

Tyfocor[®]



Technical Information

® = Registered Trademark

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

October 1995 (JWF)
Supersedes edition of July 1991



Tyfocor

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
Refractive index n ₂₀	1.432-1.434	DIN 51423
Viscosity (20 °C)	24-28 mm ² /s	DIN 51562
pH of concentrate	7-8	ASTM D 1287-78
pH of concentrate diluted 1 :2 with neutral distilled water	8-9	ASTM D 1287-7
Alkali reserve	11-15 ml 0.1N HCl	ASTM D 1121
Flash point	>120 °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

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

Tyfocor 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 Tyfocor and water do not demix.

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

Tyfocor 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/cm². It thus helps to avoid overheating at heat-transfer surfaces and the formation of deposits in the circuit.

Tyfocor does not contain any nitrites, phosphates or amines.

Miscibility

Tyfocor is miscible with all commercial antifreezes based on ethylene glycol.

Applications

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

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 Tyfocor 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/m²

Material	Tyfocor/ASTM - Water 1:2
Copper (SfCu)	-0.1
Soft solder (L SN 30)	0.0
Brass (Ms 63)	-0.1
Cast iron (GG 26)	0.0
Steel (boiler plate)	-0.2
Cast aluminium (G AlSi6Cu4)	-0.3

The outstanding anticorrosion properties of Tyfocor/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/cm².

In order to maintain effective protection from corrosion, the concentration of Tyfocor 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 Tyfocor 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 heat-transfer fluid. It thus binds the inhibitors contained in the Tyfocor, 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 Tyfocor 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 Tyfocor 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 Tyfocor and water do not attack the sealants normally used in heating systems. The following list of sealants, elastomers and plastics that are resistant to Tyfocor/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
Nitrile rubber	NBR
Polyamides at temperatures below 115 °C	PA
Polyethylene, soft/hard	PE-LD/PE-HD
Polyethylene, crosslinked	VPE
Polypropylene	PP
Polytetrafluoroethylene	PTFE
Poly(vinyl chloride), rigid	PVC h
Styrene-butadiene rubber at temperatures below 100 °C	SBR
Unsaturated polyester resins	UP

Phenolic and urea resins, plasticised 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 vulcanisation conditions. For this reason, it is recommended that their resistance to Tyfocor/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.

Gaskets that have proved to be resistant to hot mixtures of Tyfocor and water are those produced from an aramid/special NBR, e.g. Centellen 3820*.

In some cases, the low surface tension of Tyfocor/water mixtures may be responsible for leakage if the sealing strips have been produced from polytetrafluoroethylene (PTFE). Likewise, the addition of Tyfocor in heating systems may allow latent leaks to be detected, because the resultant Tyfocor/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 Tyfocor should then be added and the system topped up with the remainder of the water. The Tyfocor and the water become completely mixed after the circulation pump has been run for several hours.

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

After the installation has been filled, the Tyfocor 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 Tyfocor content can also be determined by measuring the refractive index with a refractometer. Values for the density and refractive index of Tyfocor/water mixtures are presented in the following table

% vol. Tyfocor	Density at 20 °C g/cm ³	Refractive index n _D ²⁰	Frost protection °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

In view of the specific properties of Tyfocor, 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 Tyfocor to be consumed more rapidly.
- 2 Flexible-membrane expansion tanks must conform to DIN 4807.
- 3 Silver or copper brazing solders must be used for the joints. Fluxes must not contain any chloride.
- 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.

* Manufacturer: Hecker Werke GmbH & Co
71093 Weil im Schonbuch, Germany

- 6 It must be ensured that no **external** voltages can be applied between parts of the installation that come into contact with the Tyfocor 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 filters 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 Tyfocor solution of the same concentration. In cases of doubt, the Tyfocor content must be determined.

Storage stability

Tyfocor has a shelf life of at least five years in airtight containers. It should not be stored in galvanized containers.

Packaging

Tyfocor is delivered in road tankers, 235 kg non-returnable drums, and in 34 kg plastic non-returnable cans.

Disposal

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

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

The German waste code number is 55303.

Regulations on waste avoidance and disposal must be observed.

Ecology

In the light of German legislation on water pollution, we ourselves would classify Tyfocor as a substance that generally presents no hazard, i.e. in the German WGK (0) category.

Tyfocor 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

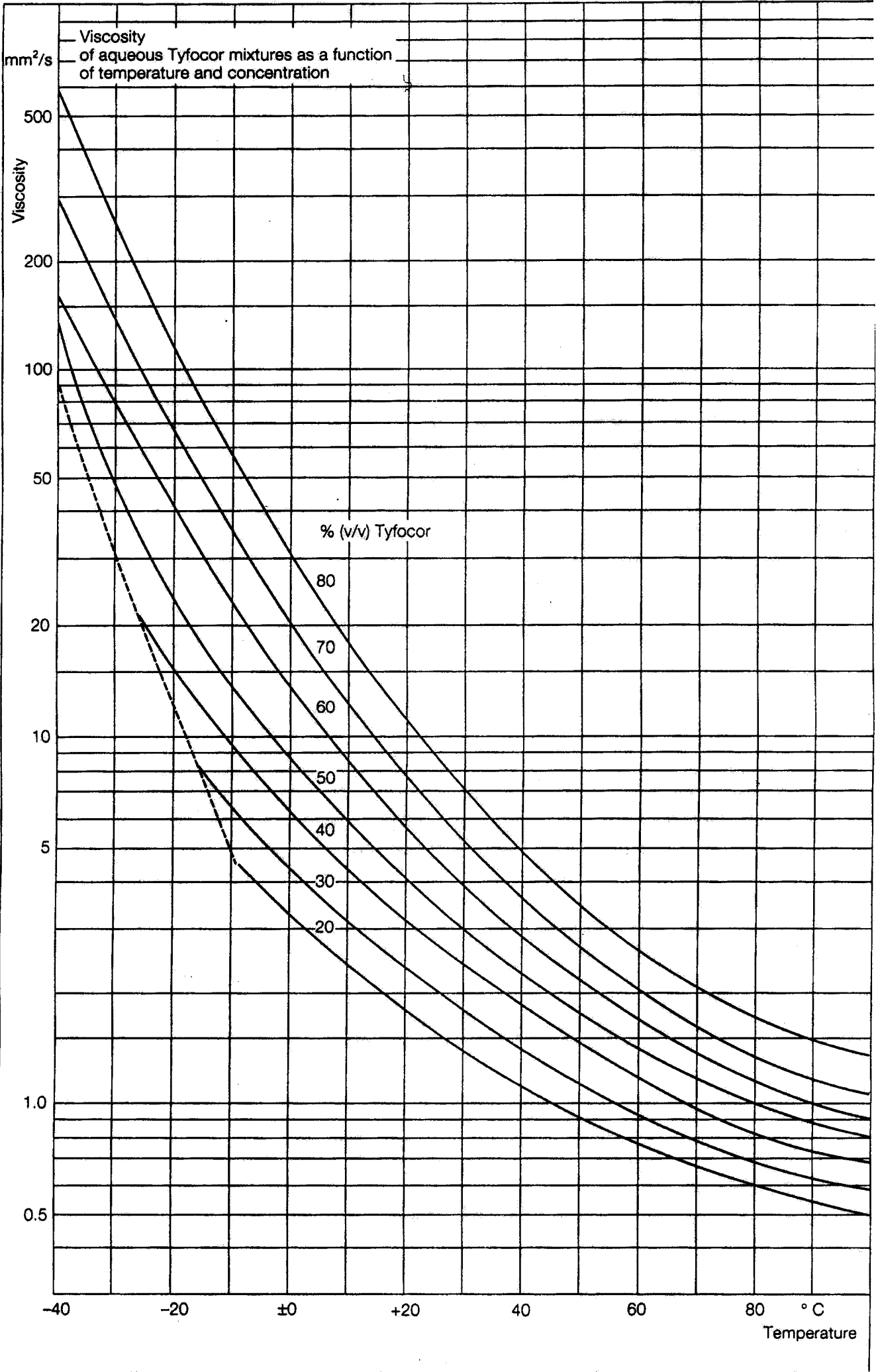
The usual safety and industrial hygiene measures relating to chemicals and flammable liquids must be observed in handling Tyfocor. The information and instructions given in our Safety Data Sheet must be strictly observed.

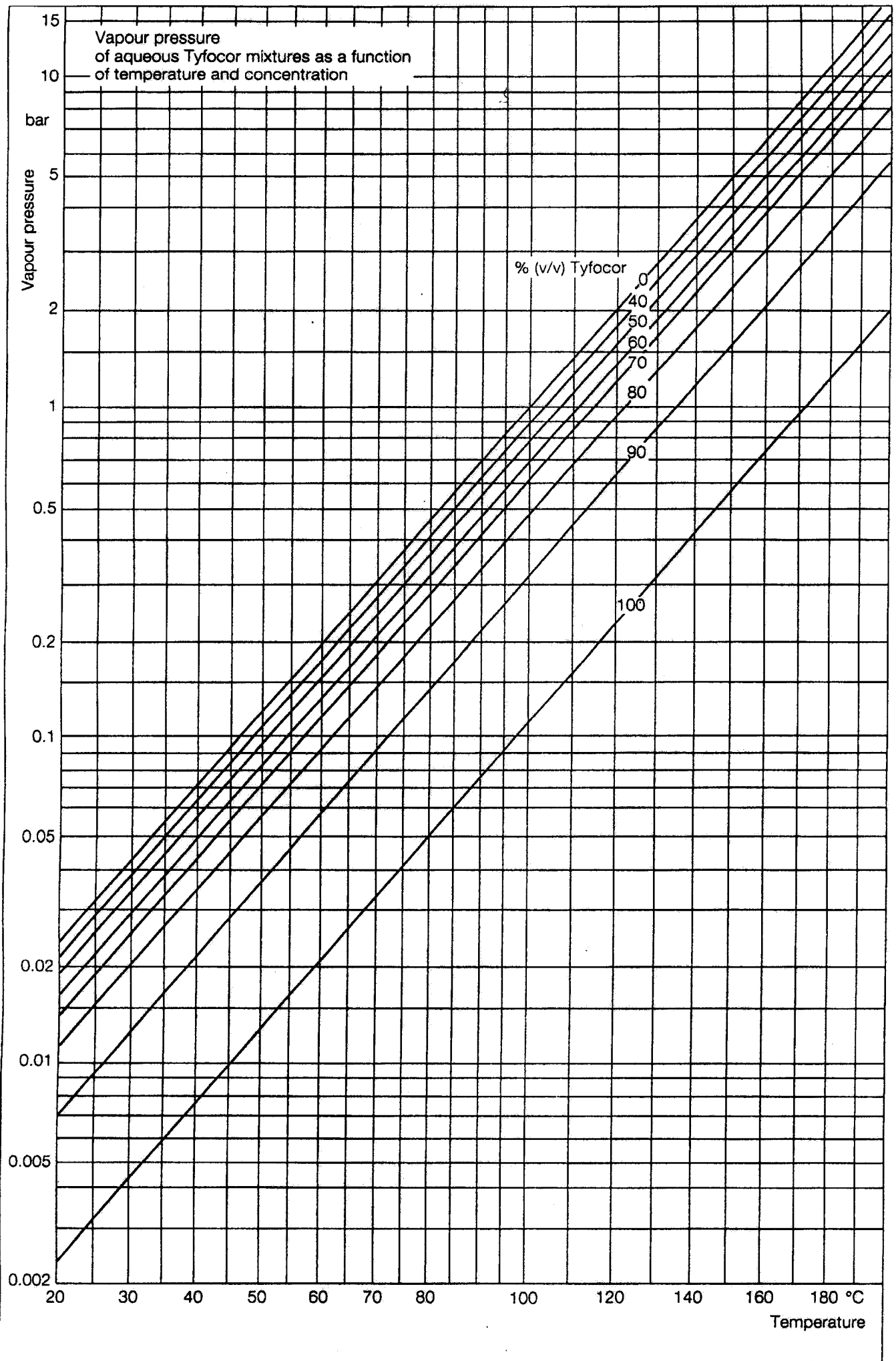
Precautionary measures

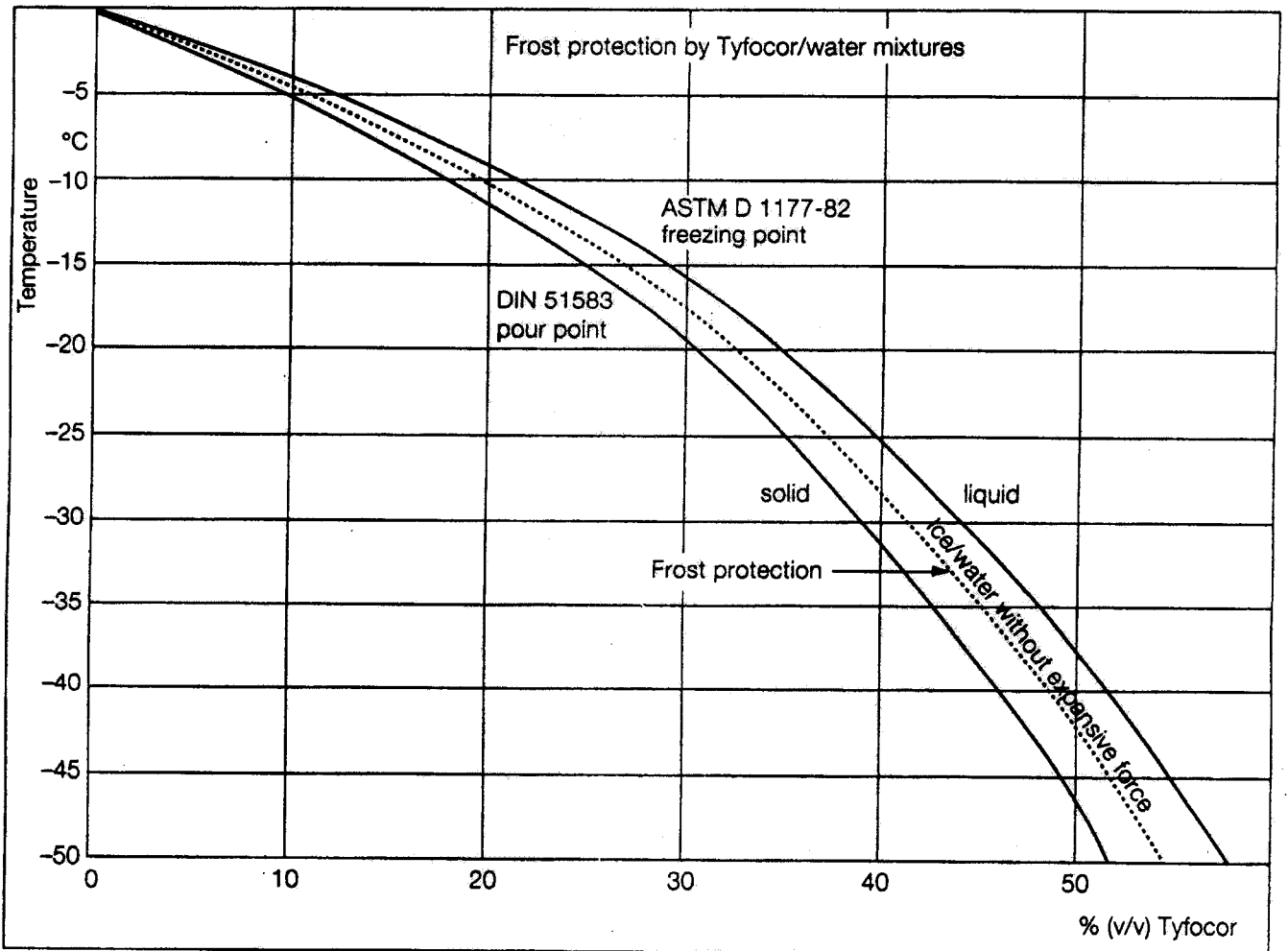
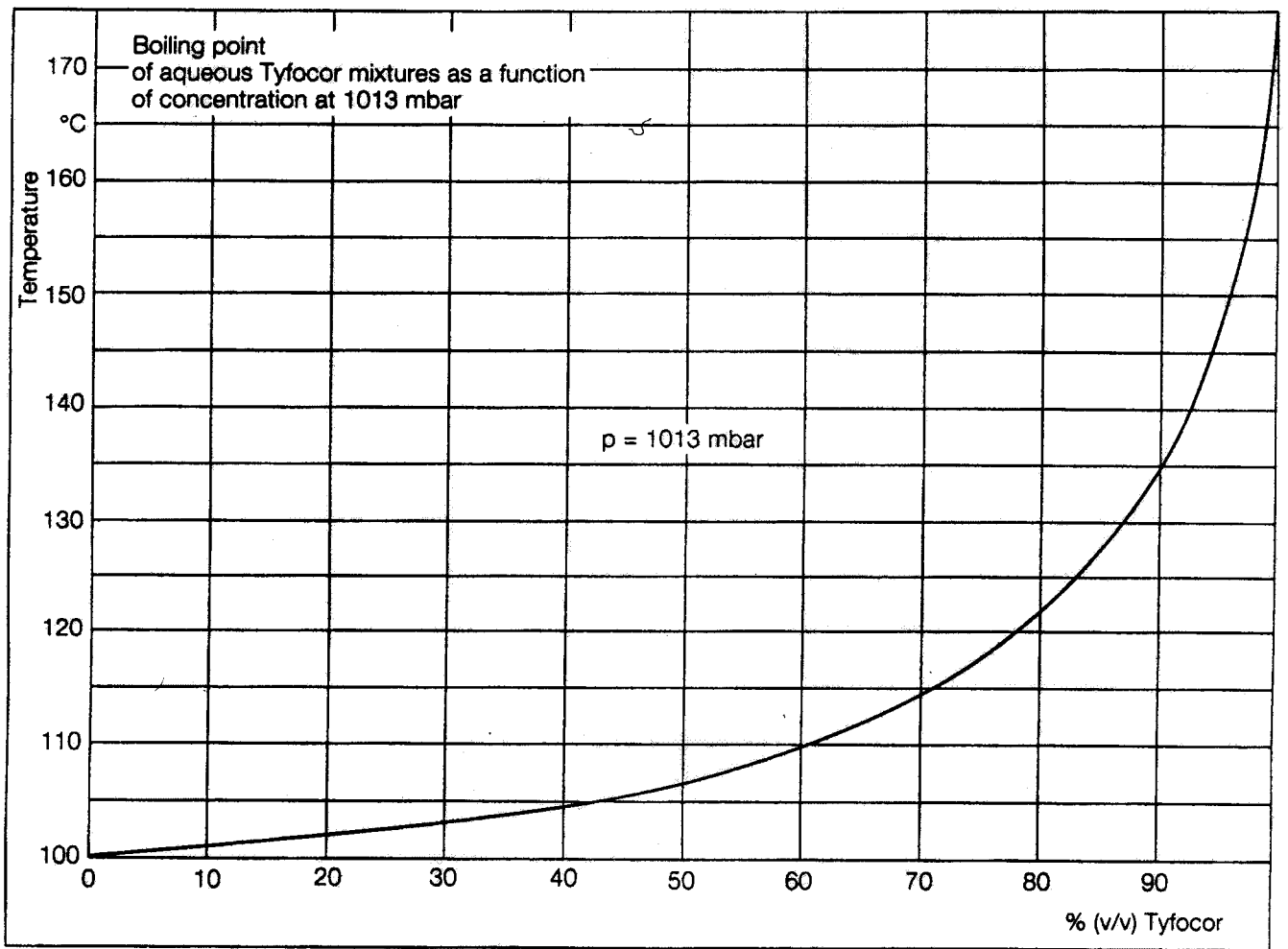
Avoid skin contact.

Safety data sheet

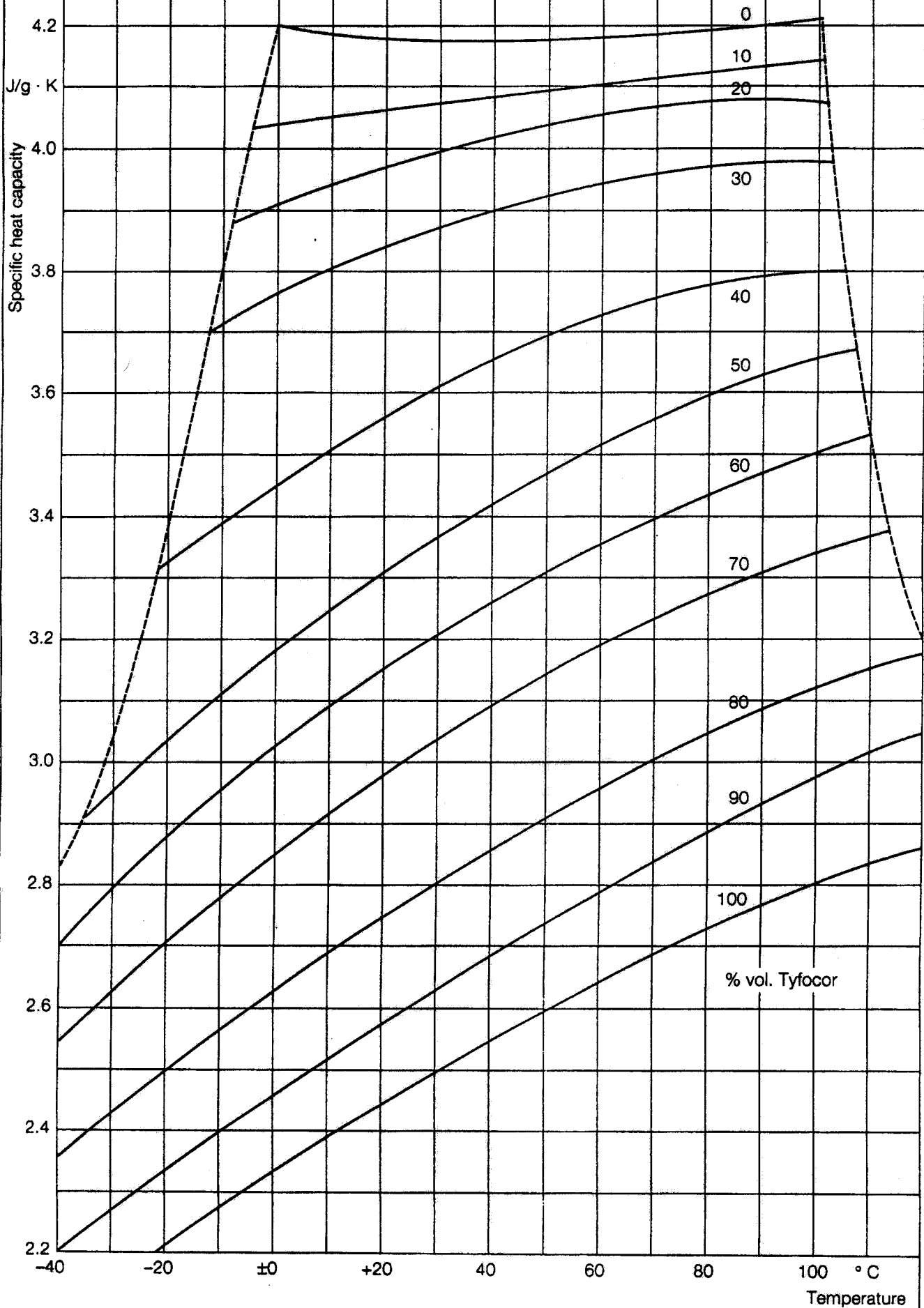
A Safety Data Sheet has been drawn up for Tyfocor along the lines laid down in the EEC Guideline 91/155/EEC.







Specific heat capacity
of aqueous Tyfocor mixtures as a function
of temperature and concentration



Thermal conductivity
of aqueous Tyfocor mixtures as a function
of temperature and concentration

W/m·K

Thermal conductivity

0.50

0.40

0.30

0.20

-40

-20

±0

+20

40

60

80

100 °C

Temperature

20

30

40

50

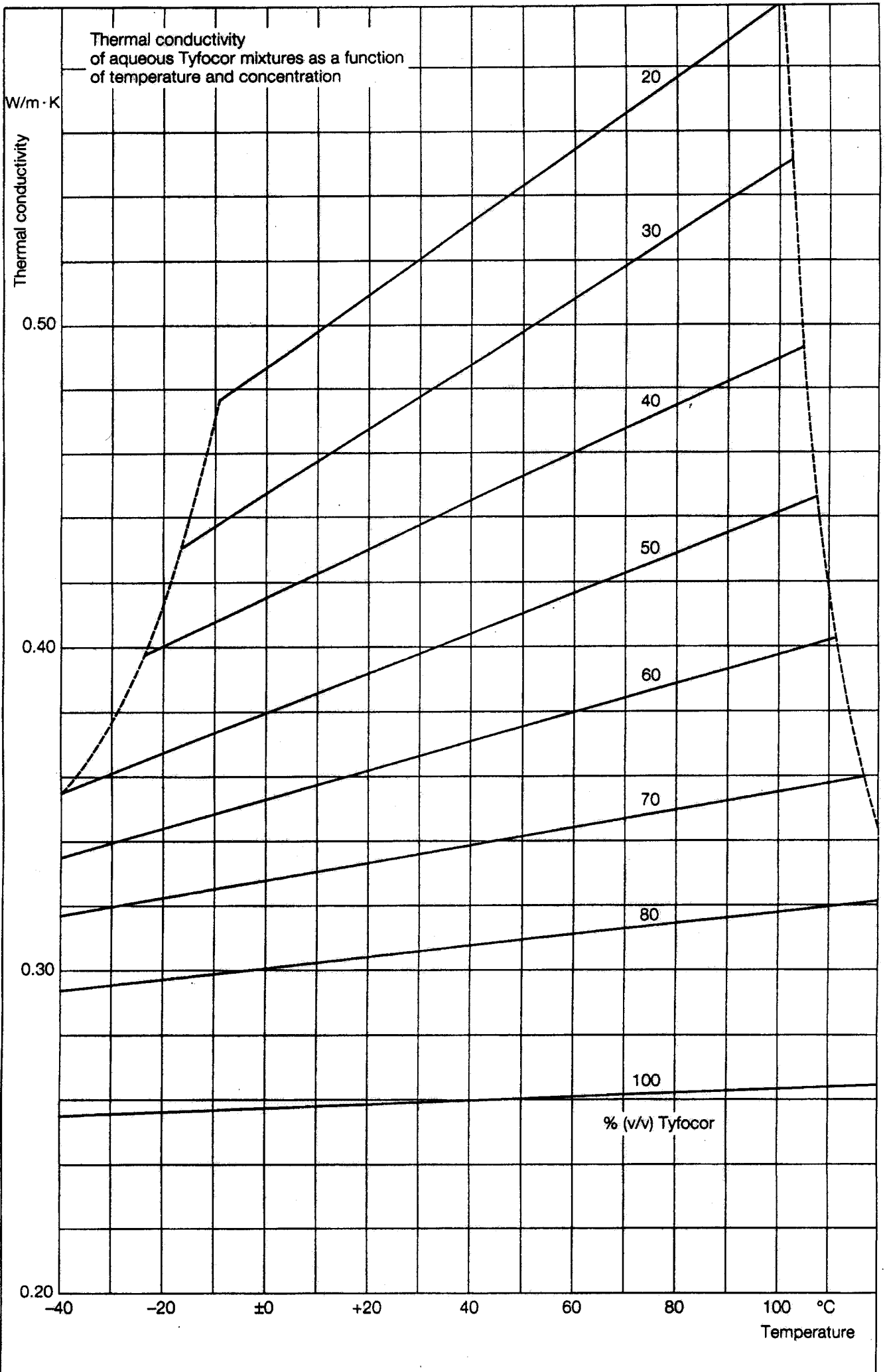
60

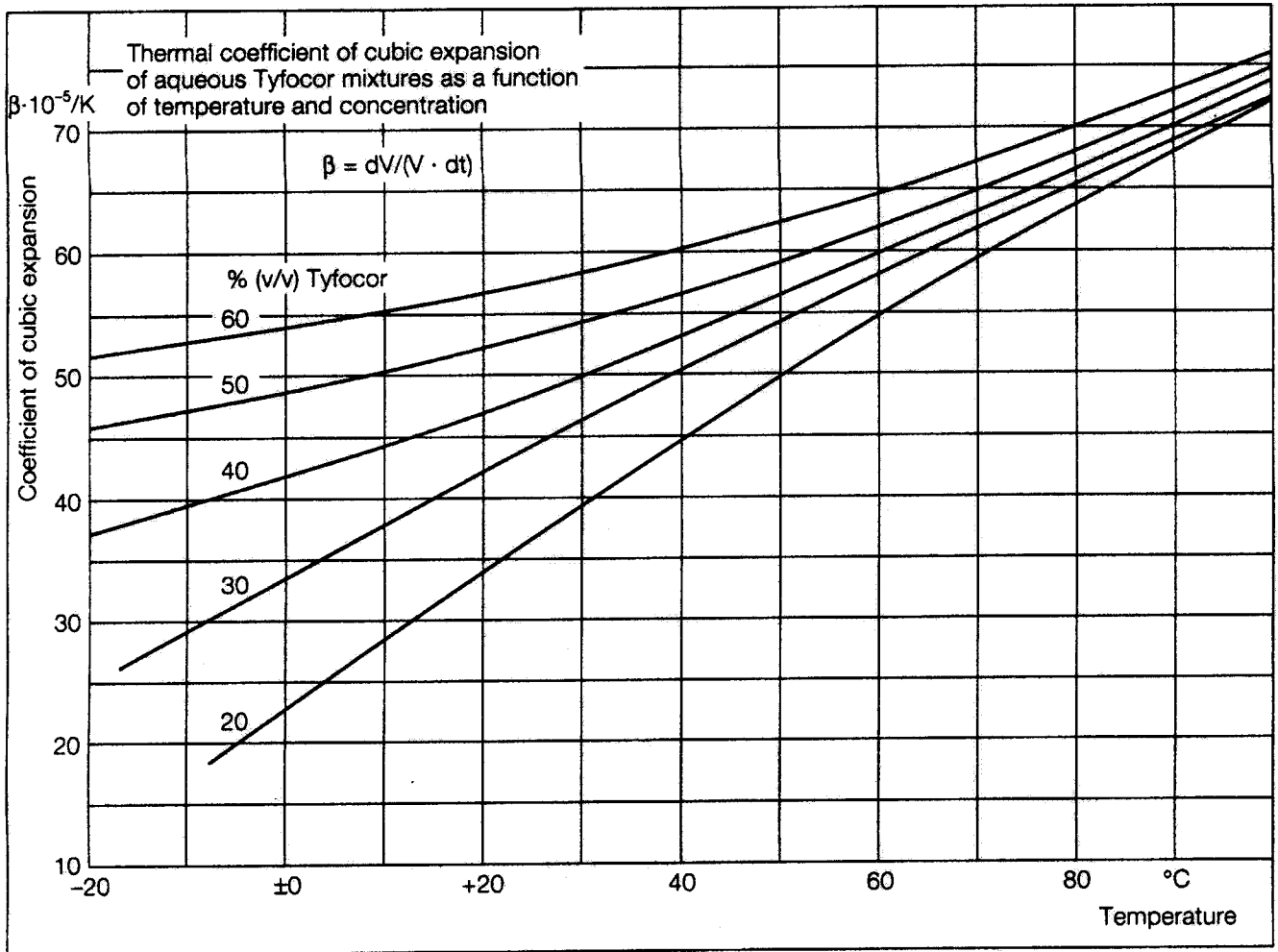
70

80

100

% (v/v) Tyfocor





Example

What would be the increase in volume in litres if $V_0 = 80$ l of a mixture consisting of 30% vol. of Tyfocor in water were to be heated from $t_0 = -10$ °C to $t_1 = 90$ °C?

$$\Delta t = t_1 - t_0 = 90 - (-10) = 100 \text{ °C}$$

$$t_{av} = t_0 + \frac{\Delta t}{2} = -10 + \frac{100}{2} = 40 \text{ °C}$$

$$\beta_{av} \text{ (read off against curve for 30\% vol.)} = 51 \times 10^{-5}$$

$$\text{Increase in volume } \Delta V = \beta_{av} \Delta t V_0 = 51 \times 10^{-5} \times 100 \times 80 = 4.0 \text{ l}$$

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 law and legislation are observed



EEC – SAFETY DATA SHEET

Acc. 91/155/EEC

Last Revision Date: 01/07/97

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1. Identification of compound/preparation, and company

Trade name: TYFOCOR®

Distributor: Environmental Process Systems Limited, Unit 18, The Business Village,
Wexham Road, Slough, UK, SL2 5HF
Tel: +44 (0)1753 692212 Fax: +44 (0)1753 692457
e-mail: info@epsltd.co.uk

Producer: Tyforop Chemie GmbH, Hamburg, Germany

2. Composition/Information on ingredients

Chemical characterisation: Inhibited ethylene glycol solution
CAS No: 000107-21-1 EINECS No: 203-473-3

3. Possible dangers

R22 – harmful if swallowed

4. First aid measures

Contact with eyes	Rinse thoroughly with plenty of water for at least 10 minutes, keeping eyes open
Contact with skin	Wash affected parts thoroughly with soap and water
Inhalation	Expose person to fresh air, consult a physician
Swallowing	Wash out mouth cavity with water, do not try to induce vomiting. Call a physician
Advice for the physician	Early administration of ethanol may prevent the toxic effects of ethylene glycol. Haemodialysis or peritoneal dialysis can be helpful, according to present experiences

5. Measures to be taken in the event of fire

Suitable extinguishing agents	Water spray, carbon dioxide, alcohol resistant foam, and dry extinguishers
Dangerous combustion products	Not known. In cases of complete water evaporation combustion will result in carbon dioxide and water
Special safety equipment	Use respiratory protective device. Wear fire brigade clothing

Special dangers caused by the substance itself or during its production, by its combustion products or gases thus generated Ethylene glycol and its aqueous solutions may form flammable vapour-air mixtures upon heating

6. Accidental release measures

Personal protective measures	Avoid excessive contact with skin and eyes. In case of release of larger amounts remove contaminated clothing and wash body down thoroughly with water
Environmental protection measures	Do not discharge product into natural waters without pretreatment (biological treatment plant). Bind the liquid by using a suitable absorbent material (sawdust, sand, etc.) and dispose of in accordance with local regulations
Process of cleaning/absorption	Wash away spills thoroughly with large quantities of water. In case of release of larger quantities which might flow into the draining system or waters, contact the appropriate authorities.

7. Handling and storage

Handling	Ensure thorough ventilation of stores and work areas. When correctly used, no special measures required. Avoid contact with skin and eyes
Fire and explosion protection	If exposed to fire keep containers cool by spraying with water
Storage	Store in polyethylene or steel containers. Do not expose containers to direct sunlight. Earth all containers and equipment. Storage in galvanised containers is not recommended

8. Measures to restrict exposure and for personnel protection equipment

Additional comments regarding the design of the technical installations	see item 7
Workplace related limits to be controlled	MAK value (D-1993): 10 ppm/ 26 mg/m ³
Personal protection equipment	
Breathing protection	Not required
Eye protection	Not required
Hand protection	Rubber gloves
Body protection	Closed working clothing
General safety and hygiene measures	Handle in accordance with good industrial hygiene and safety practice. Females of childbearing age should not come into contact with the product

Physical and chemical characteristics

Form	Liquid
Colour	Colourless
Odour	Almost odourless
Boiling point	>155 °C
Freezing point	<-18 °C
Density at 20 °C	approx. 1.12 g/cm ³
Vapour pressure at 20 °C	2 mbar
Viscosity at 20 °C	20-30 mm ² /s
Solubility in water	completely soluble
pH value (500 g/l 20 °C)	7-9
Flash point	>100 °C
Ignition temperature	>200 °C
Lower explosion limit	3.0 vol%
Upper explosion limit	15.0 vol%

10. Stability and reactivity

Chemical stability Stable with usual handling and storage

Substances to be avoided Oxidising agents (e.g. reaction with HNO₃ leads to formation of nitric acid esters)

11. Toxicological data

Acute oral toxicity (LD₅₀): >2000 mg/kg (rat)
Primary skin irritation (OECD 404): non-irritant to rabbit
Primary mucosal membrane irritation (OECD 405): non-irritant to rabbit's eyes
Inhalation risk (rat): no diagnosis

Uptake of kidney damaging amounts is possible via absorption through the skin. Oral uptake of higher doses has led to embryotoxic effects in animal tests.

Experience in humans Lethal dose if swallowed is approx. 1.5 g/kg body weight. Lethal dose approx. 90-110 g for adults and correspondingly less for children. Smaller doses can result in kidney damage, damage to central nervous system, and impaired conscious ability

Contact with eyes Temporary burning and redness may occur

Contact with skin Occasional contact produces no or only slight effects. In case of repeated exposure towards larger amounts, the product might be reabsorbed in harmful doses

Inhalation Inhalation of mists or aerosols may lead to irritation of mucosal membranes in the respiratory system

Swallowing Irritation of mucosal membranes and digestive system possible

Mutagenicity No evidence of mutagenic effects

Carcinogenicity Not carcinogenic

Additional information When correctly used as prescribed the product will not, according to best available knowledge and experience, be damaging to health

12. Ecological data

Elimination information Test method: OECD 302 B/ISO 9888/EEC 88/3032 C
>70% (Zahn-Wellens test): easy to eliminate

The product will not affect the activity of activated sludge in a biological effluent clarification plant if introduced correctly according to local regulations

Water danger class (wdc) 0 (self-classification)

Toxicity to fish LC₅₀: >10,000 mg/l (Leuciscus idus, 96h)

13. Information about the disposal of toxic waste

Disposal TYFOCOR® must be disposed of by special means, e.g. suitable incineration, in accordance with local regulations
Waste code no. 55303 (Germany)

Contaminated packaging Contaminated packaging may be used again after cleansing it thoroughly

14. Transportation data

Not subject to the regulations for inflammable liquids. May be sent by post

GGVE/RID: -	GGVS/ADR: -	IMDG-Code: -
UN-No: -	IATA-DGR: -	TA-air: -

The product is not classified according to transport regulations

15. Regulations

The product is not subject to registration according to paragraph 2 (1) 2 of the GefStoffV (German regulations of dangerous goods) and therefore does not have to be marked by law. However, in accordance with the data to hand, we voluntarily mark the product according to appendix 1, No. 1.1 of the GefStoffV concerning the EC-guide to Classification and Marking

Contents	Ethandiol
Symbol	X _n Harmful to health
R-phrases	22 Harmful to health if swallowed
S-phrases	2 Keep out of reach of children 24-25 Avoid contact with skin and eyes 46 If swallowed seek medical advice immediately and show the container label

Water danger class (wdc) 0 (self classification)

In dealing with chemicals observe the usual protection measures. When storing observe the "Wasserhaushaltsgesetz" of 16 October 1976 (BGB 11, p.373), including the 1st addendum of 26 April 1987 (German Water Metabolism Law)

16. Further information

This safety data sheet is intended to provide information and recommendations as to how to handle chemical substances and preparations in accordance with the essential requirements of safety precautions and physical, toxicological, and ecological data, and how to handle, store, transport, and use them safely.

No liability for damage occurring in connection with the use of this information or with the use, application, adaptation, or processing of the products here described will be accepted. An exception will be made in the case that our legal representatives should come to be held responsible and liable by reason of intent or gross negligence. No liability will be accepted for damage indirectly incurred.

We provide this information and data according to our present level of knowledge and experience. No assurances concerning the characteristics of our product are hereby furnished