

## ® Antifrogen N

Antifreeze and corrosion inhibitor for refrigeration, heat pump and hot water heating systems; leak detector fluid

### *Product description*

Antifrogen N is a clear liquid, tinted pale yellow, for use as a heat transfer medium in closed hot water heating systems, heat pumps and as a cooling brine in industrial refrigeration equipment. Antifrogen N is not suitable for the use in food or pharmaceutical applications. Alternatively, the use of Antifrogen L is recommended.

- Based on monoethylene glycol and anticorrosion additives
- Minimal usage concentration: 20 % v/v
- Permanent usage temperatures: approx. -35 to +150°C
- Suitability of plastics/elastomers → page 4

### Technical data

Density at 20 °C (DIN 51757)	g/cm <sup>3</sup>	about 1.14
Refractive index n <sub>D</sub> at 20 °C (DIN 51423, part 2)		about 1.436
pH value (Antifrogen N : water = 1 : 2) (DIN 51369)		7.5 – 8.5
Residual alkalinity (ASTM D 1121)	ml c (HCl) 0.1 m	min. 25
Boiling point at 1013 mbar (ASTM D 1120)	°C	about 170
Pour point (DIN 51583)	°C	about -70
Kinematic viscosity at 20 °C (DIN 51562)	mm <sup>2</sup> /s	about 28
Surface tension at 20 °C (Antifrogen N : water = 1 : 2) (ASTM D 1331)	mN/m	49
Specific heat at 20 °C	kJ/kg · K	2.3
Thermal conductivity at 20 °C	W/m · K	0,29
Specific electrical conductivity at 20 °C (Antifrogen N : water = 1 : 2)	µS/cm	4900

## Notes on use

### Product properties

The technical data below is used to describe the product and is taken from our own measurements or from literature. It does not constitute part of the delivery specification. The mandatory product specification will be found in the current technical data sheet.

The certified quality system in accordance with DIN EN ISO 9001 is used in production and quality control. This ensures consistently high product quality.

### Application properties

Antifrogen N was developed for use as a heat transfer and refrigerating medium. Its antifreeze action is based on monoethylene glycol, which with its high boiling point of about 198 °C prevents loss by evaporation. The frost resistance is determined by the mixing ratio with water. The frost resistance curve in the appendix shows that below a frost resistance of -20 °C solidified Antifrogen N/water mixtures will not cause bursts under central European conditions because slush ice is formed when they are cooled below the crystallization point. **Phase separation of Antifrogen N/water mixtures does not occur.**

The frost resistance of the mixture does not change even after many years' use, provided the Antifrogen N concentration remains constant.

The critical heat transfer coefficients of the Antifrogen N/water mixtures commonly used are only slightly different from the coefficient of tap water alone when heat is transferred to the atmosphere via radiators. In such cases, the quantity of heat that can be transferred with an Antifrogen N/water mixture is practically the same as for water alone and so the heat exchange surfaces do not need to be modified. In liquid/liquid heat transfer, on the other hand, the quantity of heat that can be transferred decreases as the content of Antifrogen N increases, so that the heat exchange surface has to be

increased according to the altered k values. Since Antifrogen N/water mixtures have a higher viscosity and density than pure water, a higher pressure drop must be expected in pipelines etc; graphs of the relative heat transfer coefficient and relative pressure drop – in comparison with pure water – are particularly useful for calculation purposes. These graphs and other physical data are to be found in the appendix.

Antifrogen N contains corrosion inhibitors that protect the metals of the cooling and heating systems, even in combined systems, permanently against corrosion and prevent the formation of boiler scale.

The effectiveness of the inhibitor combinations is checked constantly by the manufacturer by means of the well-known corrosion test method ASTM D 1384 (American Society for Testing and Materials).

**Glycol/water mixtures without inhibitors cannot be used because they are more corrosive than pure water alone.**

The following table shows the relatively low corrosion of common metals caused by an Antifrogen N/water mixtures (frost resistance: -20°C) compared with water and cooling brine.

The values, determined by the above mentioned ASTM method, show the weight loss of metals in g/m<sup>2</sup> due to corrosion:

**Corrosion of metals in g/m<sup>2</sup>, tested in accordance with ASTM D 1384 (336 h/88 °C, 6 l air/h)**

	Antifrogen N/ water mixture 1 : 2	Ethylene glycol water mixture without inhibitors 1 : 2	Mains water 14° GH*	Calcium- chloride brine 21 % (w/w)
Steel (CK 22)	< -0,5	-152	-76	-95
Cast iron (GG 25)	< -0,5	-273	-192	-310
Copper	-0,5	-2,8	-1	-11
Brass (MS 63)	-0,6	-7,6	-1	-36
Special steel (1.4541)	< -0,5	not tested	-0,5	cannot be used (pitting)
Cast alumi num (AlSi <sub>6</sub> Cu <sub>3</sub> )	-1,4	-16	-32	-135
Aluminium (99,5)	-2,0	not tested	-5	-660
Soft solder (WL 30)	-2,4	-135	-11	-443

\* German hardness; EH = 1.25 GH

Red bronze and hard silver and copper solder are also resistant to Antifrogen N/water mixtures.

**It is advisable, if at all possible, not to use the product in galvanized pipelines, since all glycol/water mixtures can dissolve zinc.**

**Antifrogen N should always be diluted with water.**

The water used to dilute Antifrogen N shall contain no more than 100 mg/kg (ppm) chlorides. This should be borne in mind particularly if systems contain components made of aluminum or aluminum alloys.

A wide range of water hardness is acceptable (between 0 and 25° GH). This means that, in addition to fully deionized water, fully deionized water ordinary tap water may be used.

The good corrosion-inhibiting properties of Antifrogen N/water mixtures decrease as expected with increasing water content. The Antifrogen N concentration of a

cooling brine or heat transfer medium should therefore be at least 20 % by volume. Such a solution is resistant to freezing down to -10 °C.

**Systems which have been operated only temporarily with Antifrogen N (e.g. for frostproofing during winter construction) must be rinsed out thoroughly with water several times before being refilled, since product residues may attack metals more severely because of the inadequate inhibitor concentration.**

After pressure testing with water or an Antifrogen N/water mixture, systems should be left filled to avoid pitting at the liquid/air phase boundary.

Emptied systems should be refilled within a few days. Before filling with an Antifrogen/water mixture, the operator must carefully inspect the state of corrosion of the system. If necessary, measures must be taken to ensure perfectly clean metal surfaces. Corroded systems in which slight rust formation is already present cannot subsequently be operated corrosion-free with Antifrogen, since the metal may be unevenly inhibited and the inhibitor consumed prematurely.

Although Antifrogen N is miscible in all proportions with water, it is advisable to fill systems with circulating pumps with about two-thirds of the required amount of water. Antifrogen N is then added and the system is topped up with water. Complete mixing is achieved by starting up the system. Depending on the system, this may take up to several days.

For pure gravity systems, Antifrogen N must be mixed with water before. This is recommended even if immediate frost protection is required.

Circulating pumps should be selected with special regard to their suitability for operation with antifreeze agents. Pump components made, for example, of materials based on phenolic resins do not meet this requirement. However, the circulating pumps normally used in heating installations have been found to be resistant.

High-quality, hot-water resistant, compressed asbestos fiber („IT<sup>®</sup>“) seals have proved to be suitable for these systems. Graphite cords can be used as gland seals. For threaded pipe connections in which hemp is used as a

® Antifrogen N

seal, coating with ®Fermit or ®Fermitol (Nissen & Volk) has proved successful. Without hemp ®Loctite 511 or 577 is useful. Leaks may occasionally occur when polytetrafluorethylene sealing tapes are used.

Tests and many years of practical experience have shown that the materials used for pressure surge compensators e.g. ®Flexon (Flamco) or ®Expansomat, Ex-Solar (Gebr. Otto KG) are not affected by Antifrogen N/water mixtures.

When a refrigeration or heating system previously operated with a salt-based cooling brine or water is charged with Antifrogen N, the lower surface tension and associated rust-removing action of this product may cause any existing corrosion damage to show up as leaks. **Older systems should therefore be thoroughly inspected and rinsed to ensure they are rust-free before the change is made. Good seals are the only way to ensure perfect functioning of the system and prevent costly leaks.**

After leakage, systems with Antifrogen N/water mixtures should only be topped up with Antifrogen N of the same concentration. Mixing with different products should be avoided, as it can lead to incompatibilities. In exceptional cases, the expert opinion of the manufacturer should be contacted.

Special antifreeze testers are available for determining frost resistance. Test instruments which operate on the principle of density measurement by hydrometer or those which determine the cooling limit by refractometry are also suitable.

According to data published in literature and the results of our own tests and trials, the following plastics and elastomers are suitable for the manufacture of components coming into contact with Antifrogen N/water mixtures of normal concentration:

Polyethylene, low-density, high density	(LDPE, HDPE)
Polyethylene crosslinked, e. g. ®Rautherm (Rehau) ®Polytherm (Hewig)	(CPE)
Polypropylene e. g. ®Hostalen PPH 2222 (Targor)	(PP)
Polybutene e. g. ®Rhiatherm (Simona)	(PB)
Polyvinyl choride, unplasticized	(uPVC)
Polytetrafluorethylene, e. g. ®Hostaflon (Dyneon)	(PTFE)
Polyamide	(PA)
Polyester resins	(UP)
Natural rubber up to 80 °C	(NR)
Styrene butadiene rubber up to 100°C	(SBR)
Butyl rubber	(IIR)
Olefin rubber, e. g. ®Buna AP (Bayer)	(EPDM)
Fluorocarbon elastomers, e. g. ®Viton (Du Pont)	(FPM)
Polyacetal, e. g. ®Hostaform (Ticona)	(POM)
Nitrile rubber, e. g. ®Perbunan (Bayer)	(NBR)
Polychlorbutadiene elastomers, e. g. ®Neopren (Du Pont)	(CR)
Silicone rubber, e. g. ®Elastosil (Wacker)	(Si)

Hot water heating systems	-10 to -20 °C
Earth-buried collectors combined with heat pumps	-10 to -15 °C
Other external circuits combined with heat pumps	-20 to -25 °C
Refrigeration systems	- 10 to -40 °C
Leak detection fluid	-20 °C

®= Registrierte Marke

Some information on the individual fields of use is given below:

**Hot water heating systems**

The advantage of using Antifrogen N in closed hot water heating systems is that the entire system or parts of it can be turned off even at subzero temperatures but is ready to be started up at any time. This results in a considerable saving in fuel costs in building which do not have to be heated all the time, e. g. weekend houses, churches and schools.

Protection from freezing down to -20 °C should be adequate in our climate even if parts of the heating pipework are installed in the external walls of the building. Antifrogen N has also proved successful as an antifreeze and corrosion inhibitor in underfloor hot water heating systems in combination with pipes made of plastic such as ®Hostalen PPH 2222. In plastic pipes without an oxygen diffusion barrier the minimum concentration of Antifrogen N should be 25 % by volume.

After the entire system has been completely drained of the previous heat transfer medium, it should be thoroughly rinsed through with water to flush out loose rust particles. Rinsing affords an opportunity to ascertain the contents of the system by reading the water meter.

Minor leaks – possible corrosion damage – in heating systems may become apparent after changing over to Antifrogen N/water mixtures. These have a lower surface tension than water.

If tightening the connections does not cure the problem in such cases, the part of the system in question must be drained and the Antifrogen N/water mixture collected. Besides renewing the sealing material the heating engineer should also ensure that the pipe connections are technically satisfactory.

**Heat pump systems**

In heat pumps Antifrogen N is used as the heat transfer medium in external circuits; the Antifrogen N/water mixture transfers heat to the internal circuit of the heat pump. To prevent corrosion, the Antifrogen N concentration should not be less than 20 % by volume.

**Heat recovery systems**

Antifrogen N/water mixtures are also used in circulating heat recovery systems if the possibility of exposure to frost cannot be ruled out.

**Refrigeration circuits**

Antifrogen N has a dual function as a refrigerating medium. The aqueous solution must remain liquid at the specified brine temperature and protect any metal components in the refrigeration system from corrosion.

Refrigeration systems previously operated with a salt-based cooling brine must be thoroughly flushed with a pickling inhibitor and then water to remove traces of salt and rust particles. If chloride-rich brines have been used, flushing must be carried out with particular care because any residues in the system tend to impair the corrosion-inhibiting effect of Antifrogen N.

If only one of several secondary circuits is converted to Antifrogen N, while the others continue to be operated with the previous brine, both coolants must be kept completely separate. Installation of a blanking-off disc is not an adequate guarantee of this in the long term.

**Antifrogen N as test liquid**

We supply Antifrogen N as a leak detection fluid for double-walled tanks in combination with leak detection equipment. Before use 35 % by volume Antifrogen N is diluted with 65 % by volume tap water in accordance with official regulations.

Antifrogen N has been officially approved in accordance with the „Technical regulations for flammable liquids“ (TRbF 501 and 502).

Prospective users are asked to send for the approval and test certificates issued by the Federal Institute for Materials Testing (BAM) Az. 1.3/9790 and 5.1/3436.

**Servicing and monitoring**

It has been found that Antifrogen N can be used in installations for many years. However, the Antifrogen N concentration in the installation should be checked

annually. This check is also advisable when the installation is topped up with liquid. Dealers have Antifrogen N antifreeze testers for this purpose.

The performance of the Antifrogen N/water mixture should also be checked at intervals of one to two years. If a 250 ml sample is provided, a dealer can also perform this service. For major industrial installations these tests can also be undertaken by Clariant GmbH, Werk Gendorf, Division Functional Chemicals, R&D, D-84504 Burgkirchen, Germany, phone +49(0) 86 79/7-22 72 (see also: [www.antifrogen.de](http://www.antifrogen.de)).

The data in our service report relate solely to the sample sent to us. Guidance on further use of the product tested assumes that the system is in proper condition and properly operated. We would expressly point out that, particularly where corrosion or scale is already present in the system, interactions with the product may occur with unpredictable consequences. We accept no liability whatsoever for any damage resulting from the improper condition or operation of the system.

**Safety and handling**

Maximum allowable workplace concentration <sup>1)</sup> (MAK-Wert, TRGS 900)	ml/m <sup>3</sup> mg/m <sup>3</sup>	10 26 peak limit cat. I risk of absorption through skin pregnancy group: C
Acute oral toxicity LD <sub>50</sub> (rat)	mg/kg	4000
Flash point (DIN 51758)	°C	120
Ignition temperature (DIN 51794)	°C	410
Temperature class (DIN/VDE 0165)		T2
German clean air regulations (1988)		Class III (3.1.7)
German regulations on dangerous substances (GefStoffV)		must bear a hazard warning label <sup>2)</sup> hazard symbol: Xn hazard warning: harmful R phrases: 22 S phrases: 2 concentration limit for exemption 25 %
German chemicals act (ChemG)		existing commercial chemical substance (components included in EINECS)
Water hazard class (WGK)		1
Index number		603- 027-00-1

1) Published by the „Kommission zur Prüfung gesundheitsschädlicher Arbeitsstoffe der Deutschen Forschungsgemeinschaft“ (MAK-Werte 1992)

2) Designation of the substance monoethylene glycol, ethanediol (glycol)

Antifrogen N ist harmful to humans and animals if swallowed. Consult a doctor immediately if the product is swallowed inadvertently.

The lethal dose for humans can be assumed to be 100 ml taken at once. In the majority of reported cases of poisoning cerebral damage and pulmonary edemas in particular have been observed besides renal damage.

Ethylene glycol, the product on which Antifrogen N is based, is **classified in water hazard class WGK 1 (slightly water-polluting)** according to the list of water-polluting substances (Vw Vw S from 17.05.1999). **This also applies to mixtures of Antifrogen N with water.**

Spent Antifrogen N/water mixtures can be disposed of in a special waste incineration plant in accordance with local regulations. According to the 2nd general administrative regulation relating to the German waste management act of 10.04.1990, reuse is preferable to disposal. The product is fully recyclable. On request we will gladly supply addresses of disposal sites or collecting points.

In concentration up to 1000 mg/l, Antifrogen N/water mixtures show no acute harmful effects on fish and bacteria. They are readily biodegradable. Antifrogen N/water mixtures can therefore be taken to a biological treatment plant for biodegradation, after consultation with the operator, provided the relevant legal provisions on water and waste allow this.

Antifrogen N contains more than 92 % ethylene glycol together with some water and organic and inorganic salts, which are present in a wellbalanced combination and act as corrosion inhibitors with a long-lasting effect. Antifrogen N contains no amines. To prevent the possible formation of harmful compounds, e.g. nitrosamines, Antifrogen N should not be mixed with products containing amines.

Antifrogen N/water mixtures have neither a flash point nor a fire point.

Further information will be found in the current EG safety data sheet.

### Transport and storage

VbF (German regulations on flammable liquids)	-
GGVE/RID	non-regulated
GGVS/ADR	non-regulated
ADNR	non-regulated
IMDG-Code	non-regulated
UN number	-
IATA-DGR	non-regulated

Antifrogen N is supplied in road tankers, rail tankers and non-returnable drums (235 kg). Smaller canisters are available from our dealers.

Antifrogen N has a storage stability of two years. Since zinc is not resistant to Antifrogen N, this should be borne in mind when the product is transferred to other containers.

### Antifrogen L

While Antifrogen N is based on monoethylene glycol, **Antifrogen L** contains as the base product the toxicologically harmless 1,2-propylene glycol, which is approved, for example, by the FDA (Food and Drug Administration) in the USA for use as a food additive. Antifrogen L should therefore be given preference to Antifrogen N in all instances where the product is intended to be used in the food and drinks sector or where the possibility of the heat transfer medium entering process water or hot water cannot be excluded. A special data sheet on this product is available.

### Antifrogen Homepage

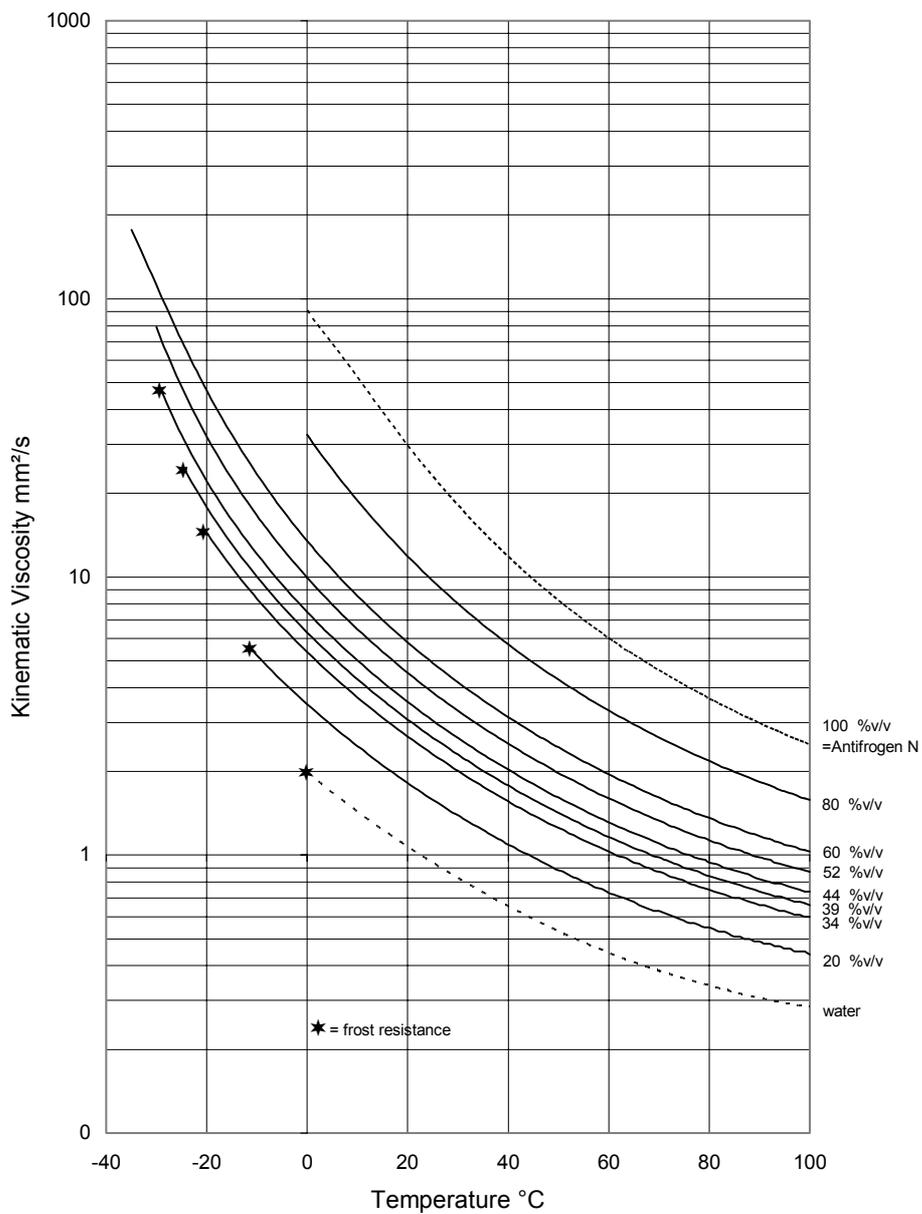
Please visit us at [www.antifrogen.de](http://www.antifrogen.de), where you can find newest informations on our product range.

Additionally, a technical calculation program with all relevant physical data and the technical leaflets can be downloaded there.

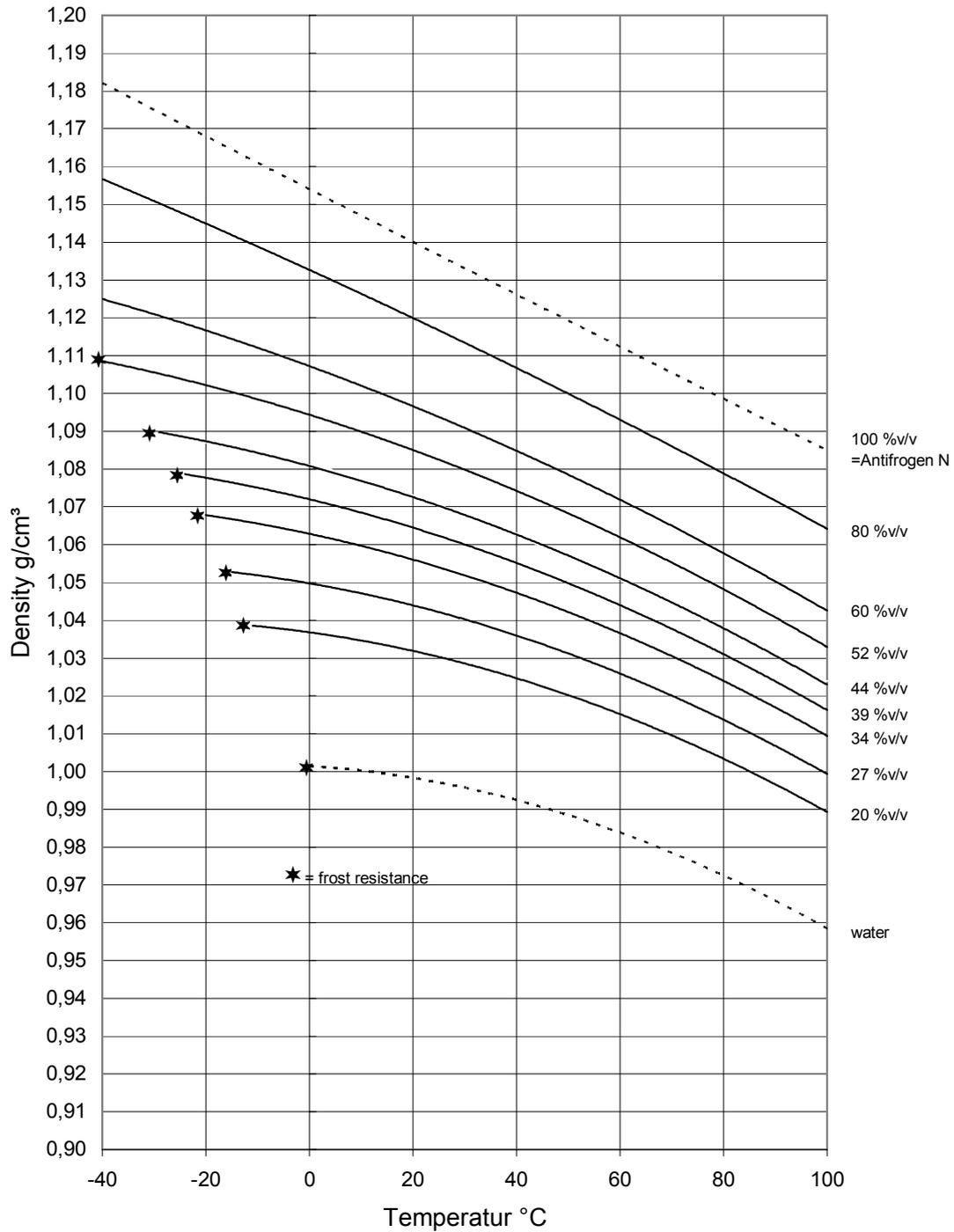
**Appendix**

The following graphs show the most important physical properties of Antifrogen N/water mixtures.

**Kinematic Viscosity**  
of Antifrogen N-water mixtures of different concentrations

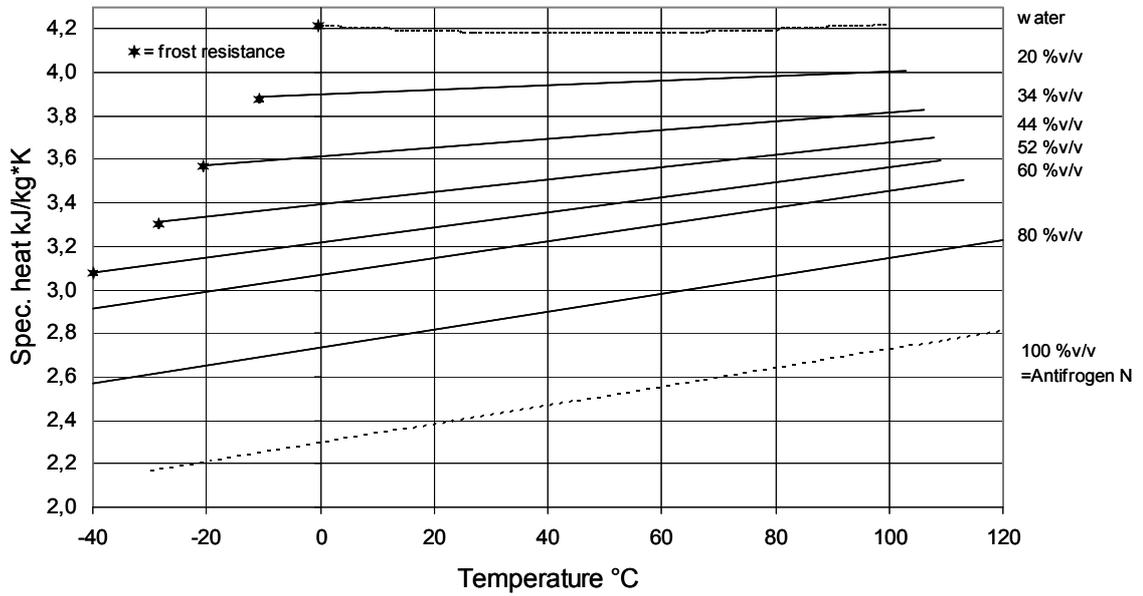


**Density**  
of Antifrogen N-water mixtures of different concentrations



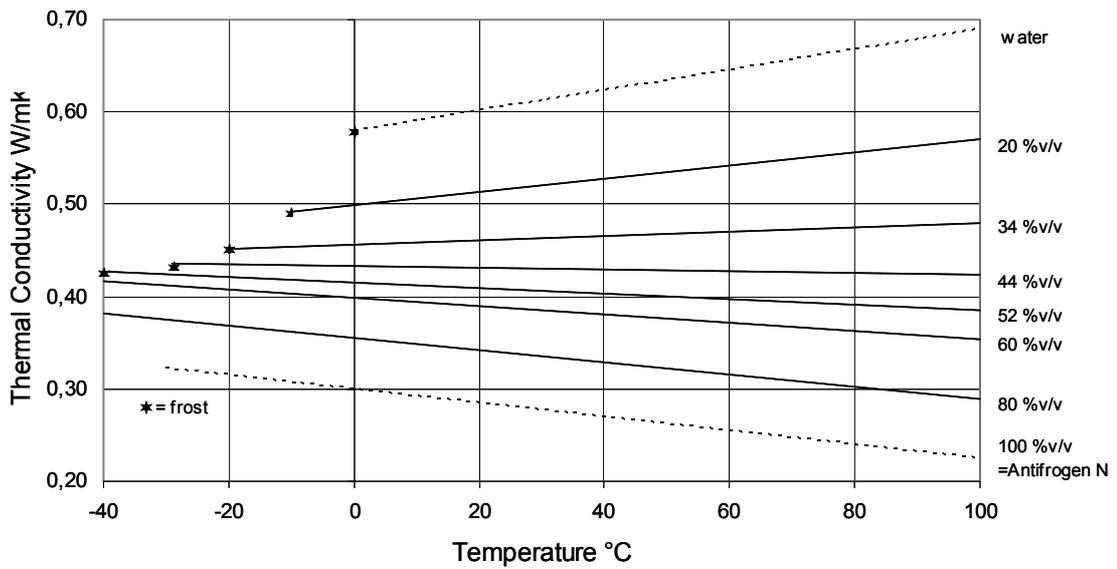
**Specific heat**

of Antifrogen N-water mixtures of different concentrations

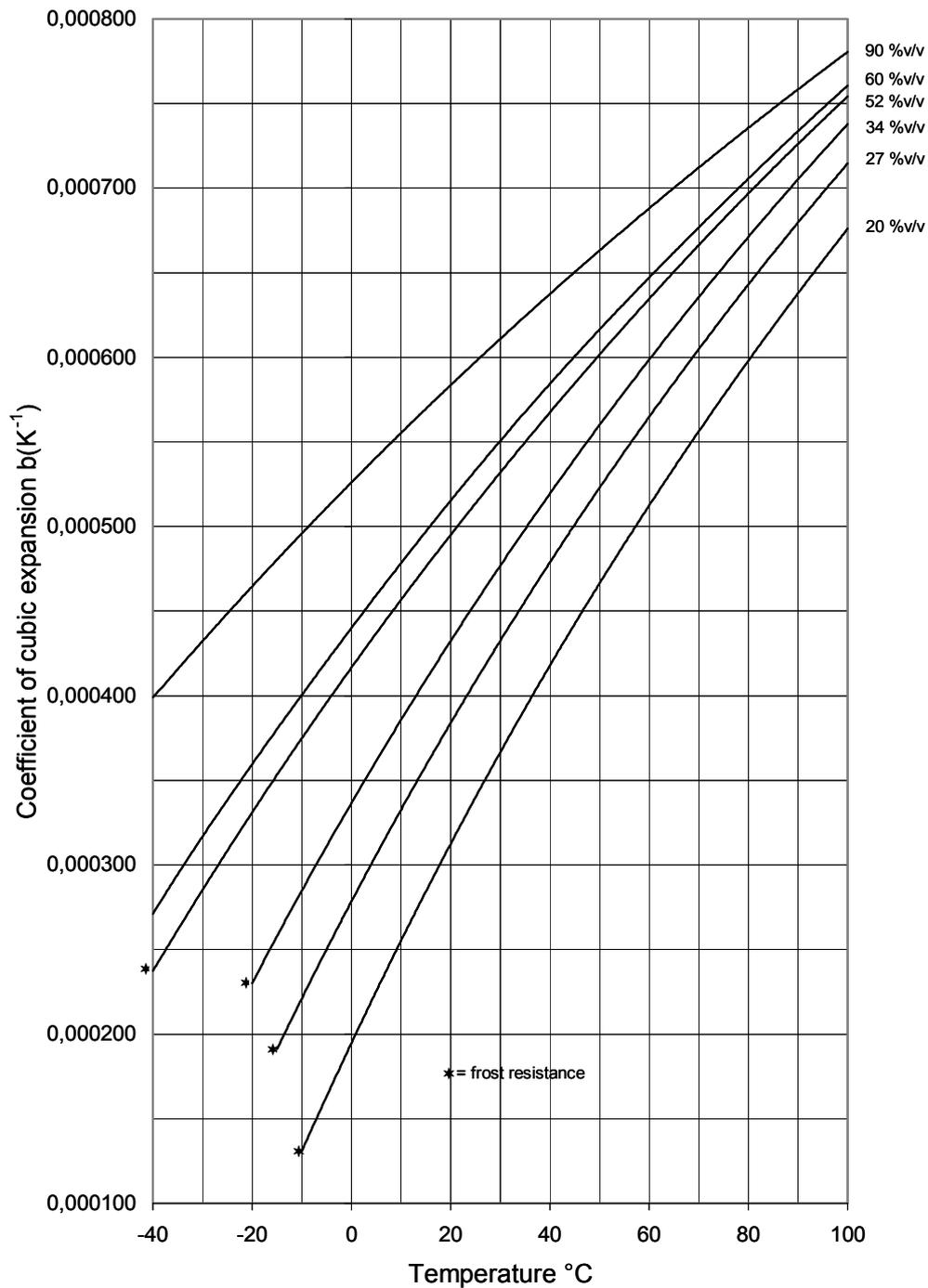


**Thermal conductivity**

of Antifrogen N-water mixtures of different concentrations



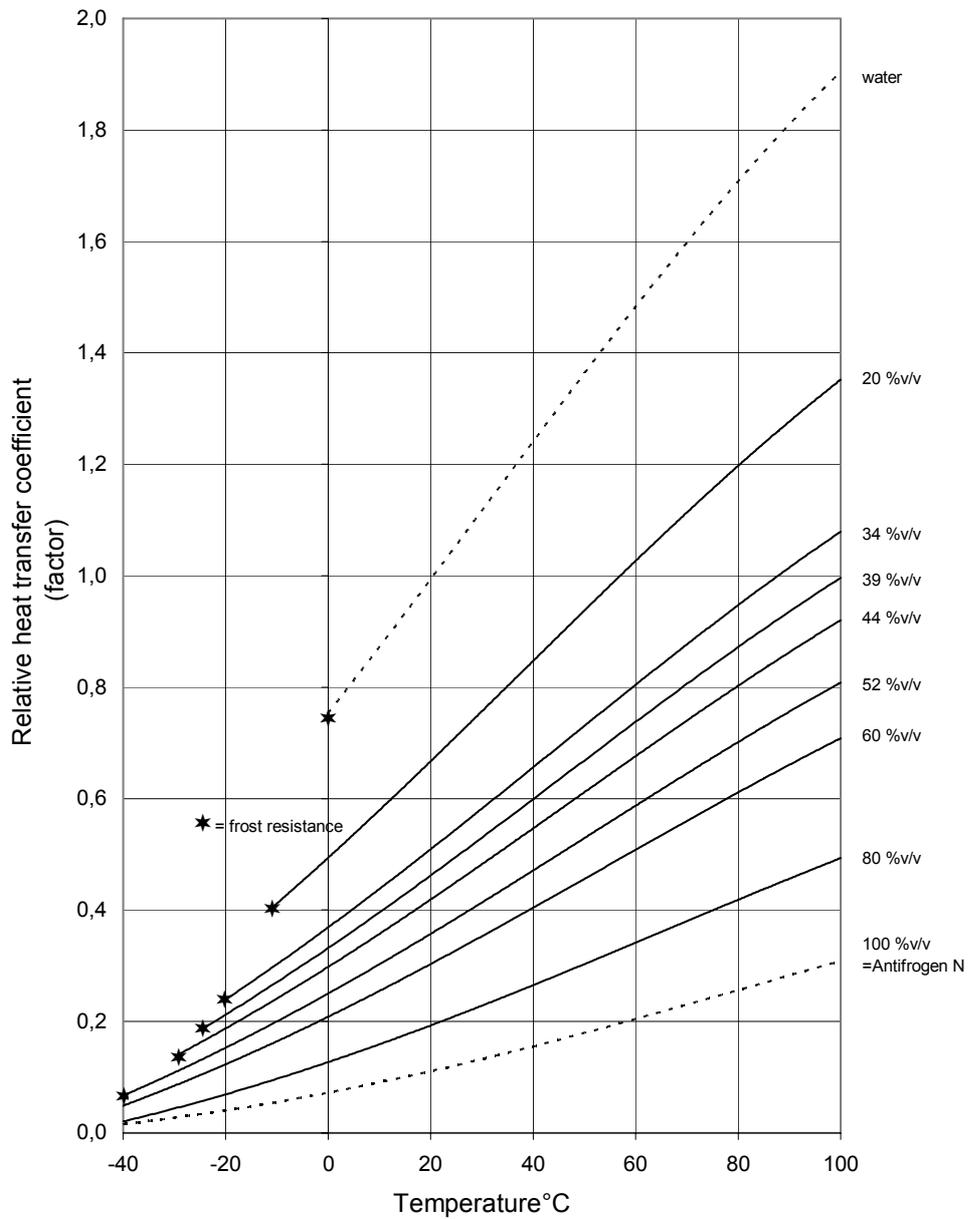
**Coefficient of cubic expansion**  
of Antifrogen N-water mixtures of different concentrations



$$\text{Prandtl-Zahl} = \frac{\rho \cdot v \cdot C_p}{\lambda}$$

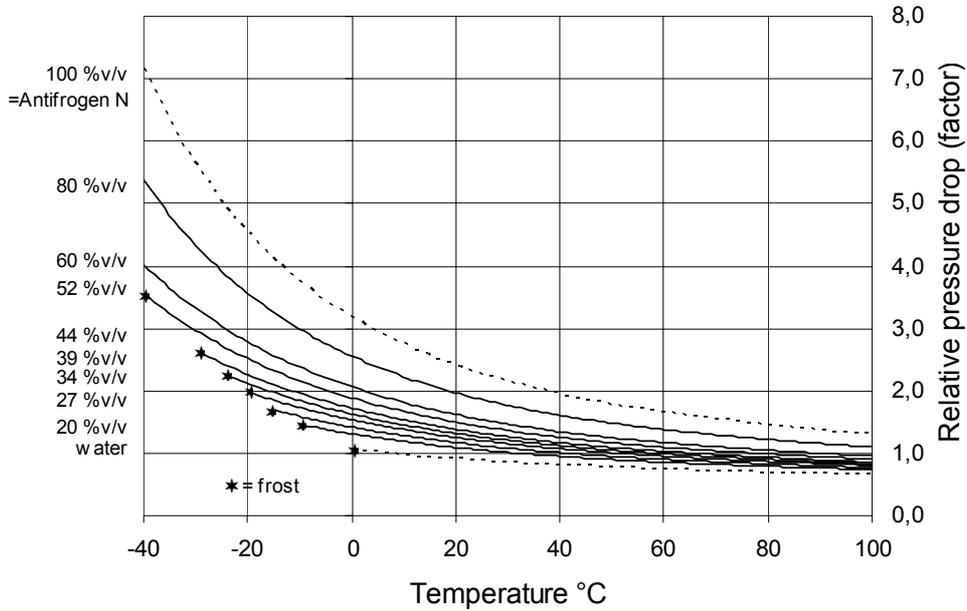
**Relative heat transfer coefficient**

of Antifrogen N-water mixtures in comparison with water (+20°C) in turbulent flow



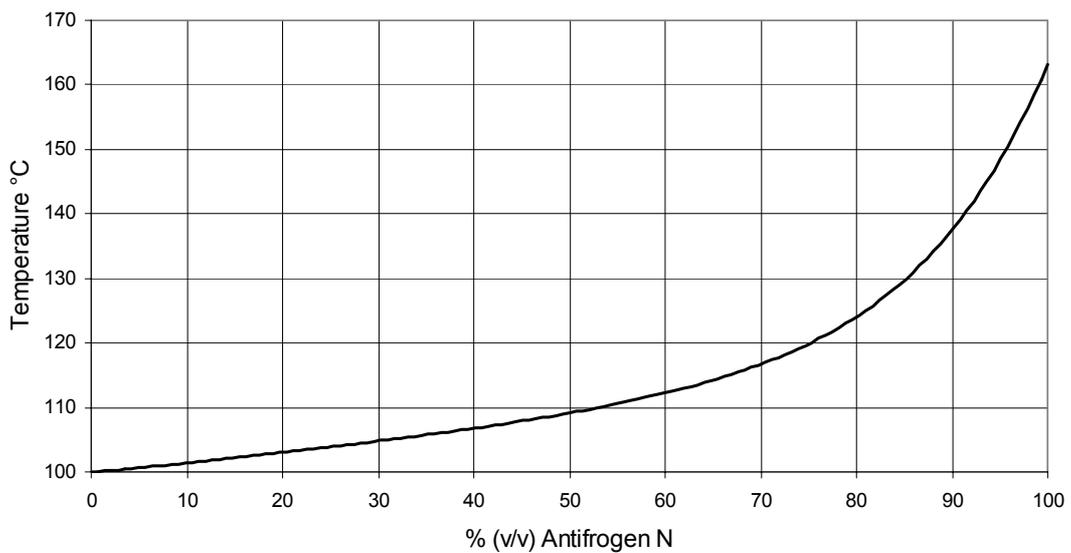
**Relative pressure drop**

of Antifrogen N-water mixtures in comparison with water (+10°C) in turbulent flow

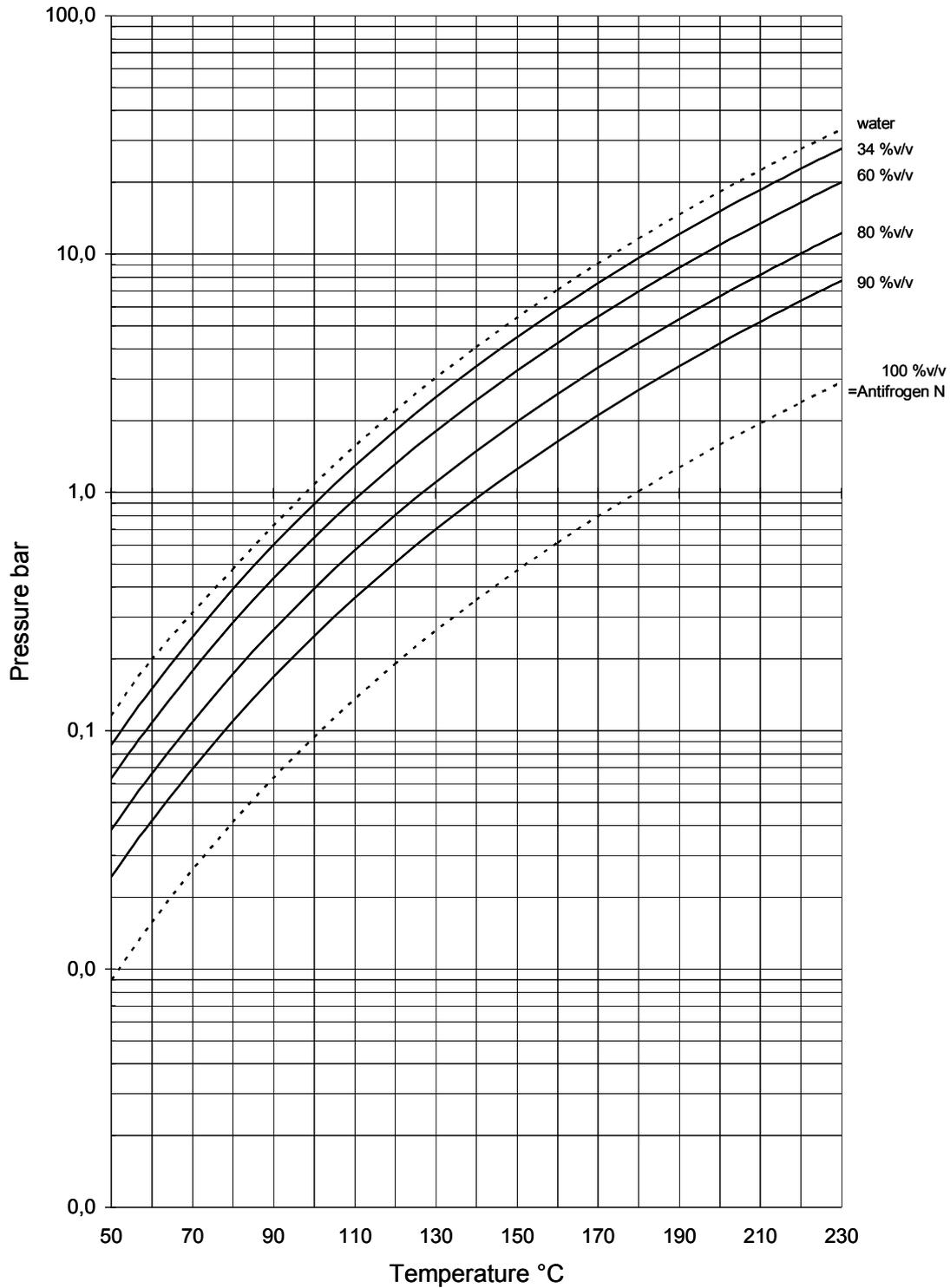


**Boiling Points**

of Antifrogen N-water mixtures of different concentrations in accordance with ASTM D 1120 at 1013 hPa (mbar)

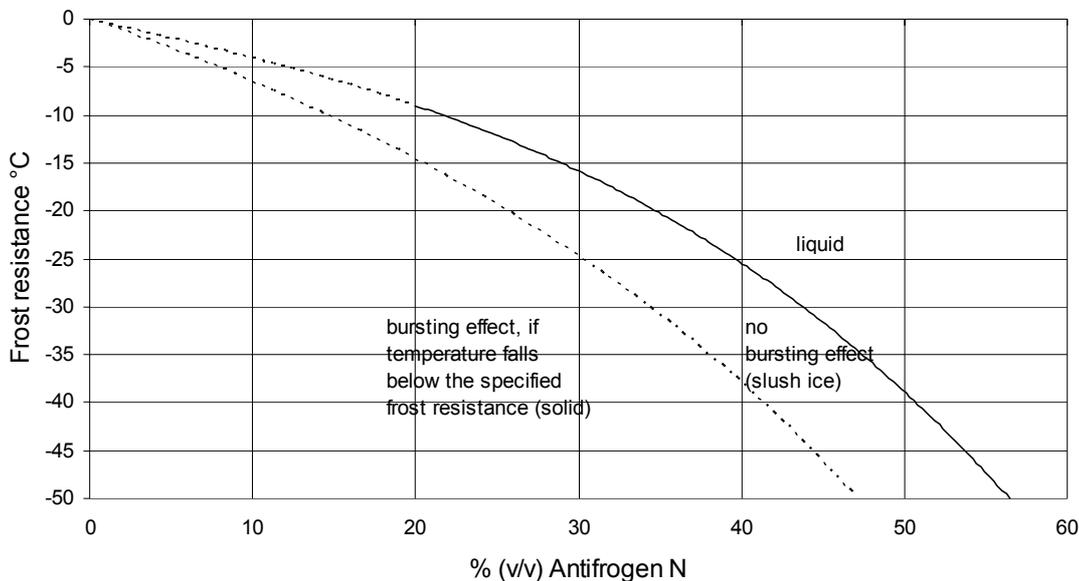


**Vapor pressure**  
for Antifrogen N-water mixtures as a function of temperature



**Frost resistance**

of Antifrogen N-water mixtures (crystallization point in accordance with ASTM D 1177)



This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as guaranteeing specific properties application.

Any existing industrial property rights must be observed. The quality of our products is guaranteed under our General Conditions of Sale.

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Clariant GmbH, Division Functional Chemicals  
Functional Fluids/Marketing  
D-65840 Sulzbach  
Tel. +49 6196/757-8155, Fax: +49 6196/757-8945

Clariant GmbH, Werk Gendorf  
Division Functional Chemicals  
Functional Fluids/R&D  
D-84504 Burgkirchen  
Tel. +49 8679/7-22 72, Fax: +49 8679/7-50 85

Internet: <http://clariant.com>  
<http://www.antifrogen.de>

Your regional contact: