# ProSol™ L-HT

Technical
Information

Premixed reversibly vaporizable special Propylene Glycol-based Heat Transfer Fluid, for solar heating installations

SOLARnetix INC.

**Chemical Composition:**

A blend of virgin (not recycled) propylene glycol, water and inhibitors.

**Physical Properties:**

| | |
|---|---|
| Appearance | Clear, yellow colored liquid |
| Density 20°C (68°F) | 1060.0 kg/m³ (66.17 lb/ft³) |
| Refractive index 22°C (72°F) | 1.3903 |
| pH value | 9.5-10.7 |
| Reserve Alkalinity (min) | 16.0 ml |
| Viscosity 10°C (50°F) | 10.6481mPa·s (10.65 cps) |
| Boiling point °C @ 101 kPa | 106 |
| (°F@ 760 mmHg) | 222 |
| Flash point | none |
| Water content | 46 – 50 % |
| Frost protection °C /°F | -35 / -31 |

**Description:**

**ProSol™ L-HT** is a clear, yellow colored, practically odorless liquid, based on virgin (not recycled) propylene glycol, water and specially designed industrial package of liquid inhibitors. It has been designed specifically for use 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 **ProSol™ L-HT** 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 **ProSol™ L-HT** 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 mineral salts, or clusters of mineral salts, from forming large enough particles to precipitate, or drop, out of solution. If the system is prudently engineered, **ProSol™ L-HT** consistently ensures high thermal efficiency of the solar thermal system.

**In order to maintain its specific properties, ProSol™ L-HT must not be mixed with other heat transfer fluids, or diluted by water. If leakage or other pressure loss happens, the heat transfer fluid in the system must be refilled with ProSol™ L-HT only.**

## Application:

**ProSol™ L-HT** 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 **ProSol™ L-HT** 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 empty.

## Expansion factor

Like any fluids, **ProSol™ L-HT** expands as temperature increases. Therefore, expansion tanks must be sized appropriately. To determine capacity of the expansion tank, use the following formula:

$$V_N = \frac{(V_v + V_{ex} + z \cdot V_c) \cdot (P_e + 1)}{P_e - (P_{st} + 7.33)}$$

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 (net positive suction head) in gal.
$V_v$ =0.005 · $V_A$ in gal, (0.8 minimum)
$V_A$= fluid capacity of the entire system
$P_{st}$= tank's diaphragm pre-charge pressure in psig

$P_{st}$ =22 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

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

Where,
$\rho(T_{LOW})$ = the density at the lowest anticipated temperature (winter operation mode).
$\rho(T_{HIGH})$ = the density at the highest anticipated temperature (stagnation).

Density data for **ProSol™ L-HT** are given in **Table 1**

**Pe** = permissible end pressure in psig
**Pe** =Pprv – 0.1 · Pprv
**Pprv** =safety valve blow off pressure in psig.

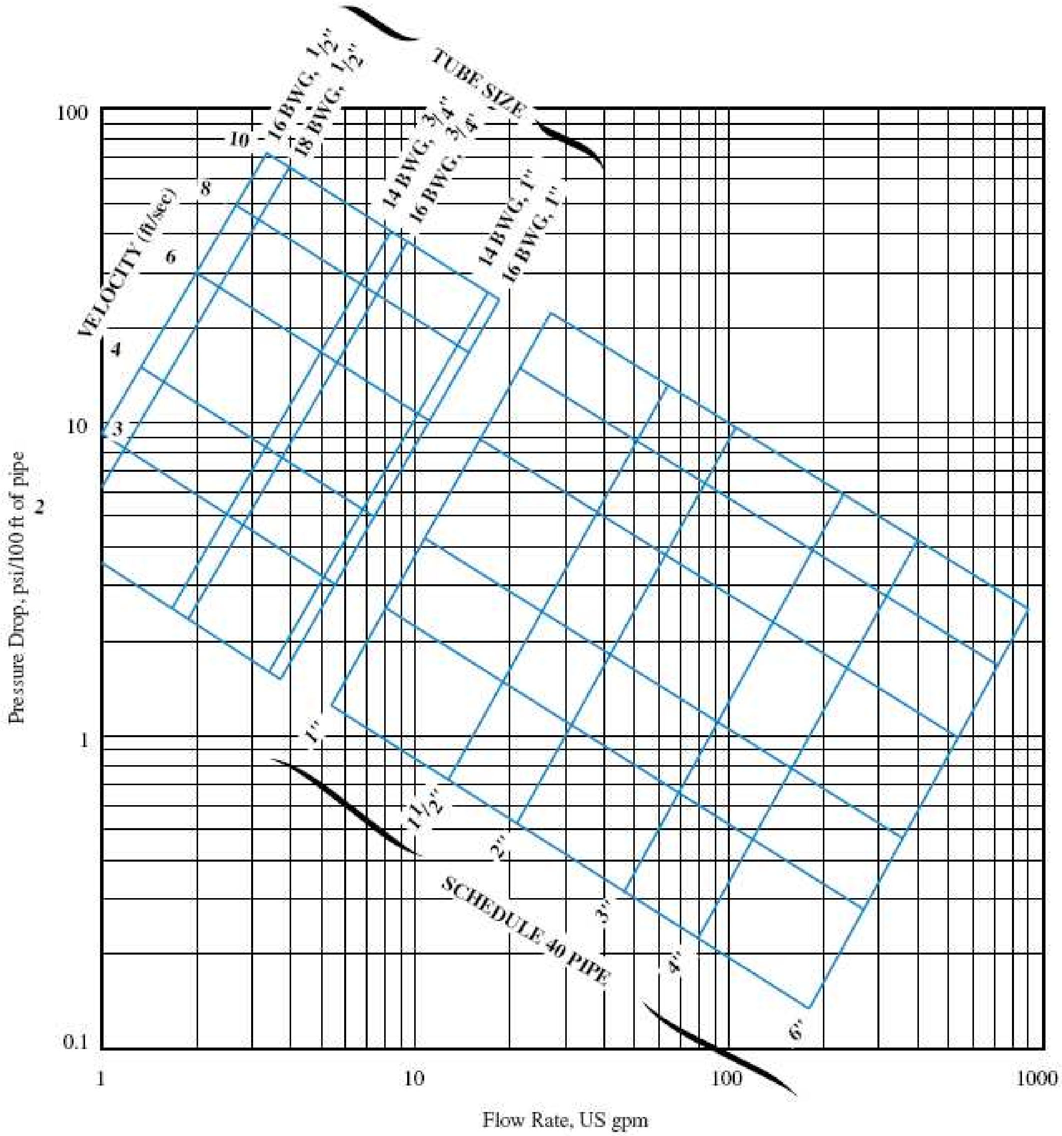
**Application guidelines**:

In view of the specific properties of **ProSol™ L-HT**, 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 to 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 trisodium phosphate 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, **ProSol™ L-HT** 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 **ProSol™ L-HT**.
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 occur due to leakage or take-out, the heat-transfer fluid in the system must be refilled with **ProSol™ L-HT** only**. Do not top up with water!**

**Table1 ─ Saturation properties of ProSol™ L-HT heat transfer fluid -English Units**

| Temp.°F | Specific Heat (Btu/(lb·°F ) | Densities (lb/ft³) | Viscosities (cph) | Thermal Conductivity (Btu/(hr·ft2)(°F /ft)) | Vapor 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 | 64.06 | 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 |



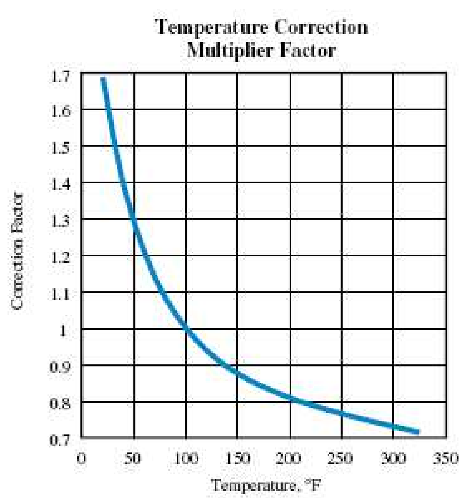
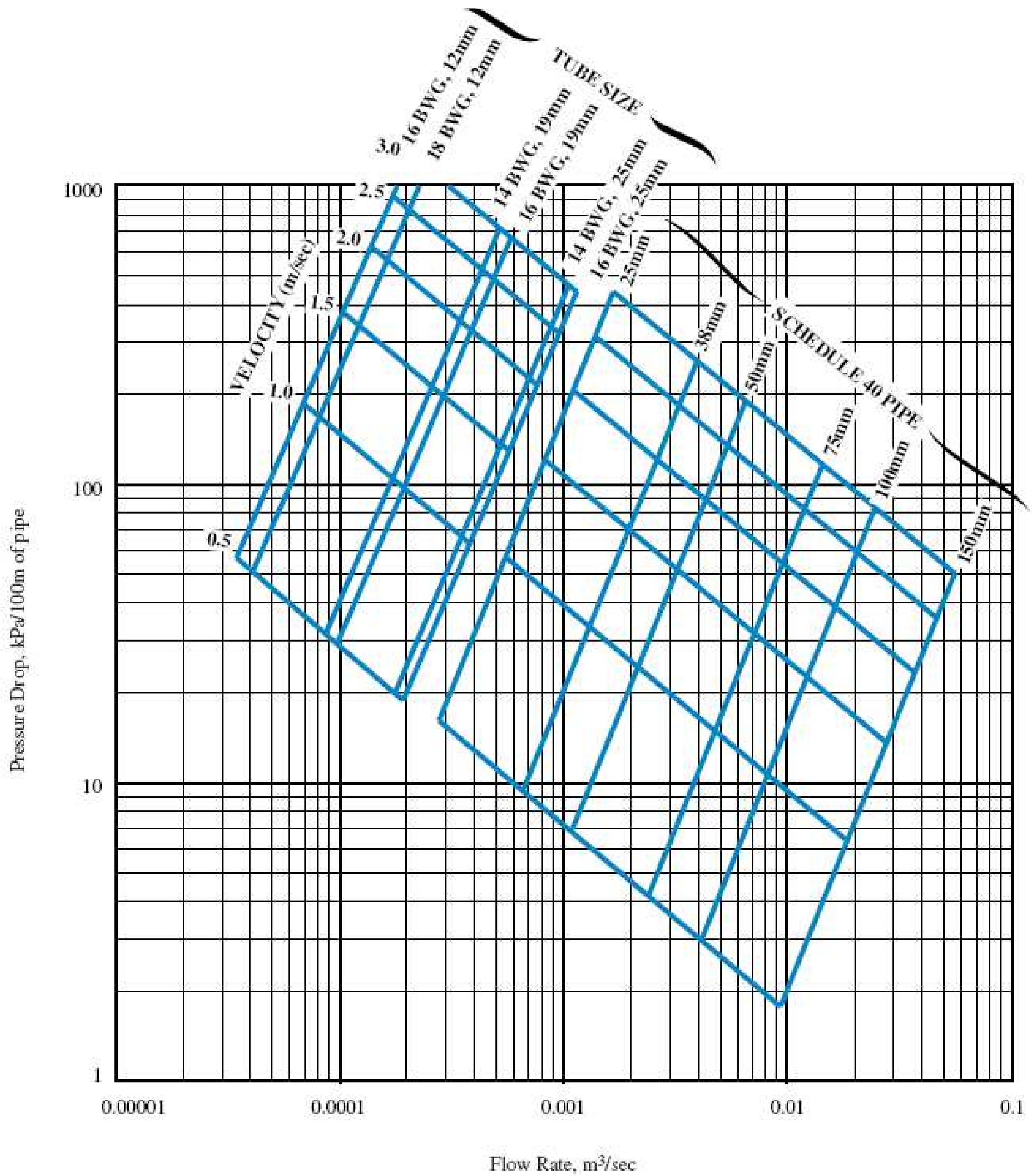




**Figure 1 – Pressure drop of ProSol™ L- HT heat transfer fluid - English Units**

**Table2 — Saturation properties of ProSol™ L-HT heat transfer fluid - Metric Units**

| Temp.°C | Specific Heat (kJ/kg K ) | Densities (kg/m³) | Viscosities (mPa sec) | Thermal Conductivity (W/mK) | Vapor 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 | 950.5 | 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 |



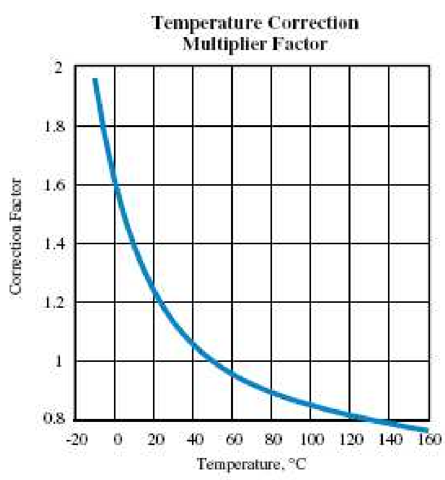




**Figure 2 – Pressure drop of ProSol™ L- HT heat transfer fluid - Metric Units**

## Safety, Handling, Storage, and Disposal of ProSol™ L- HT heat transfer fluid

### Toxicology
For complete product toxicological information for **ProSol™ L- HT** heat transfer fluid, request Material Safety Data (MSD) sheet from Solarnetix. The MSD sheet 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 **ProSol™ 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
**ProSol™ 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. Drums 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 (LC 50 > 100 mg/L) with LC 50's ε 10,000 mg/L for fathead minnow, rainbow trout and Daphnia magna.

### Spill, leak and 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.

### Salvage
Some distributors of **ProSol™ L- HT** fluid are equipped to reclaim and/or dispose of spent or contaminated fluids. Occasionally, where regulations permit, diluted spent fluids that are not otherwise contaminated can be disposed of in local sewage treatment facilities, provided those facilities are advised and prepared for such disposal in advance. Aerobic bacteria easily oxidize the fluids to carbon dioxide and water within the usual 20-day test period. The Solarnetix Inc. does not provide a disposal or reprocessing service for spent or contaminated glycol-based fluids.

For further information call toll-free 1-800-567-0695