0.210	3.2
160	0.866	64.0	1.35	0.211	4.1
170	0.872	63.78	1.20	0.212	5.2
180	0.878	63.50	1.08	0.213	6.5
190	0.884	63.21	0.97	0.213	8.1
200	0.890	62.91	0.88	0.214	9.9
210	0.896	62.60	0.81	0.214	12.1
220	0.902	62.28	0.74	0.214	14.8
230	0.908	61.95	0.69	0.214	17.8
240	0.914	61.62	0.64	0.214	21.4
250	0.920	61.27	0.59	0.214	25.6
260	0.926	60.92	0.56	0.214	30.3
270	0.932	60.56	0.52	0.214	35.8
280	0.938	60.19	0.49	0.213	42.1
290	0.944	59.81	0.47	0.213	49.3
300	0.950	59.42	0.44	0.213	57.4
310	0.956	59.02	0.43	0.212	66.5
320	0.962	58.62	0.41	0.211	76.8
325	0.965	58.41	0.40	0.211	82.4

**TABLE 2 – Saturation properties of SOLAR MATE L-HT heat transfer fluid –
Metric Units**

Temp. °C	Specific Heat (kJ/kg K)	Densities (kg/m ³)	Viscosities (mPa sec)	Thermal Conductivity (W/mK)	Vapour Pressure (kPa)
-30	3.166	1081.9	171.54	0.302	
-25	3.189	1080.2	109.69	0.306	
-20	3.211	1078.4	72.42	0.311	
-15	3.234	1076.5	49.29	0.315	
-10	3.256	1074.5	34.51	0.319	
-5	3.279	1072.4	24.81	0.323	
0	3.302	1070.1	18.28	0.327	
5	3.324	1067.8	13.77	0.331	
10	3.347	1065.3	10.59	0.334	
15	3.370	1062.7	8.30	0.338	
20	3.392	1060.0	6.62	0.341	
25	3.415	1057.2	5.36	0.344	
30	3.437	1054.3	4.41	0.347	
35	3.460	1051.3	3.68	0.350	
40	3.483	1048.1	3.10	0.353	
45	3.505	1044.9	2.65	0.355	
50	3.528	1041.5	2.28	0.358	10.8
55	3.551	1038.0	1.99	0.360	13.7
60	3.573	1034.5	1.75	0.362	17.3
65	3.596	1030.8	1.55	0.363	21.7
70	3.618	1026.9	1.38	0.365	27.0
75	3.641	1023.0	1.24	0.366	33.4
80	3.664	1019.0	1.12	0.367	40.9
85	3.686	1014.8	1.02	0.368	49.9
90	3.709	1010.5	0.93	0.369	60.4
95	3.732	1006.2	0.86	0.370	72.7
100	3.754	1001.7	0.79	0.370	87.1
105	3.777	997.1	0.74	0.371	103.8
110	3.800	992.3	0.69	0.371	123.0
115	3.822	987.5	0.64	0.371	145.0
120	3.845	982.6	0.60	0.371	170.2
125	3.867	977.5	0.57	0.370	198.9
130	3.890	972.3	0.54	0.370	231.4
135	3.913	967.1	0.51	0.370	268.1
140	3.935	961.7	0.48	0.369	309.4
145	3.958	956.2	0.46	0.368	355.8
150	3.981	905.5	0.44	0.367	407.6
155	4.003	944.8	0.42	0.366	465.3
160	4.026	939.0	0.40	0.365	529.4