Technical Information

Antifreeze and Anticorrosion Concentrate for Heating and Cooling Circuits in Food and Beverage Industry, for Thermal Solar and Ground Source Heat Pump Systems

TYFOCOR® L

Characteristics of TYFOCOR® L Concentate

Appearance	clear, colourless liquid	
Boiling point	> 150 °C	ASTM D 1120
Pour point	< -50 °C	DIN ISO 3016
Density (20 °C)	1.054–1.058 g/cm^3	DIN 51757
Viscosity (20 °C)	68–72 mm^2/s	DIN 51562
Refraction nD20	1.435–1.437	DIN 51423
pH value (20 °C)		
- concentrate	7.0–8.0	ASTM D 1287
- 33 vol. %	7.5–8.5	ASTM D 1287
Water content	max. 4 %	DIN 51777
Flash point	> 100 °C	DIN 51758
Reserve alkalinity	> 10 ml 0.1 m HCl	ASTM D 1121

The above data represent average values that were valid when this Technical Information Bulletin went into print. They do not have the status of a product specification. Specified values are the subject of a special leaflet.

Properties

TYFOCOR® L is a virtually odourless, hygroscopic liquid. It is based on toxicologically unobjectionable propylene glycol. TYFOCOR® L thus can be used as a coolant or heat-transfer fluid in food processing and water purification applications.

The corrosion inhibitors contained in the product reliably protect the metals normally used in heating and cooling systems as well as in solar technology even in mixed installations against corrosion, ageing and deposits over long periods of time. TYFOCOR® L maintains the surfaces of heat exchangers clean, and thus ensures consistently high thermal efficiency of the system.

TYFOCOR® L is miscible with water in all proportions. It's mixtures with water protect against frost at temperatures down to -50 °C, depending on their concentration. Water hardness constituents do not affect the performance of the product, and do not lead to precipitations from the heat-transfer fluid. Mixtures of TYFOCOR® L and water do not separate. The product neither contains nitrites nor phosphates, nor amines.

Miscibility

TYFOCOR® L is miscible with all commercial antifreezes based on propylene glycol. If mixing of TYFOCOR® L with other products is intended, we recommend, however, to contact our department of application technique beforehand.

Application

TYFOCOR® L / water mixtures are used as brines for cooling and heating circuits in the food and beverage industry, as heat-transfer fluids for solar thermal systems and heat pump installtions, and as antifreeze for sprinkler systems. Neutral water (potable water quality with a maximum chloride content of 100 mg/kg), or demineralised water must be used when mixed with TYFOCOR® L. In order to prevent the systems from corrosion, the following minimum and maximum concentration limits for TYFOCOR® L must be observed:

in solar installations: 40-75 vol. % TYFOCOR® L
in other installations: 25-75 vol. % TYFOCOR® L

Temperature Stability in Solar Installations

Sustained temperatures higher than 170 °C cause premature ageing of TYFOCOR® L. For solar thermal systems with stagnation temperatures above 170 °C it is thus recommended to choose expansion vessels of sufficient size to ensure that the solar medium will be taken up completely in case of stagnation.

Temperatures above 200 °C lead to slow alteration of the chemical properties of the heat-transfer fluid, with the result that the reliability of operation of the system may be endangered.

Antifreeze Effect, Density, Refractive index

TYFOCOR® L Concentrate	Anti-freeze*	Density at 20 °C	Refractive index nD20
25 vol. %	-10.7 °C	1024 kg/m^3	1.3618
30 vol. %	-14.0 °C	1029 kg/m^3	1.3677
35 vol. %	-17.6 °C	1034 kg/m^3	1.3734
40 vol. %	-21.5 °C	1039 kg/m^3	1.3792
45 vol. %	-26.0 °C	1043 kg/m^3	1.3847
50 vol. %	-32.4 °C	1047 kg/m^3	1.3901
55 vol. %	-40.4 °C	1050 kg/m^3	1.3955
60 vol. %	-48.4 °C	1053 kg/m^3	1.4001

*Antifreeze = Freezing point, see also page 7.

Anticorrosion Effect

The following table demonstrates the anticorrosion effect of a 33 vol. % TYFOCOR® L / water mixture after a 14 days test at 88 °C under permanent aeration. Corrosion test accordingly ASTM D 1384 (American Society for Testing and Materials).

Material	Average change of weight
Copper (SF Cu)	– 0.20 g/m^2
Soft solder (L Sn 30)	– 0.10 g/m^2
Brass (MS 63)	– 0.30 g/m^2
Steel (HI)	+ 0.70 g/m^2
Cast Iron (GG 26)	± 0.00 g/m^2
Cast Aluminium (G-AlSi6Cu4)	– 0.50 g/m^2

Compatibility with Sealing Materials

TYFOCOR® L / water mixtures do not attack the sealings that are normally used in heating and cooling systems as well as in solar technology. The following table of sealants, elastomers and plastics that are resistant to TYFOCOR® L / water mixtures has been compiled from experimental results, experience, and literature data:

Examples of sealants are Fermit®, Fermitol® (registered trademarks of Nissen & Volk GmbH, Hamburg, Germany), hemp

Butyl rubber	IIR
Chloroprene	CR
Ethylene-propylene-diene-rubber	EPDM
Fluorocarbon elastomers	FPM
Natural rubber below 80 °C	NR
Nitrile rubber	NBR
Polyacetal	POM
Polyamides below 115 °C	PA
Polybutene	PB
Polyethylene, soft, hard	PE-LD/HD
Polyethylene, crosslinked	PE-X
Polypropylene	PP
Polytetrafluorethylene	PTFE
Polyvinylchloride, rigid	PVC h
Silicone rubber	Si
Styrene butadiene rubber below 100 °C	SBR
Unsaturated polyester resins	UP

Phenolic and urea resins, plasticized PVC, and polyurethane elastomers are not resistant.

An important point to note is that the performance of elastomers is not only governed by the properties of the rubber itself, e.g. EPDM, but also by the nature and amount of the constituent additives and the vulcanisation conditions. For this reason, it is recommended that their resistance to TYFOCOR® L / water mixtures is checked by performance tests before these elastomers are taken into use for the first time. This applies in particular to elastomers intended as membranes for expansion vessels as described in DIN EN 12828 and DIN 4807 Part 2, respectively.

Gaskets that have proved to be resistant to hot TYFOCOR® L / water mixtures are: up to 160 °C gaskets made from 70 EPDM 281 (Carl Freudenberg GmbH, D-69465 Weinheim). Up to 200 °C: flat gaskets such as REINZ-AFM 34 (REINZ-Dichtungs-GmbH, D-89229 Neu-Ulm) or Centellen 3820 based on aramide/special-NBR (Hecker Werke GmbH, D-71093 Weil im Schönbuch).

Application Guidelines

In view of the specific properties of TYFOCOR® L, the following instructions must be observed to ensure long-term protection for the installations.

1. Installations must be designed as closed circuits, as otherwise the contact with atmospheric oxygen will accelerate the consumption of inhibitors.

2. The systems must not be equipped with internally galvanised heat exchangers, tanks or pipes, because zinc can be detached by propylene glycol / water mixtures.

3. Flexible-membrane expansion tanks must conform to DIN EN 12828 and DIN 4807 Part 2, resp.

4. Silver or copper brazing solders are preferably to be used on joints. Fluxes used in combination with soft solder usually contain chlorides. Their residues must be removed from the system by thorough flushing. Otherwise, an increased content of chlorides in the heat-transfer fluid may lead for example to pitting corrosion on stainless steel.

5. Chemically speaking, TYFOCOR® L / water mixtures are largely inert. It is important, however, to ensure that the manufacturer's recommendations state that all the sealants and connector materials used are resistant up to the maximum fluid temperature.

6. The only flexible connections that are permitted for use are hoses, preferably made of metal, that are resistant to oxygen diffusion.

7. It must be ensured that no external voltages are applied between parts of the system that come into contact with TYFOCOR® L / water mixtures (risk of corrosion).

8. The layout of the piping must ensure that the circulation of the heat-transfer fluid will not be disturbed by gas pockets or deposits.

9. The fluid level must never be allowed to fall below the highest point in the system. A closed vessel fitted with a bleed valve must be provided at the highest point in the circuit in order to bleed gases from the system.

10. If automatic bleed valves are used, they must not allow subsequent suction of air into the system.

11. Scaling on copper surfaces must be removed from the system before filling. Otherwise, these particles will be removed by the hot heat-transfer fluid and transported into other areas of the system, which may subsequently lead to formation of deposits and obstruction of the fluid flow rate.

12. Dirt and water must not be allowed to enter the installation or its components during assembly and before filling. After the assembly has been completed, the system should be flushed to remove e.g. swarf, fluxes, assembly aids and any other impurities. Following to the flushing process and the leak test, the circuit should be completely drained and then immediately be filled with the TYFOCOR® L / water mixture, even if the system is put into operation at a later date, in order to protect the circuit from corrosion.

13. It must be ensured that no air remains in the installation after it has been filled. It Is essential to eliminate any existing air or gas pockets, because their collapse following a temperature drop would give rise to a vacuum and thus cause air to be sucked into the system. An insufficient deaeration furthermore affects the heat-transfer efficiency of the system.

14. In-circuit filter elements must be cleaned within 14 days at the latest after the system was put into operation, in order to ensure that no obstruction to the fluid flow may occur due to deposits in any part of the installation.

15. The concentration of the TYFOCOR® L / water

mixture can be checked by measuring the fluid density with a hydrometer or an antifreeze tester suitable for propylene glycol / water mixtures. An equally convenient and accurate way to determine the content of TYFOCOR® L is the measurement of the refractive index by a hand-held refractometer. A summary of the freezing points, densities and refractive indices of TYFOCOR® L / water mixtures can be found on page 1.

16. If losses occur due to evaporation, the system can be topped up with neutral potable or demineralised water. Losses caused by leakage or removal from the system must be replaced by a mixture of TYFOCOR® L Concentrate and potable or demineralised water of equal content. In cases of doubt, the content must be determined via density or refractive index as described under **15**.

Storage Stability

TYFOCOR® L has a shelf life of at least three years in airtight containers. It must not be stored in galvanised containers.

Delivery Form and Packaging

TYFOCOR® L is available as a concentrate or ready-mix according to customer's specification. It is supplied in road tankers, in 1000 litre IBCs, in 200 litre drums, and in 60, 30, 25, 20 and 10 litre non-returnable plastic cans.

Disposal

Spills of TYFOCOR® L must be taken up with an absorbent binder and disposed of in accordance with the regulations. For further information, please refer to the Safety Data Sheet.

Ecology

TYFOCOR® L is classified in water hazard class 1, (low-rate endangering, Germany) according to german water hazard regulations (*Verwaltungsvorschrift für wassergefährdende Stoffe* of May 17, 1999). The product is readily biodegradable.

Handling

The usual safety and industrial hygiene measures relating to chemicals must be observed in handling TYFOCOR® L. The information and instructions given in our Safety Data Sheet must be strictly observed.

Safety Data Sheet

A current Safety Data Sheet in accordance with EU Directive 1907/2006/EC [REACH] is available on our website www.tyfo.de.

Density of TYFOCOR® L / water mixtures [kg/m^3]
as a function of temperature and concentration

T [°C]	25 vol. %	30 vol. %	35 vol. %	40 vol. %	45 vol. %	50 vol. %	55 vol. %	60 vol. %
120	963	966	967	969	971	973	973	975
110	970	972	975	977	979	982	982	984
100	977	979	982	985	987	990	990	993
90	984	986	989	993	995	995	996	1001
80	991	993	997	1000	1002	1005	1006	1009
70	997	999	1004	1007	1010	1013	1014	1017
60	1004	1007	1010	1014	1017	1020	1022	1025
50	1010	1013	1017	1021	1024	1027	1029	1032
40	1015	1019	1023	1027	1030	1034	1036	1039
30	1020	1024	1029	1033	1037	1041	1043	1046
20	1024	1029	1034	1039	1043	1047	1050	1053
10	1028	1033	1039	1044	1049	1053	1056	1060
0	1031	1037	1043	1049	1054	1059	1062	1067
-10	1033	1040	1047	1054	1059	1065	1069	1073
-20	-	-	-	1058	1064	1070	1075	1080
-30	-	-	-	-	-	1075	1081	1086
-40	-	-	-	-	-	-	1086	1093
-50	-	-	-	-	-	-	-	-

Specific heat capacity of TYFOCOR® L / water mixtures [kJ/kg·K]
as a function of temperature and concentration

T [°C]	25 vol. %	30 vol. %	35 vol. %	40 vol. %	45 vol. %	50 vol. %	55 vol. %	60 vol. %
120	4.17	4.16	4.11	4.05	3.98	3.90	3.79	3.68
110	4.15	4.13	4.08	4.01	3.94	3.85	3.75	3.64
100	4.13	4.10	4.04	3.98	3.90	3.81	3.71	3.60
90	4.10	4.07	4.01	3.94	3.86	3.77	3.67	3.56
80	4.08	4.04	3.98	3.91	3.82	3.73	3.63	3.52
70	4.05	4.01	3.94	3.87	3.78	3.69	3.59	3.48
60	4.03	3.98	3.91	3.83	3.74	3.64	3.54	3.44
50	4.00	3.94	3.87	3.79	3.70	3.60	3.50	3.40
40	3.98	3.91	3.94	3.76	3.66	3.56	3.46	3.36
30	3.95	3.88	3.80	3.72	3.62	3.52	3.42	3.32
20	3.93	3.85	3.77	3.68	3.58	3.48	3.38	3.28
10	3.90	3.81	3.73	3.64	3.54	3.43	3.34	3.24
0	3.88	3.78	3.70	3.61	3.50	3.39	3.30	3.20
-10	3.85	3.75	3.66	3.57	3.46	3.35	3.25	3.16
-20	-	-	-	3.53	3.42	3.31	3.21	3.12
-30	-	-	-	-	-	3.27	3.17	3.08
-40	-	-	-	-	-	-	3.13	3.04
-50	-	-	-	-	-	-	-	-

Thermal conductivity of TYFOCOR® L / water mixtures [W/m·K]
as a function of temperature and concentration

T [°C]	25 vol. %	30 vol. %	35 vol. %	40 vol. %	45 vol. %	50 vol. %	55 vol. %	60 vol. %
120	0.689	0.651	0.608	0.564	0.535	0.507	0.483	0.458
110	0.665	0.628	0.588	0.546	0.515	0.490	0.467	0.443
100	0.640	0.605	0.567	0.528	0.498	0.473	0.452	0.429
90	0.616	0.583	0.547	0.511	0.482	0.457	0.436	0.414
80	0.592	0.560	0.527	0.493	0.465	0.441	0.421	0.400
70	0.568	0.538	0.507	0.475	0.449	0.426	0.407	0.386
60	0.544	0.515	0.487	0.458	0.433	0.411	0.392	0.373
50	0.519	0.493	0.466	0.440	0.417	0.396	0.378	0.359
40	0.495	0.470	0.446	0.422	0.401	0.382	0.364	0.346
30	0.471	0.447	0.426	0.405	0.385	0.368	0.350	0.332
20	0.447	0.425	0.406	0.387	0.370	0.353	0.336	0.319
10	0.423	0.402	0.386	0.369	0.354	0.339	0.322	0.305
0	0.399	0.380	0.366	0.352	0.338	0.324	0.307	0.291
-10	0.374	0.357	0.345	0.334	0.322	0.309	0.293	0.278
-20	-	-	-	0.316	0.305	0.294	0.278	0.264
-30	-	-	-	-	-	0.278	0.264	0.250
-40	-	-	-	-	-	-	0.248	0.236
-50	-	-	-	-	-	-	-	-

Kinematic viscosity of TYFOCOR® L / water mixtures [mm²/s]
as a function of temperature and concentration

T [°C]	25 vol. %	30 vol. %	35 vol. %	40 vol. %	45 vol. %	50 vol. %	55 vol. %	60 vol. %
120	0.43	0.47	0.47	0.48	0.50	0.52	0.55	0.57
110	0.48	0.53	0.56	0.59	0.63	0.68	0.73	0.79
100	0.54	0.59	0.64	0.70	0.77	0.85	0.94	1.03
90	0.61	0.67	0.74	0.82	0.93	1.04	1.16	1.29
80	0.69	0.76	0.85	0.96	1.10	1.24	1.40	1.58
70	0.79	0.89	1.00	1.14	1.30	1.49	1.70	1.92
60	0.93	1.06	1.20	1.36	1.58	1.81	2.07	2.36
50	1.13	1.30	1.48	1.69	1.96	2.27	2.61	2.94
40	1.41	1.66	1.89	2.18	2.55	2.96	3.42	3.96
30	1.85	2.21	2.55	2.96	3.49	4.10	4.77	5.57
20	2.55	3.09	3.64	4.28	5.12	6.08	7.17	8.47
10	3.70	4.57	5.53	6.69	8.13	9.83	11.8	14.2
0	5.71	7.20	9.06	11.4	14.2	17.6	21.6	26.5
-10	9.45	12.1	16.1	21.4	27.5	35.2	44.7	56.3
-20	-	-	-	44.7	60.2	80.2	106	138
-30	-	-	-	-	-	211	293	400
-40	-	-	-	-	-	-	962	1383

Prandtl numbers of TYFOCOR® L / water mixtures
as a function of temperature and concentration

T [°C]	25 vol. %	30 vol. %	35 vol. %	40 vol. %	45 vol. %	50 vol. %	55 vol. %	60 vol. %
120	2.50	2.90	3.07	3.34	3.61	3.89	4.20	4.47
110	2.91	3.39	3.79	4.23	4.72	5.25	5.76	6.39
100	3.41	3.91	4.48	5.20	5.95	6.78	7.64	8.58
90	4.00	4.61	5.37	6.28	7.41	8.54	9.73	11.10
80	4.71	5.44	6.40	7.61	9.05	10.54	12.14	14.03
70	5.62	6.63	7.75	9.35	11.05	13.07	15.21	17.60
60	6.92	8.25	9.73	11.53	13.88	16.35	19.10	22.31
50	8.80	10.53	12.50	14.86	17.81	21.19	24.87	28.74
40	11.51	14.07	17.08	19.95	23.97	28.52	33.68	39.96
30	15.83	19.64	23.41	28.09	34.03	40.83	48.61	58.26
20	22.46	28.80	34.95	42.29	51.67	62.76	75.73	91.71
10	35.07	44.74	55.52	68.90	82.94	104.7	129.3	159.4
0	56.91	74.27	95.53	122.6	155.0	195.0	246.6	310.9
-10	100.5	132.2	178.8	241.1	312.9	406.4	530.0	686.7
-20	-	-	-	528.3	718.2	966.1	1316	1761
-30	-	-	-	-	-	2668	3803	5352
-40	-	-	-	-	-	-	13186	19472

Boiling points of TYFOCOR® L / water mixtures [°C]
as a function of pressure and concentration

p [bar]	25 Vol. %	30 vol. %	35 vol. %	40 vol. %	45 vol. %	50 vol. %	55 vol. %	60 vol. %
10.0	181.5	182.0	182.5	183.0	184.0	185.0	186.5	188.0
9.0	176.5	177.0	177.5	178.0	179.5	181.0	182.5	184.0
8.0	171.5	172.0	172.5	173.0	174.0	175.0	176.0	177.5
7.0	166.0	166.5	167.0	167.5	168.0	168.5	170.0	172.0
6.0	159.0	159.5	160.5	161.0	161.5	162.0	163.5	165.0
5.0	152.5	153.0	154.0	155.0	156.0	157.0	158.0	159.0
4.0	144.5	145.0	145.5	146.0	147.0	148.0	149.0	151.0
3.5	141.5	142.0	142.5	143.0	143.5	144.0	145.0	146.0
2.0	122.5	123.0	123.5	124.0	125.0	126.0	127.0	128.0
1.0	100.5	101.0	101.5	102.0	103.0	104.0	105.0	106.0

Cubic expansion coefficient of TYFOCOR® L / water mixtures [●10^{-5}/K]
as a function of temperature and concentration

T [°C]	25 vol. %	30 vol. %	35 vol. %	40 vol. %	45 vol. %	50 vol. %	55 vol. %	60 vol. %
120	73	70	77	86	86	86	91	93
110	73	71	76	83	84	83	88	89
100	72	71	75	80	81	81	84	86
90	70	70	73	77	78	78	81	82
80	68	69	71	74	75	76	78	79
70	65	67	68	70	72	73	75	76
60	61	64	65	67	69	70	73	73
50	57	60	62	63	66	68	70	71
40	51	56	58	60	63	65	68	69
30	46	51	54	56	60	62	65	67
20	39	45	49	53	57	60	63	65
10	32	38	44	49	53	57	61	63
0	24	31	38	45	50	54	59	62
-10	15	23	32	41	47	52	57	61
-20	-	-	-	38	44	49	55	60
-30	-	-	-	-	-	46	54	60
-40	-	-	-	-	-	-	52	59
-50	-	-	-	-	-	-	-	-

Example for calculating the volume expansion:

What would be the increase in volume if V_0 = 80 litres of a 30 vol. % TYFOCOR® L / water mixture will be heated from t_0 = -10 °C to t_1 = +90 °C ?

$\Delta t = t_1 - t_0 = +90 - (-10) = 100$ °C, $t_{average} = t_0 + \Delta t/2 = -10 + 100/2 = +40$ °C

$ß_{average}$ (from table for 30 % vol.) = $56 \cdot 10^{-5}$

$\Delta V = ß_{average} \cdot \Delta t \cdot V_0 = 56 \cdot 10^{-5} \cdot 100 \cdot 80 = 4.48$ litres increase in volume

Vapour pressure of TYFOCOR® L / water mixtures [bar]
as a function of temperature and concentration

T [°C]	25 vol. %	30 vol. %	35 vol. %	40 vol. %	45 vol. %	50 vol. %	55 vol. %	60 vol. %
180	9.77	9.64	9.50	9.35	9.13	8.82	8.48	8.15
170	7.68	7.58	7.46	7.33	7.16	6.92	6.65	6.40
160	5.97	5.88	5.79	5.69	5.55	5.37	5.16	4.96
150	4.58	4.51	4.44	4.36	4.25	4.11	3.95	3.80
140	3.47	3.41	3.36	3.30	3.22	3.11	2.99	2.88
130	2.59	2.55	2.50	2.46	2.40	2.32	2.23	2.15
120	1.90	1.87	1.84	1.80	1.76	1.70	1.64	1.58
110	1.37	1.35	1.32	1.30	1.27	1.23	1.18	1.14
100	0.97	0.95	0.94	0.92	0.90	0.87	0.84	0.81
90	0.67	0.66	0.65	0.64	0.63	0.61	0.59	0.57
80	0.46	0.45	0.44	0.44	0.43	0.41	0.40	0.39
70	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.26
60	0.19	0.19	0.19	0.19	0.18	0.17	0.17	0.17
50	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11
40	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
30	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

Relative pressure drop factor of TYFOCOR® L / water mixtures
in comparison with water at 10 °C, turbulent pipe flow (approximate values)

T [°C]	25 vol. %	30 vol. %	35 vol. %	40 vol. %	45 vol. %	50 vol. %	55 vol. %	60 vol. %
100	0.80	0.81	0.84	0.86	0.88	0.90	0.93	0.96
90	0.82	0.83	0.86	0.89	0.90	0.92	0.96	0.99
80	0.85	0.86	0.89	0.92	0.92	0.94	0.99	1.03
70	0.89	0.90	0.92	0.95	0.99	1.01	1.05	1.09
60	0.93	0.94	0.98	1.01	1.06	1.08	1.12	1.16
50	0.98	1.00	1.04	1.07	1.13	1.15	1.20	1.24
40	1.05	1.07	1.11	1.14	1.21	1.23	1.27	1.31
30	1.11	1.14	1.19	1.23	1.30	1.32	1.37	1.42
20	1.21	1.24	1.30	1.34	1.47	1.49	1.56	1.62
10	1.32	1.35	1.46	1.50	1.68	1.70	1.77	1.83
0	1.49	1.53	1.67	1.72	1.89	1.92	2.02	2.11
-10	1.71	1.75	1.98	2.02	2.27	2.30	2.44	2.58
-20	-	-	-	2.45	2.77	2.80	3.01	3.23

Antifreeze effect of TYFOCOR® L / water mixtures

The **freezing point**, colloquially called 'antifreeze', is a measure for the freezing-point depression of antifreeze fluids. When a given TYFOCOR® L / water mixture will be cooled down, the freezing point is the temperature at which initial ice crystals begin to form. The resulting ice slurry does not possess any expansive force. Further reduction in temperature causes further thickening of the ice slurry until it solidifies at the **pour point.** Only below this temperature, there is danger of bursting for the installation. The arithmetic mean from freezing point and pour point is referred to as **frost protection**.

The following table displays the freezing points, frost protection and pour points of TYFOCOR® L / water mixtures as a function of the concentration:

TYFOCOR® L Concentrate	Freezing point (acc. ASTM D 1177)	Frost protection (calculated)	Pour point (acc. DIN 51583)
25 vol. %	-10.7 °C	-11.5 °C	-12.3 °C
30 vol. %	-14.0 °C	-15.0 °C	-16.0 °C
35 vol. %	-17.6 °C	-19.0 °C	-20.4 °C
40 vol. %	-21.5 °C	-23.7 °C	-26.0 °C
45 vol. %	-26.0 °C	-29.6 °C	-33.3 °C
50 vol. %	-32.4 °C	-38.2 °C	-44.0 °C
55 vol. %	-40.4 °C	-48.5 °C	< -50 °C
60 vol. %	-48.4 °C	< -50 °C	< -50 °C

Note

The information submitted in this publication is based on our current knowledge and experience. In view of the many factors that may affect processing and application these data do not relieve processors of the responsibility of carrying out their own tests and experiments, neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislations are observed.

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