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Glythermin® NF

Nitrite-free concentrate for protecting heating and cooling circuits from frost and corrosion

Properties

Appearance	Clear liquid	
Boiling point	> 165 °C	ASTM D 1120
Pour point	< –15 °C	ISO 3016
Density (20 °C)	1.120 – 1.125 g/cm^3	DIN 51757/ASTM D 4052
Refractive index n_D^{20}	1.432 – 1.434	DIN 51423
Viscosity (20 °C)	24 – 28 mm^2/s	DIN 51562
pH of concentrate	7 – 8	ASTM D 1287
pH of concentrate diluted 1 : 2 with neutral distilled water	8–9	ASTM D 1287
Alkali reserve	11 – 15 ml M/10 HCl	ASTM D 1121
Flash point	> 100 °C	ISO 2592
Water content	< 4.0 %	ASTM D 1123

Quality control

The above data represent average values that were valid at the time 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

Glythermin NF is a clear, colourless liquid with a faint odour and is based on ethylene glycol.

Glythermin NF is miscible with water in all proportions. Its mixtures with water protect against frost at temperatures of down to –50 °C, depending on their concentration, and lengthen the life of the installations that they protect.

Mixtures of Glythermin NF and water do not demix.

The corrosion inhibitors contained in Glythermin NF allow the metals normally used in heating, refrigeration and mixing installations to be reliably protected for long periods against corrosion, ageing and fouling.

Glythermin NF has excellent stability at high temperatures and prevents the formation of harmful deposits on hot metal surfaces (at temperatures of up to 200 °C) at watt densities as high as about 40 W/cm^2. It thus helps to avoid overheating at heat-transfer surfaces and the formation of deposits in the circuit.

Glythermin NF does not contain any nitrites, phosphates or amines.

Miscibility

Glythermin NF is miscible with all commercial heat transfer fluids based on ethylene glycol.

Applications

The concentration of Glythermin NF should be at least 20 % v/v. in water of drinking quality (100 mg/kg Cl^- max.). However, the protection against frost deteriorates if the Glythermin NF concentration is higher than 58 % v/v.

Temperature stability

Sustained temperatures higher than 140 °C cause premature ageing of the heat-transfer liquid, but brief exposure to temperatures higher than 140 – 200 °C can be tolerated if the liquid is subsequently cooled. At temperatures above 200 °C, the heat-transfer liquid commences to undergo chemical change, with the result that the dependability of the installation may be endangered. A blanket of nitrogen is recommended to lengthen the life of the heat-transfer liquid if the sustained operating temperature is higher than 110 °C.

The anticorrosion effect of a mixture of Glythermin NF and water is evident from the following table, which lists the results of ASTM D-1384-70 corrosion tests.

Average change in weight of coupons in g/m^2

Material	Glythermin NF/ASTM – Water 1 : 2
Copper (F-Cu)	– 0.1
Soft solder (L Pb Sn 30)	± 0.0
Brass (Ms 63)	– 0.1
Cast iron (GG 25)	± 0.0
Steel (H II)	– 0.2
Cast aluminium (G AlSi6Cu4)	– 0.3

The outstanding anticorrosion properties of Glythermin NF/water mixtures have also been demonstrated in high-temperature corrosion tests on cast iron (GG 25) and cast aluminium (G-AlSi10Mg) coupons subjected to the flow and heat-transfer conditions relating to watt densities of up to 40 W/cm^2.

In order to maintain effective protection from corrosion, the concentration of Glythermin NF must not be allowed to fall below 20 % v/v. The corresponding protection against frost is effective at temperatures down to – 9 °C. Concentrations lower than 20 % v/v are insufficient and incur the **risk of corrosion.**

If Glythermin NF is run into existing installations in which only water has previously been circulated, it should be noted that the rust in these systems greatly increases the effective area of contact with the heattransfer fluid. It thus binds the inhibitors contained in the Glythermin NF, with the consequence that their effective concentration may be reduced to such an extent that the protection against corrosion is impaired.

For this reason, the rust in these installations should be flushed out to the utmost extent before the Glythermin NF is run in. In particularly severe cases, pickling with subsequent neutralization of the acid is recommended.

After they have been emptied, installations that have been run temporarily with Glythermin NF must be thoroughly flushed several times to ensure that all residual traces of the product are removed, because any product residues may give rise to increased **corrosion.**

Mixtures of Glythermin NF and water do not attack the sealants normally used in heating systems. The following list of sealants, elastomers and plastics that are resistant to Glythermin NF/water mixtures has been compiled from experimental results, experience, and the literature.

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

Butyl rubber	IIR
Chloroprene	CR
Ethylene-propylene-diene rubber	EPDM
Fluorocarbon elastomers	FPM
Natural rubber up to 80 °C	NR
Nitrile rubber	NBR
Polyacetal	POM
Polyamides at temperatures below 115 °C	PA
Polybutene	PB
Polyethylene, soft/hard	PE-LD/PE-HD
Polyethylene, crosslinked	VPE
Polypropylene	PP
Polytetrafluoroethylene	PTFE
Poly(vinyl chloride), rigid	PVC h
Silicone rubber	Si
Styrene-butadiene rubber at temperatures 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 governed not only by the properties of the rubber itself, e. g. EPDM, but also by the nature and amount of the constituent additives and the vulcanization conditions. For this reason, it is recommended that their resistance to Glythermin NF/water mixtures is checked by performance tests before these elastomers are taken into use for the first time. This applies particularly to elastomers intended as membranes for expansion tanks as described in DIN 4807.

Seals based on 70 EDPM 281* have been shown to be resistant to mixtures of Glythermin NF and water at temperatures of up to 160 °C, and flat-flange gaskets such as REINZ-AFM 34** or Centellen 3820 based on aramid and special NBR*** have been shown to be resistant at temperatures of up to 200 °C.

In some cases, the low surface tension of Glythermin NF/water mixtures may be responsible for leakage if the sealing strips have been produced from polytetrafluoroethylene (PTFE). Likewise, the addition of Glythermin NF in heating systems may allow latent leaks to be detected, because the resultant Glythermin NF/water mixture has better wetting power.

If the leakage cannot be prevented by tightening the connections, the system must be drained. The seals must then be replaced, and the connection must be rechecked to ensure that there is no leakage. It is important that all the connections with renewed seals are retightened after the system has been restarted and brought to the maximum operating temperature.

The procedure for filling installations with forced circulation is to run in about two-thirds of the requisite amount of water first of all.

The Glythermin NF should then be added and the system topped up with the remainder of the water. The Glythermin NF and the water become completely mixed after the circulation pump has been run for several hours.

The Glythermin NF and the water must be completely mixed together before they are filled into installations with natural circulation.

After the installation has been filled, the Glythermin NF content should be checked by measuring the density of the mixture with a hydrometer (see density/concentration diagram). It must be ensured that the hydrometer is free to float in the cylinder.

The Glythermin NF content can also be determined by measuring the refractive index with a refractometer. Values for the density and refractive index of Glythermin NF/water mixtures are presented in the following table.

% vol. Glythermin NF	Density at 20 °C	Refractive index g/cm^3	Frost protection n_D^{20} °C
20	1.029	1.3545	– 9.0
25	1.037	1.3599	– 12.3
30	1.044	1.3653	– 16.1
35	1.052	1.3707	– 20.4
40	1.059	1.3762	– 25.2
45	1.066	1.3816	– 30.8
50	1.073	1.3868	– 37.6
55	1.079	1.3918	– 45.4
58	1.082	1.3947	– 51.0

* *Carl Freudenberg, Dichtungs- und Schwingungstechnik, Postfach 100363, D-69465 Weinheim*
** *REINZ-Dichtungs GmbH, Postfach 1909, D-89229 Neu-Ulm*
*** *Hecker Werke GmbH & Co., D-71093 Weil im Schönbuch*

In view of the specific properties of Glythermin NF, the following instructions must be adhered to for ensuring long-term protection.

1. The installations must be designed as closed circuits, because the entry of atmospheric oxygen causes the inhibitors in Glythermin NF to be consumed more rapidly.

2. Flexible-membrane expansion tanks must conform to DIN 4807.

3 Silver or copper brazing solder should preferably be used for joints. If flux is used that contains chlorine compounds in conjunction with tin-lead solder, it is important that all traces are flushed out of the system, because increased chlorine levels in the heat-transfer fluid can cause corrosion.

4. The only flexible connections that are permissible are hoses, preferably metal, that do not permit the diffusion of oxygen.

5. The surfaces of heat exchangers, tanks and tubes exposed to the heat-transfer liquid must not be galvanized, because zinc is detached by water/glycol mixtures.

6. It must be ensured that no **external** voltages can be applied between parts of the installation that come into contact with the Glythermin NF solution, as otherwise corrosion may occur.

7. The layout of the tubes must ensure that circulation cannot be disturbed by gas pockets or deposits.

8 The level of the heat-transfer liquid must never be allowed to fall below the highest point in the system.

9. Dirt and water must not be allowed to enter the installation or its components during assembly and before filling. After assembly has been completed and the connections have been soldered, the system must be flushed to remove any foreign matter (swarf, fluxes, packaging residues, sawdust, etc.) and assembly aids.

10. It must be ensured that no air pockets remain in the installation after it has been filled.

    It is essential to eliminate gas pockets, because their collapse following a drop in temperature would give rise to a vacuum and thus cause air to be sucked into the system.

11. In order to ensure that there are no obstructions to the flow of the heat-transfer liquid, the in-circuit fillers must be cleaned within 14 days, at the latest, after the installation has been charged and taken into operation for the first time.

12. If leakage or other losses occur, the heat-transfer liquid in the system must be replenished with an aqueous Glythermin NF solution of the same concentration. In cases of doubt, the Glythermin NF content must be determined.

Storage stability

Glythermin NF has a shelf life of at least three years if it is stored in hermetically sealed containers. We do not recommend storing it in galvanized containers, because zinc is attacked by mixtures of glycol and water.

Packaging/form of delivery

Glythermin NF is supplied in road tankers and in 230 kg non-returnable metal drums.

Disposal

Glythermin NF spills must be taken up in an absorbent binder and disposed of in accordance with regulations.

If the pertinent local regulations are observed, Glythermin NF can be disposed of by special treatment, e. g. combustion in an authorized incinerator.

Ecology

Glythermin NF is biodegradable. If it is run with the appropriate care into an acclimated water treatment plant, it will not impair the efficiency of the activated sludge.

Safety

Handling

Glythermin NF may not be used in plants in which there is a possibility that the heat-transfer fluid may come into contact with foodstuffs or potable water. We would recommend using Glythermin P 44 for this type of application, because it is based on propylene glycol and poses no hazard to health.

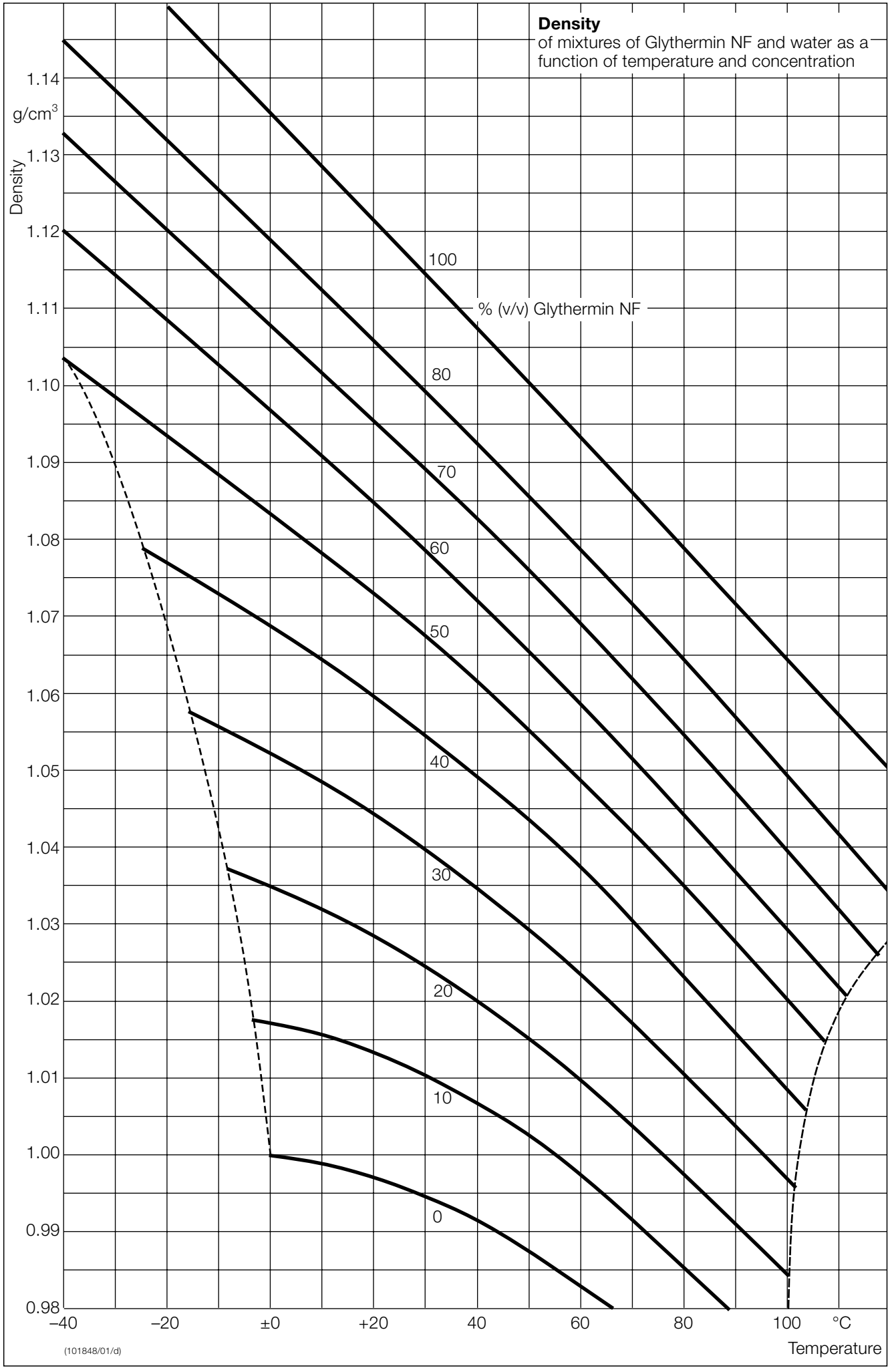
The usual safety and industrial hygiene measures relating to chemicals and flammable liquids must be observed in handling Glythermin NF. The information and instructions given in our Safety Data Sheet must be strictly observed.

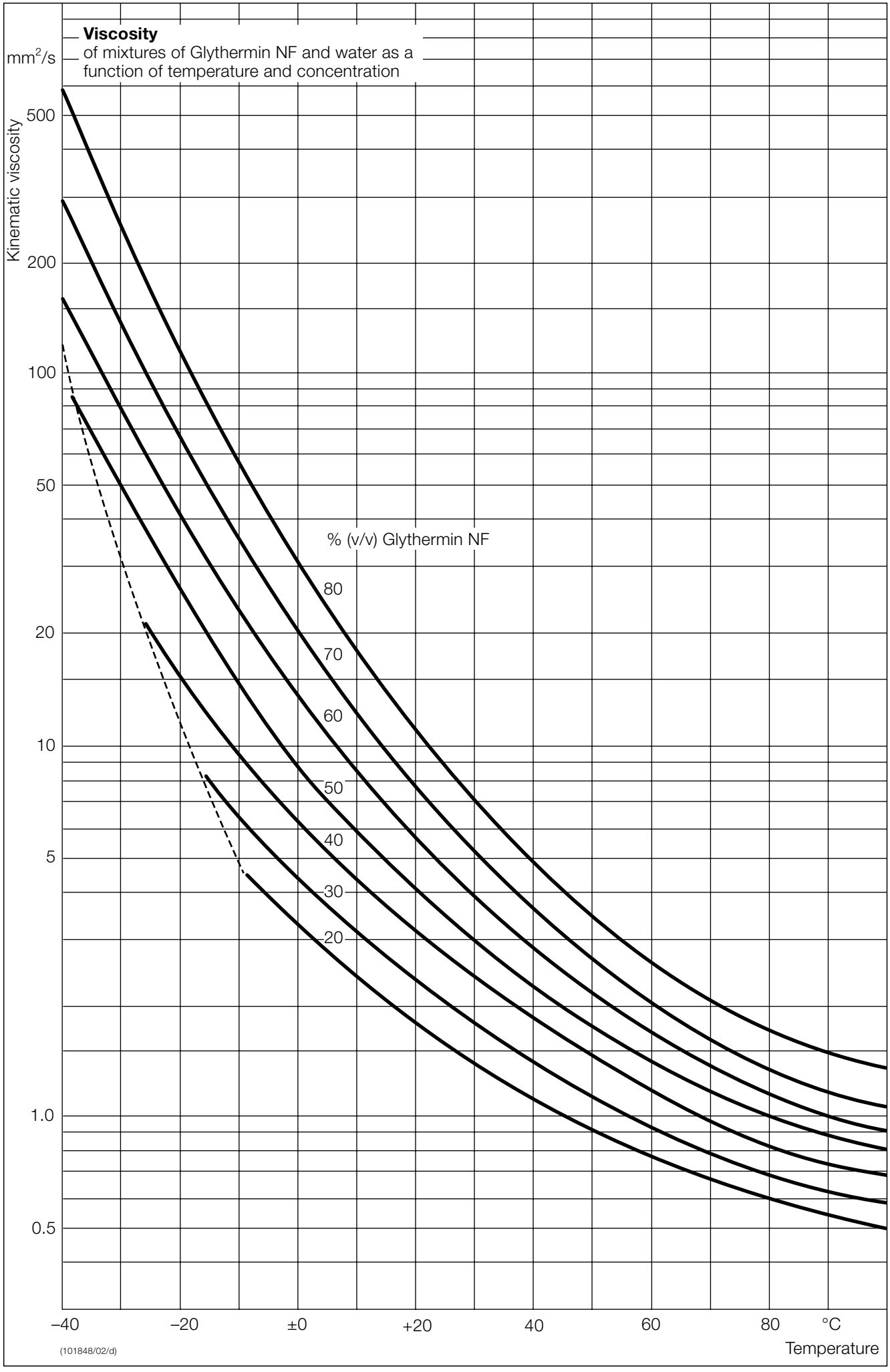
Precautionary measures

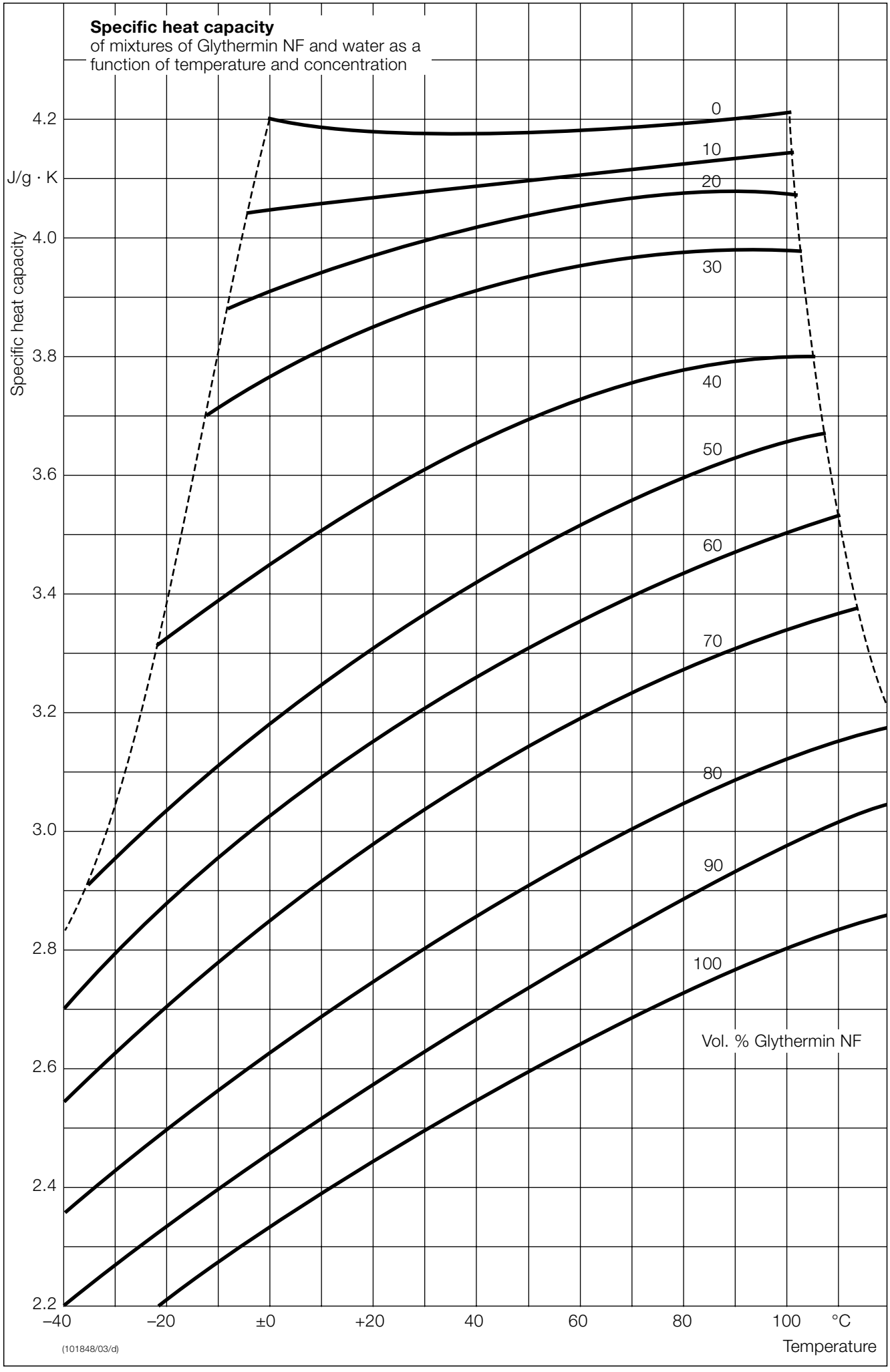
Avoid skin contact.

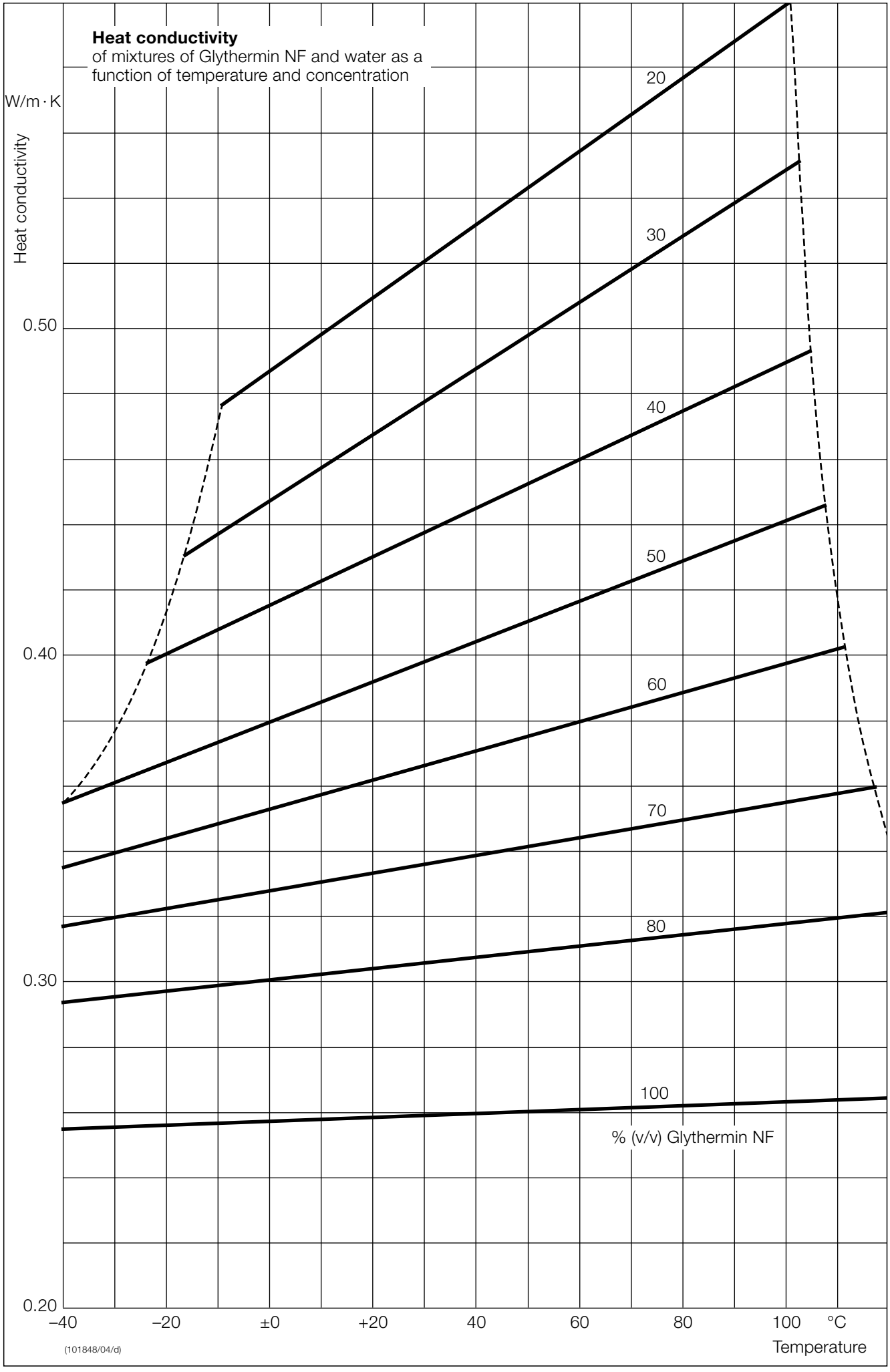
Safety Data Sheet

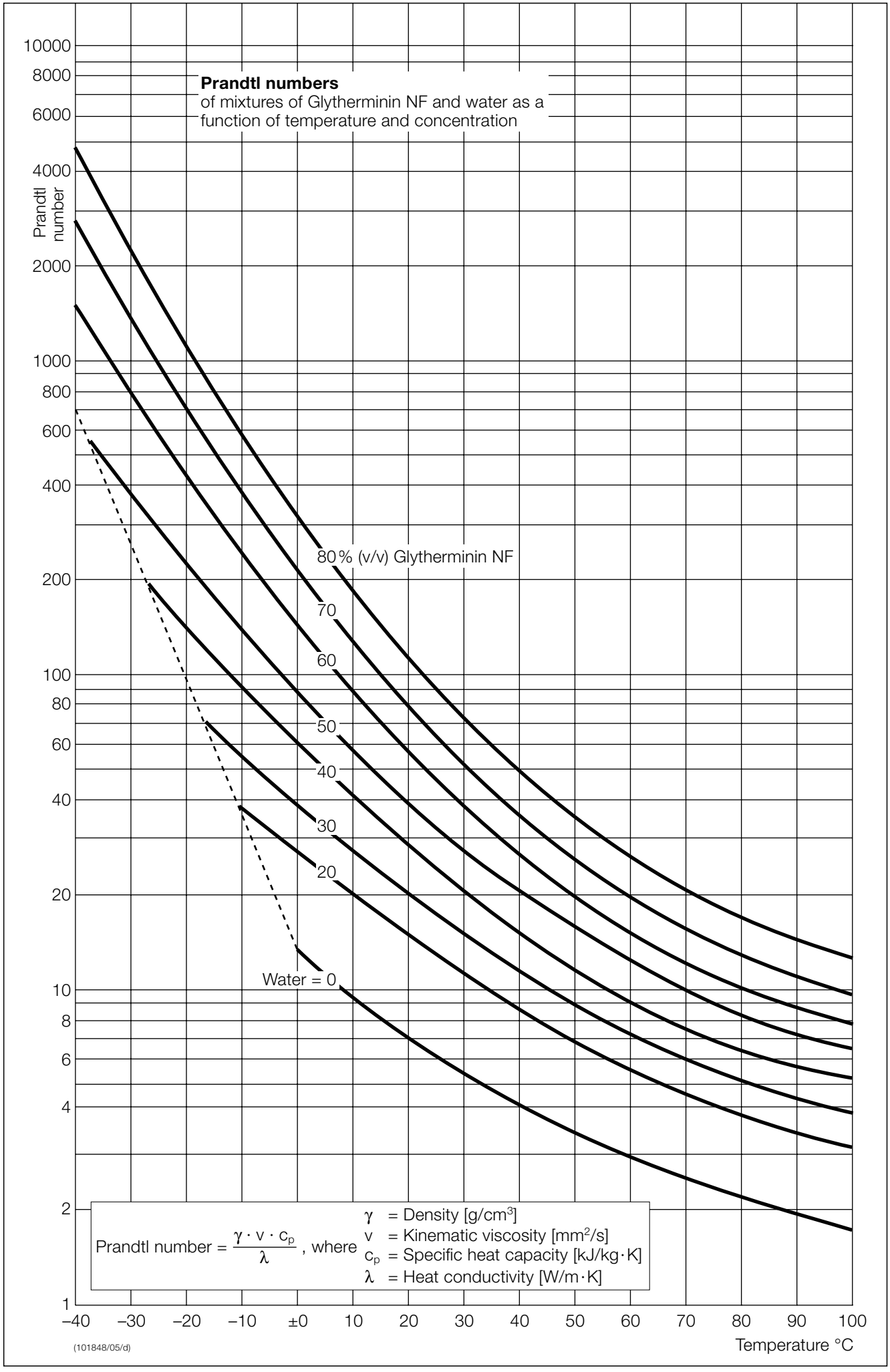
A Safety Data Sheet has been drawn up for Glythermin NF along the lines laid down in the EEC Guideline 91/155/EEC.

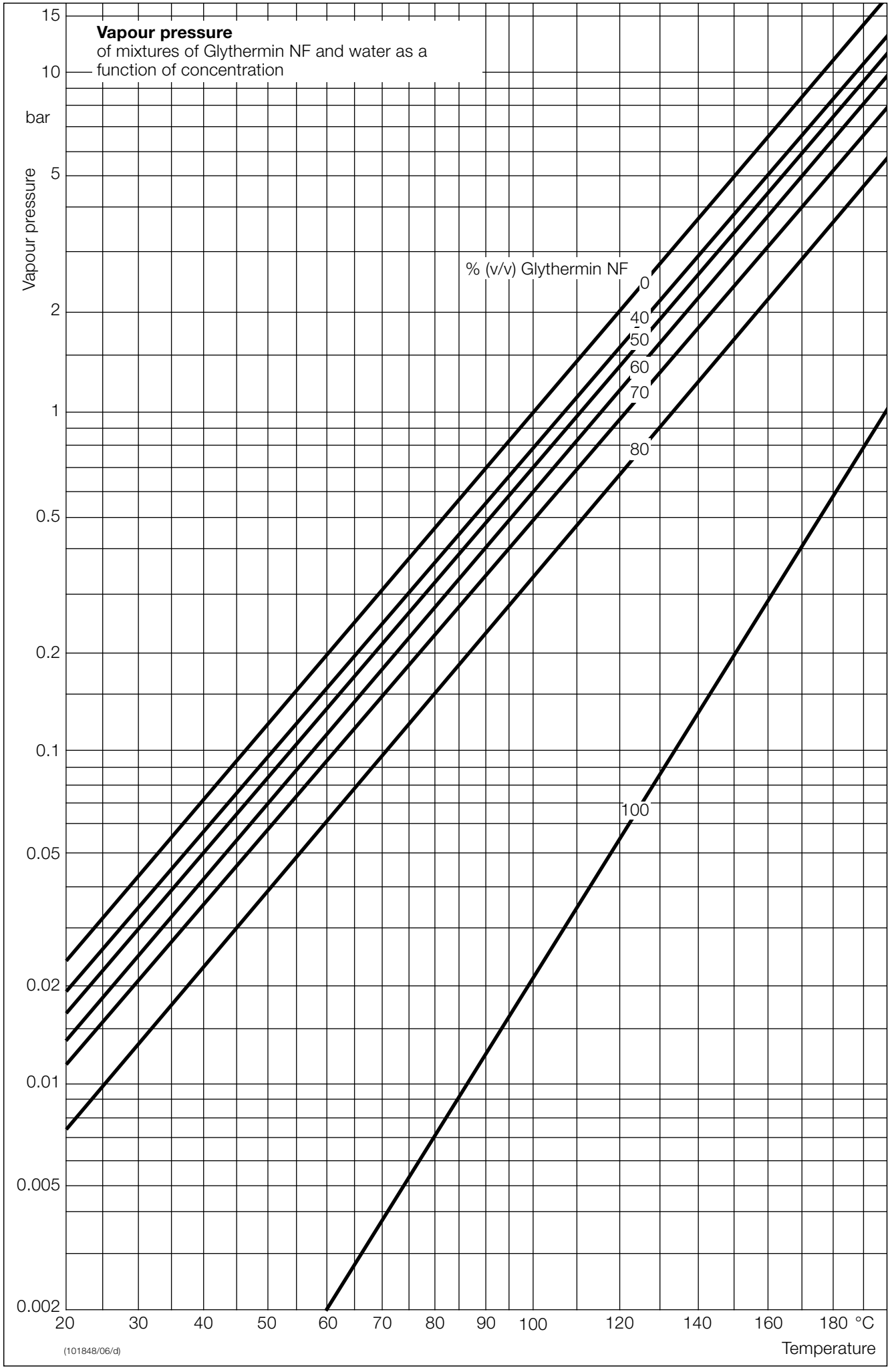

Density
of mixtures of Glythermin NF and water as a function of temperature and concentration
Density
g/cm3
1.14
1.13
1.12
1.11
1.10
1.09
1.08
1.07
1.06
1.05
1.04
1.03
1.02
1.01
1.00
0.99
0.98
100
% (v/v) Glythermin NF
80
70
60
50
40
30
20
10
0
–40
–20
±0
+20
40
60
80
100
°C
Temperature
(101848/01/d)

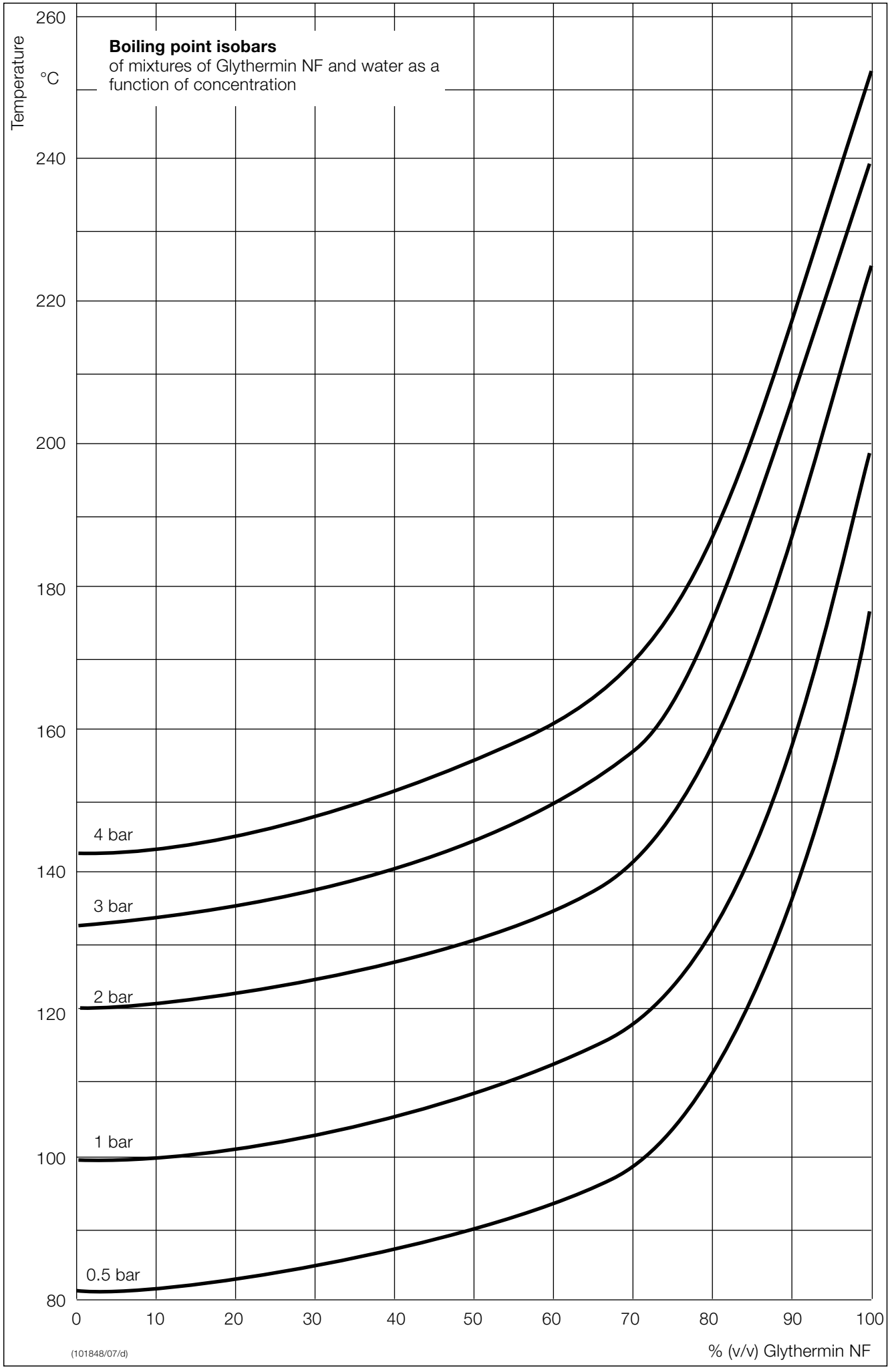

Viscosity
of mixtures of Glythermin NF and water as a function of temperature and concentration
mm²/s
Kinematic viscosity
500
200
100
50
20
10
5
1.0
0.5
% (v/v) Glythermin NF
80
70
60
50
40
30
20
–40
–20
±0
+20
40
60
80
°C
Temperature
(101848/02/d)

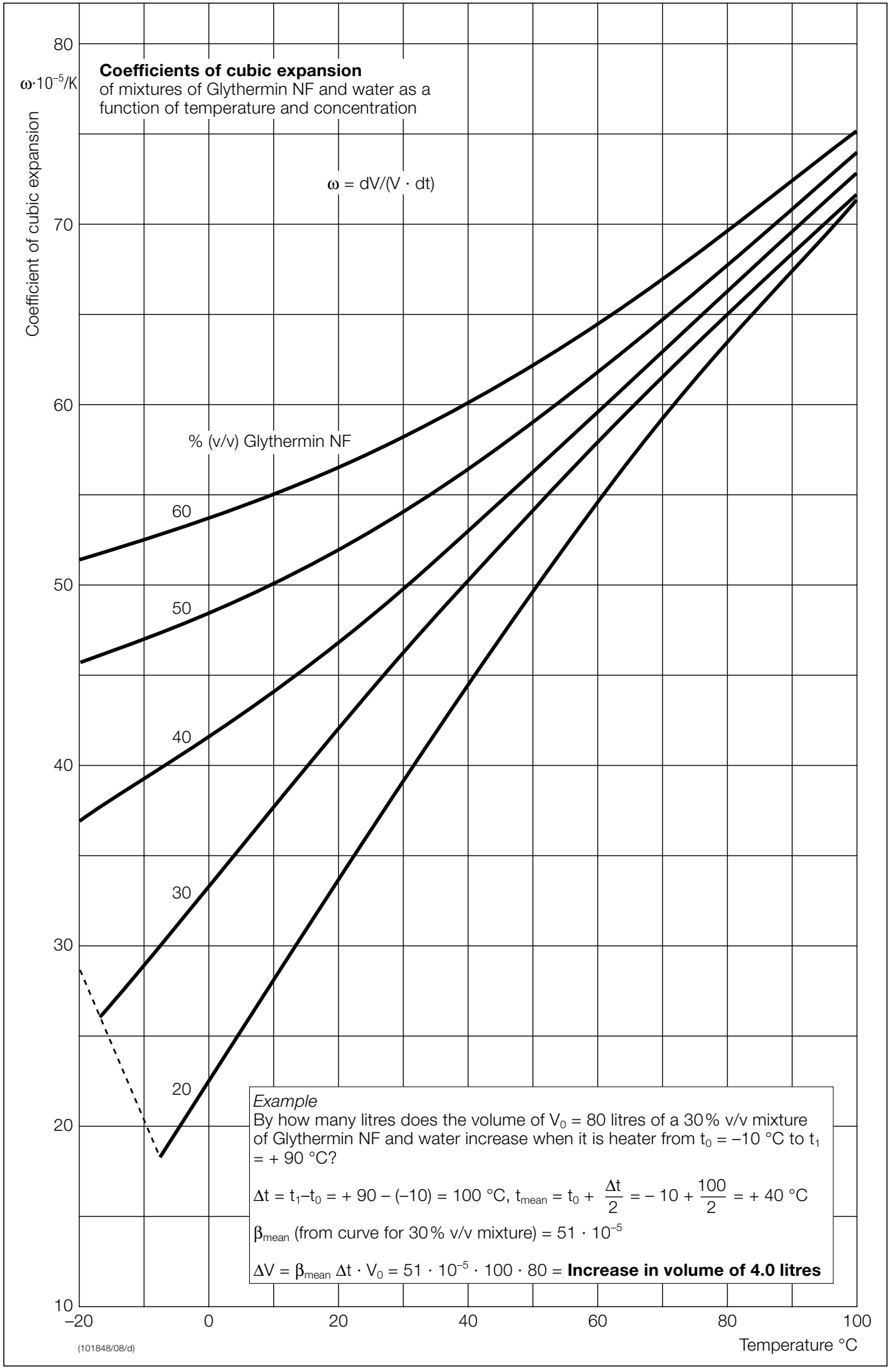

Specific heat capacity
of mixtures of Glythermin NF and water as a function of temperature and concentration
Specific heat capacity
J/g · K
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
0
10
20
30
40
50
60
70
80
90
100
Vol. % Glythermin NF
–40
–20
±0
+20
40
60
80
100
°C
Temperature
(101848/03/d)

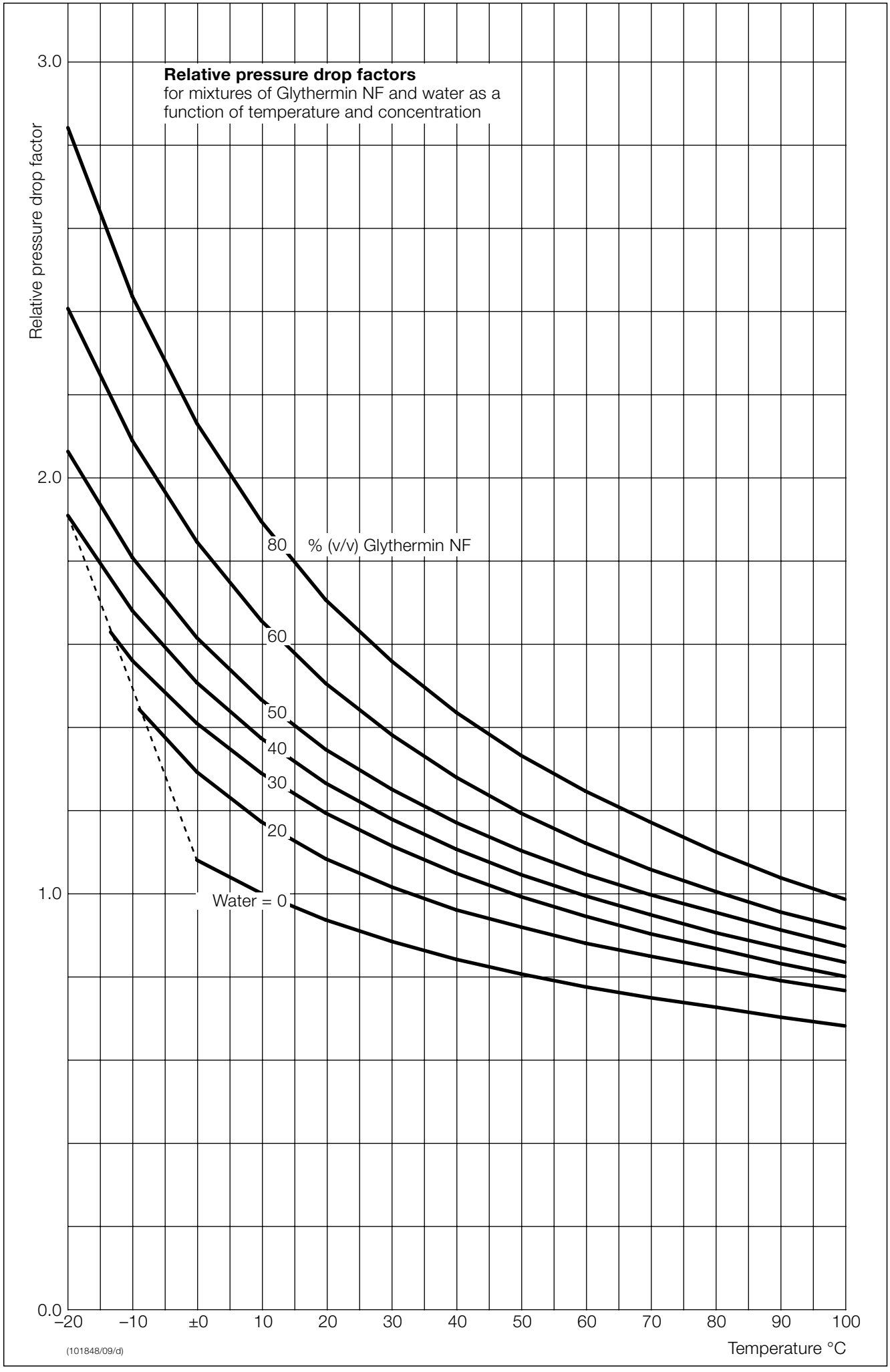

Heat conductivity
of mixtures of Glythermin NF and water as a function of temperature and concentration
W/m · K
Heat conductivity
0.50
0.40
0.30
0.20
20
30
40
50
60
70
80
100
% (v/v) Glythermin NF
–40
–20
±0
+20
40
60
80
100
°C
Temperature
(101848/04/d)

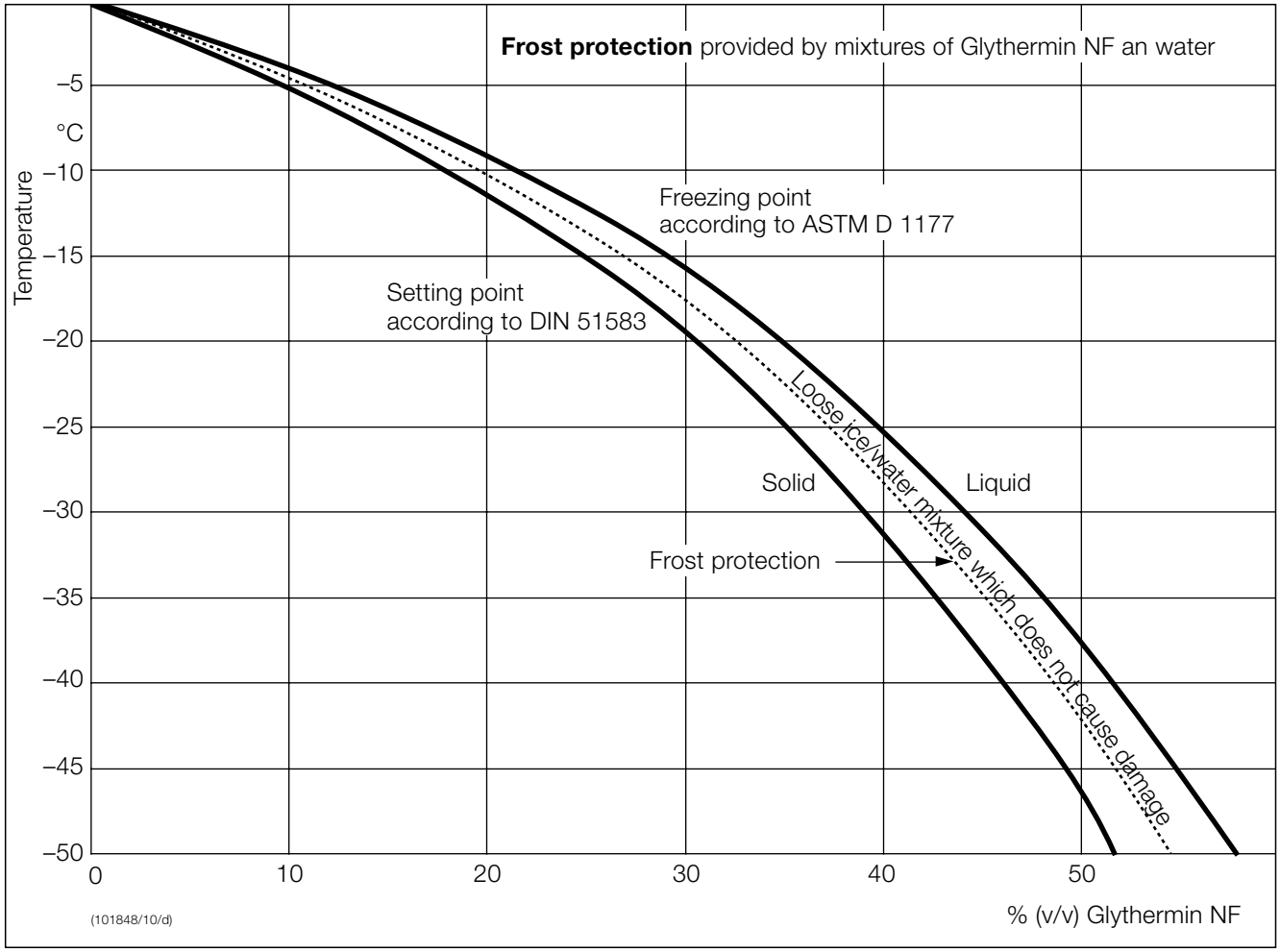

Prandtl numbers
of mixtures of Glytherminin NF and water as a function of temperature and concentration
Prandtl number
10000
8000
6000
4000
2000
1000
800
600
400
200
100
80
60
40
20
10
8
6
4
2
1
80 % (v/v) Glytherminin NF
70
60
50
40
30
20
Water = 0
–40 –30 –20 –10 ±0 10 20 30 40 50 60 70 80 90 100
Temperature °C
Prandtl number = $\frac{\gamma \cdot v \cdot c_p}{\lambda}$, where
γ = Density [g/cm³]
v = Kinematic viscosity [mm²/s]
c_p = Specific heat capacity [kJ/kg·K]
λ = Heat conductivity [W/m·K]
(101848/05/d)


Vapour pressure
of mixtures of Glythermin NF and water as a function of concentration
bar
Vapour pressure
15
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
0.005
0.002
% (v/v) Glythermin NF
0
40
50
60
70
80
100
20
30
40
50
60
70
80
90
100
120
140
160
180 °C
Temperature
(101848/06/d)


Boiling point isobars
of mixtures of Glythermin NF and water as a function of concentration
Temperature
°C
260
240
220
200
180
160
140
120
100
80
4 bar
3 bar
2 bar
1 bar
0.5 bar
0
10
20
30
40
50
60
70
80
90
100
% (v/v) Glythermin NF
(101848/07/d)


Coefficients of cubic expansion
of mixtures of Glythermin NF and water as a function of temperature and concentration
ω·10⁻⁵/K
Coefficient of cubic expansion
ω = dV/(V · dt)
% (v/v) Glythermin NF
60
50
40
30
20
80
70
60
50
40
30
20
10
–20
0
20
40
60
80
100
Temperature °C
(101848/08/d)
Example
By how many litres does the volume of V0 = 80 litres of a 30% v/v mixture of Glythermin NF and water increase when it is heater from t0 = –10 °C to t1 = + 90 °C?
Δt = t1–t0 = + 90 – (–10) = 100 °C, tmean = t0 + Δt/2 = – 10 + 100/2 = + 40 °C
βmean (from curve for 30% v/v mixture) = 51 · 10⁻⁵
ΔV = βmean Δt · V0 = 51 · 10⁻⁵ · 100 · 80 = Increase in volume of 4.0 litres


Relative pressure drop factors
for mixtures of Glythermin NF and water as a function of temperature and concentration
Relative pressure drop factor
3.0
2.0
1.0
0.0
80 % (v/v) Glythermin NF
60
50
40
30
20
Water = 0
–20
–10
±0
10
20
30
40
50
60
70
80
90
100
Temperature °C
(101848/09/d)



Note

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out their own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed.

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BASF Aktiengesellschaft
Performance Chemicals for
Automotive and Refinery Industry
67056 Ludwigshafen, Germany
www.basf.com/automotive-oil