

Antifrogen® L

Cooling brine for the food industry, antifreeze and corrosion inhibitor for refrigeration and heat pump systems, approved fire extinguishing agent.

Product description

Antifrogen L is a clear liquid, tinted light blue, for use as a cooling brine and heat transfer medium in heat pump systems and in the food industry, e.g. in breweries, dairies, ice-cream factories, cold stores and fish processing factories. The product is inhibited without the use of nitrites, amines, borate and phosphates.

You can find further information about the products on our homepage www.antifrogen.com.

- Based on 1,2-propylene glycol
- Including anticorrosion additives
- Minimal usage concentration: 25 % v/v
- Permanent usage temperatures: approx. -25 to +150 °C

Technical data

Density at 20 °C (DIN 51757)	g/cm ³	approx. 1.043
Refractive index n _D at 20 °C (DIN 51423, Part 2)		approx. 1.432
pH-value (Antifrogen L : water = 1 : 2; DIN 51369)		approx. 8.6
Reserve alkalinity (ASTM D 1121)	ml c (HCl) 0.1 m	min. 4
Boiling point at 1013 mbar (ASTM D 1120)	°C	approx. 155
Pour point (DIN 51583)	°C	approx. -58
Kinematic viscosity at 20 °C (DIN 51582)	mm ² /s	approx. 59
Surface tension at 20 °C (Antifrogen L : water = 1 : 2; ASTM D 1331)	mN/m	47
Specific electrical conductivity at 20 °C (Antifrogen L : water = 1 : 2)	µS/cm	approx. 2800
Specific heat at 20 °C	kJ/kg·K	2.5
Thermal conductivity at 20 °C	W/m·K	0.21

Product properties

The technical data below is used to describe the product. It does not constitute part of the delivery specification.

Application properties and general application indications

Antifrogen L fulfills a dual function as a heat transfer medium. It ensures that the aqueous solution remains liquid at the required brine temperature and protects any metal components in the refrigeration system from corrosion. Its antifreeze action is based on monopropylene glycol, which with its high boiling point of about 198 °C prevents loss by evaporation.

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

Hot water heating systems

The advantage of using Antifrogen L 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 buildings 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 pipe work are installed in the external walls of the building. Antifrogen L has also proved successful as an antifreeze and corrosion inhibitor in under floor hot water heating systems in combination with pipes made of plastic. In plastic pipes without an oxygen diffusion barrier the minimum concentration of Antifrogen L should be 30 % v/v.

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 L/water mixtures. These have a lower surface tension than water.

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

Minor leaks – possible corrosion damage – in heating systems may become apparent after changing over to Antifrogen L/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 L/water mixture collected. Besides renewing the sealing material the heating engineer should also ensure that the pipe con

Heat pump systems

In heat pumps Antifrogen L is used as the heat transfer medium in external circuits; the Antifrogen L/water mixture transfers heat to the internal circuit of the heat pump. To prevent corrosion, the Antifrogen N concentration should not be less than 25 % v/v.

Heat recovery systems

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

Refrigeration circuits

Antifrogen L 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 L.

If only one of several secondary circuits is converted to Antifrogen L, 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.

Gravity systems

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

Antifrogen L as fire extinguishing agent

Antifrogen L is the first glycol based antifreeze which is approved by the VdS (Verband der Schadensversicherer = German Assurance Association; VdS approval no. G 4040093) for the use as a fire extinguishing agent.

Since that, Antifrogen L/water mixtures up to 38 % v/v (represents a freezing point of -20 °C) are approved for the use as a fire extinguishing medium in sprinkler systems for fighting class A fires.

The use of higher concentrated Antifrogen L/water mixtures is not recommended since the glycol base of the product could be of any contribution to the fire! Higher concentrates are not approved by the VdS as fire extinguishing agent!

The antifreeze can be used to fill up the pipe network of sprinkler systems. However, it must be proved that pure water comes out of the sprinklers after max. 4 minutes after triggering – even at the hydraulically adverse sprinkler head. Additionally, it must be ensured that no impermissible pressures occur in the system which could possibly be created by any variations in temperature.

Antifrogen L/water mixtures in sprinkler systems are not allowed for the use in galvanized pipes or in connection with other zinc containing components. In a worst case scenario, the sprinkler head could be clogged by dissolved zinc residues.

For the use of Antifrogen L/water mixtures in sprinkler systems, the Clariant product service for determining physical/chemical properties and the freezing point must be used once a year. A copy of the test results must be forwarded to VdS – Technische Prüfstelle (VdS Technical Department).

For the use in fire extinguishing systems with more than 20 sprinklers, coordination with the VdS is necessary.

Pre-diluted Antifrogen L/water mixtures are available in 25, 32, 35 and 38 % v/v concentrations.

All mentioned mixtures can be used in the sprinkler systems from 0 to 16 bar pressure.

General application indications:

- In installing the system, only chloride-free soldering agents should be used.
- Systems which have been operated only temporarily with Antifrogen L (e.g. for frost proofing 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 L/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.
- When a refrigeration system previously operated with a salt-based cooling brine or a heating system previously filled with water is charged with Antifrogen L, the low 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 L/water mixtures should only be topped up with Antifrogen L 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.
- Although Antifrogen L 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 L 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.

- The critical heat transfer coefficient of the Antifrogen L/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 L/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 L increases, so that the heat exchange surface has to be increased according to the altered k- values. Since Antifrogen L/water mixtures have a higher viscosity and density, 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.

Frost resistance and usage concentration

The frost resistance is determined by the mixing ratio with water. **The minimum usage concentration of Antifrogen L is 25 % v/v.** The frost resistance curve in the appendix shows that below a frost resistance of -20 °C solidified Antifrogen L/water mixtures will not cause bursts because slush ice is formed when they are cooled below the crystallization point.

The frost resistance of the mixture does not change even after many years' use, provided the Antifrogen L concentration remains constant. Furthermore phase separation of Antifrogen L/water mixtures does not occur.

Antifrogen L should always be diluted with water.

The water used to dilute Antifrogen L 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 L/water mixtures decrease as expected with increasing water content.

The Antifrogen L concentration of a cooling brine or heat transfer medium should therefore be at least 25 % v/v. Such a solution is resistant to freezing down to -10 °C. Below this concentration in the brine exists the danger of bacterium and alga growth. This can lead to organic sediments.

Practical experience has shown frost resistance over the following temperature ranges to be adequate:

Hot water heating systems	-10 to -20 °C
Other external circuits combined with heat pumps	-20 to -25 °C

® = registered brand

Refrigeration systems	- 10 to -40 °C
Earth-buried circuits combined with heat pumps	-20 °C

Special antifreeze testers are available for determining frost resistance. Special antifreeze testers are available for determining frost resistance. For further information please apply to our Antifrogen-distributors (www.antifrogen.com).

Material compatibilities

Antifrogen L 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).

The following table shows the relatively low corrosion of common metals caused by an Antifrogen L/water mixture compared with a monopropylene glycol/water mixture.

The values, determined by the above mentioned ASTM method, show the weight loss of metals in g/m² due to corrosion.

Corrosion of metals in g/m², tested with ASTM D 1384 (336 h / 88 °C / 6 l air/h):

	Antifrogen L ^a	monopropylene glycol ^b	weight-loss-limits
Copper	-0.7	-2.8	10
Soft solder (WL 30)	-3.3	-135	30
Brass (MS 63)	-0.8	-7.6	10
Steel (CK 22)	+0.2	-152	10
Cast iron (GG 25)	+0.7	-273	10

Cast aluminum (AlSi6Cu3)	-2.3	-16	30
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^a Antifrogen L/water mixture 1:2; ^b monopropylene glycol/water mixture without inhibitors 1:2

To test the effectiveness of the corrosion inhibitors for extended periods of time thus closer to practical, the testing period of the ASTM D 1384 was lengthen from 336 h (14 days) to 3000 h (125 days).

Corrosion of metals in g/m², tested with ASTM D 1384 (3000 h / 88 °C / 6 l air/h):

	Antifrogen L ^a	Antifrogen L ^a	weight-loss-limits
Copper	-2.8	-0.4	10
Soft solder (WL 30)	-2.4	-1.5	30
Brass (MS 63)	-1.8	-0.5	10
Steel (CK 22)	+0.5	±0	10
Cast iron (GG 25)	+0.9	-0.4	10
Cast aluminum (AlSi6Cu3)	-1.3	-4.9	30

^a Antifrogen L/water mixture 1:2

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

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

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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 L/water mixtures*:

Butyl rubber	(IIR)
Fluorocarbon elastomers, e. g. ®Viton (Du Pont)	(FPM)
Natural rubber up to 80 °C	(NR)
Nitrile rubber, e. g. ®Perbunan (Bayer)	(NBR)
Polyacetal, e. g. ®Hostaform (Ticona)	(POM)
Polyamide	(PA)
Polybutene e. g. ®Rhiatherm (Simona)	(PB)
Polyester resins	(UP)
Polyethylene, crosslinked, e.g. ®Rautherm (Rehau) ®Polytherm (Hewing)	(VPE)
Polyethylene, low-density, high density	(LDPE, HDPE)
Polypropylene e. g. ®Hostalen PPH 2222 (Targor)	(PP)
Polytetrafluorethylene, e. g. ®Hostaflon (Dyneon)	(PTFE)

Polyvinyl choride, unplasticized	(uPVC)
Styrene butadiene rubber up to 100°C	(SBR)
Silicone rubber, e. g. ®Elastosil (Wacker)	(Si)
Acrylnitrile butadiene styrole	(ABS)
Olefinkautschuk, e. g. Buna® AP (Bayer)	(EPDM)

*The materials have been tested at +80 °C in specific conditions. Please consider the specifications and material compatibilities given by the manufacturer of the elastomers and plastics. In the table not listed materials we like to check them for compatibility.

Polyurethane elastomers, plasticized PVC and phenol-formaldehyde resins are not resistant.

Graphite cords can be used as gland seals. For threaded pipe connections in which hemp is used as a seal. Leaks may occasionally occur when polytetrafluorethylene (PTFE) sealing tapes are used.

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.

Servicing and monitoring

It has been found that Antifrogen L can be used in installations for many years. However, the Antifrogen L concentration in the installation should be checked annually. This check is also advisable when the installation is topped up with liquid. Distributors have Antifrogen L antifreeze testers for this purpose.

The performance of the Antifrogen L/water mixture should also be checked at intervals of one to two years. If a 250 ml sample is provided, a distributors can also perform this service. For major industrial installations these tests can also be undertaken by Clariant Produkte (Deutschland) GmbH, Werk Gen-

dorf, BU ICS / R&D, D-84508 Burgkirchen, Germany, phone +49(0) 86 79/7-22 72, (see also: www.antifrogen.com).

The data in our service report relate solely to the sample sent to us. Guidance on further use for 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.

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Safety and handling

Flash point (DIN 51758)	°C	104
Ignition temperature (DIN 51794)	°C	450
Temperature class (DIN/VDE 0165)		T2

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

Antifrogen L may be described as relatively harmless according to the usual classification systems. The base product of Antifrogen L, 1,2 propylene glycol, is a permitted additive as a solvent and extractant under the German food additives trade regulations of 10.7.1984 (BG Bl. (Federal Law Gazette) I p. 897), appendix 2, list 9. In the USA, propylene glycol is permitted as a generally harmless food additive according to section 184.1666 of the Federal Register dated 1.4.1985.

Transport and storage

VbF	-
GGVE/RID	non-regulated
GGVS/ADR	non-regulated
ADNR	non-regulated
IMDG code	non-regulated
UN number	-
IATA-DGR	non-regulated

Antifrogen N

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

1,2-propylene glycol is classified in water hazard class **WGK 1 (slightly water-polluting)** according to the list of water-polluting substances (VwVwS from 17.05.1999). **This also applies to mixtures of Antifrogen L with water.**

Spent Antifrogen L/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 10.4.1990, reuse is preferable to disposal.

In concentration up to 100 mg/l, Antifrogen L/water mixtures show no acute harmful effects on fish and bacteria. They are readily biodegradable.

Spent Antifrogen N/water mixtures can be disposed off in a special waste incineration plant in accordance with local regulations.

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

Antifrogen L is supplied by our Antifrogen-distributors in road tankers, intermediate bulk containers (IBC, 1050 kg), non-returnable corrugated drums (220 kg) and divers small containers. Further informations about our Antifrogen-distributors you can find on our homepage www.antifrogen.com.

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

suitable for the use in food or pharmaceutical applications. Alternatively, the use of Antifrogen L is recommended.

Antifrogen KF

Antifrogen KF is a non-toxic clear liquid, based on an aqueous formiate solution which is used as a low-temperature brine down to -50 °C in industrial and food refrigeration systems. The brine has a low viscosity at low temperatures.

Antifrogen SOL HT

Antifrogen SOL HT is a physiologically harmless, yellowish, clear liquid based on an aqueous solution higher boiling glycols, which is used as a heat transfer medium in solar heating, especially those exposed to high thermal loads. The product is premixed with deionized water to give a frost resistance of about -23 °C.

Antifrogen Homepage

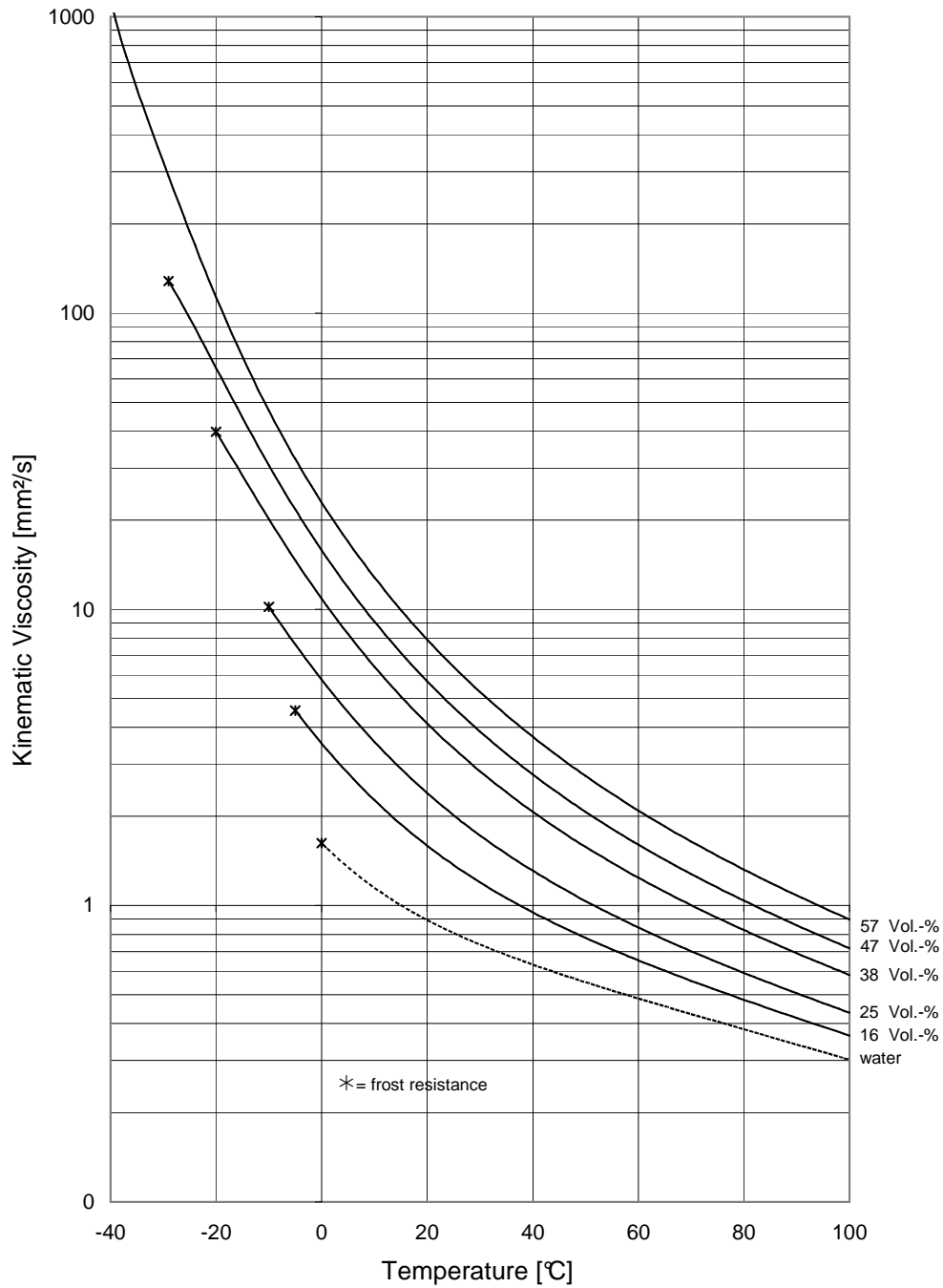
Please visit us at www.antifrogen.com, where you can find newest informations on our product range. Additionally, a technical calculation program with all relevant physical data and the technical leaflets can be downloaded there.

Appendix

The following graphs show the most important physical properties of Antifrogen L/water mixtures. Due to the calculation software, which has been used to gain the related curves, small variances of the physical values are possible.

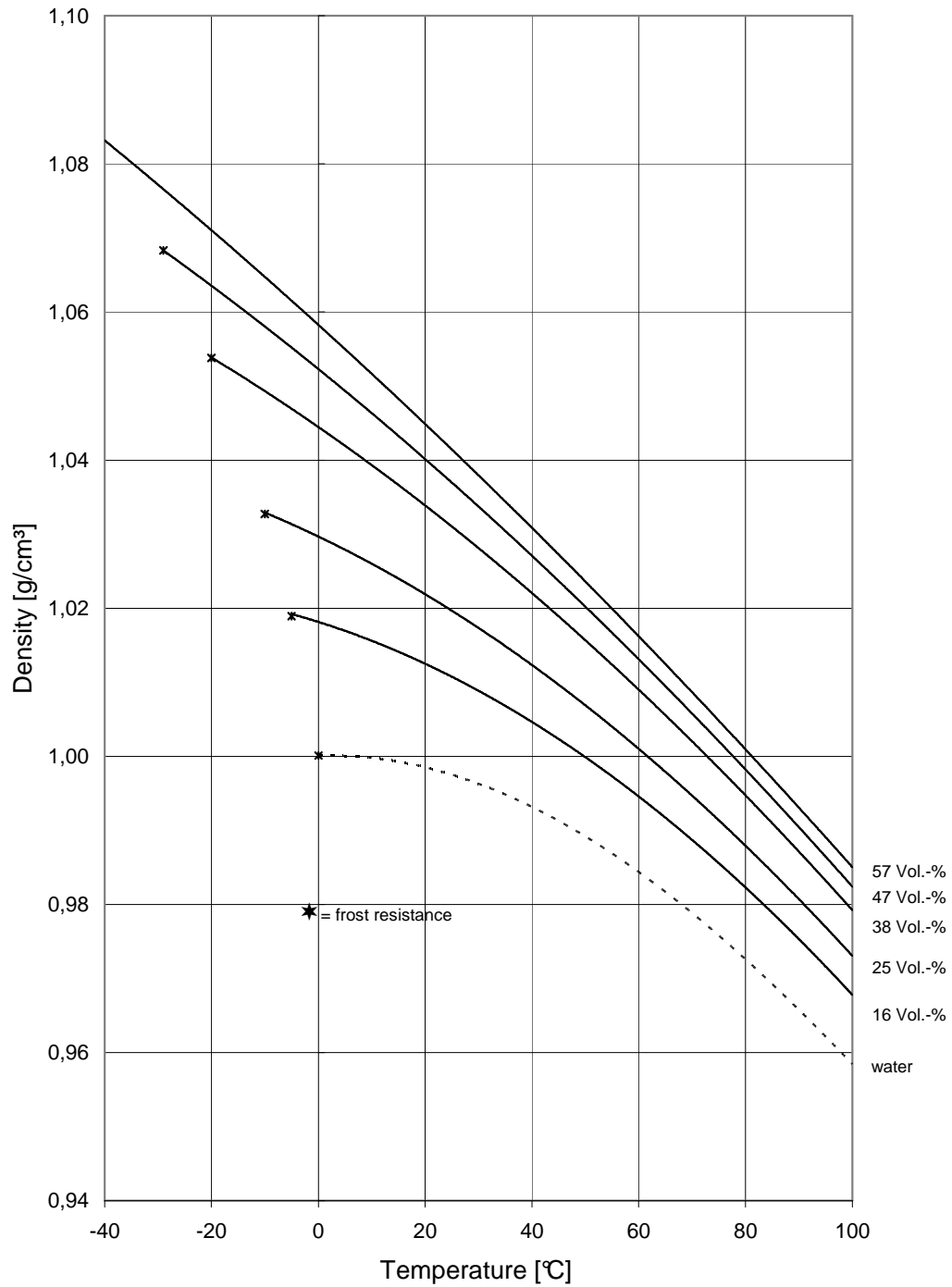
Kinematic Viscosity

of Antifrogen L-water mixtures of different concentrations



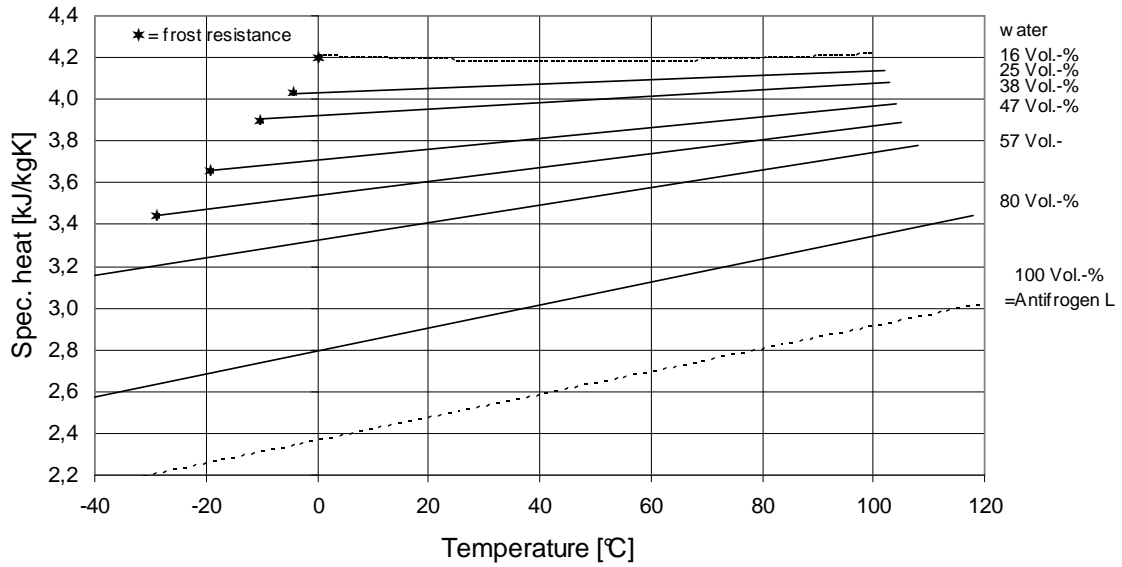
Density

of Antifrogen L-water mixtures of different concentrations



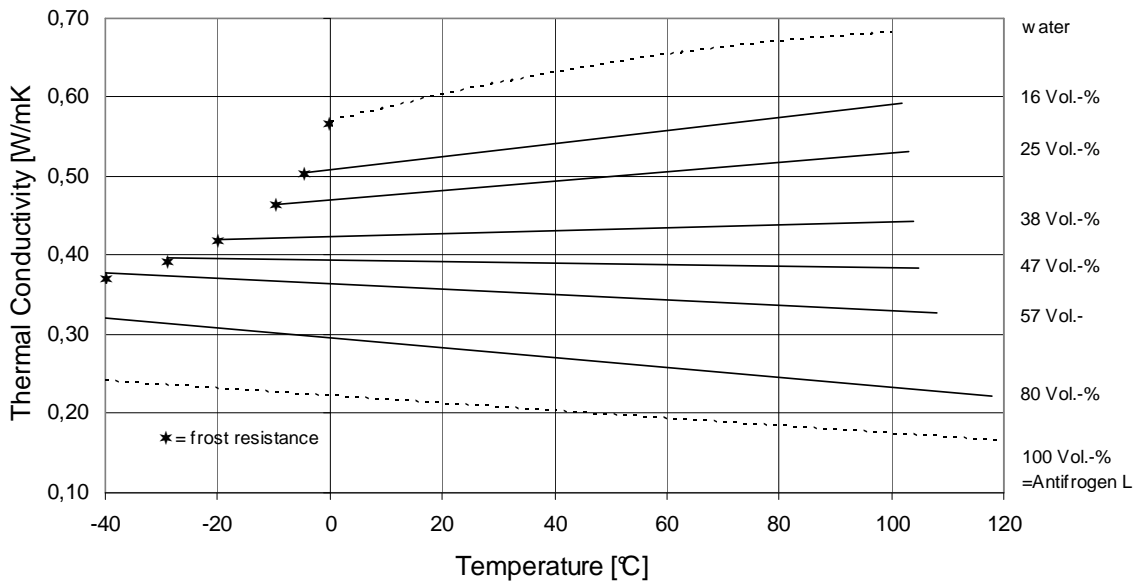
Specific Heat

of Antifrogen L-water mixtures of different concentrations



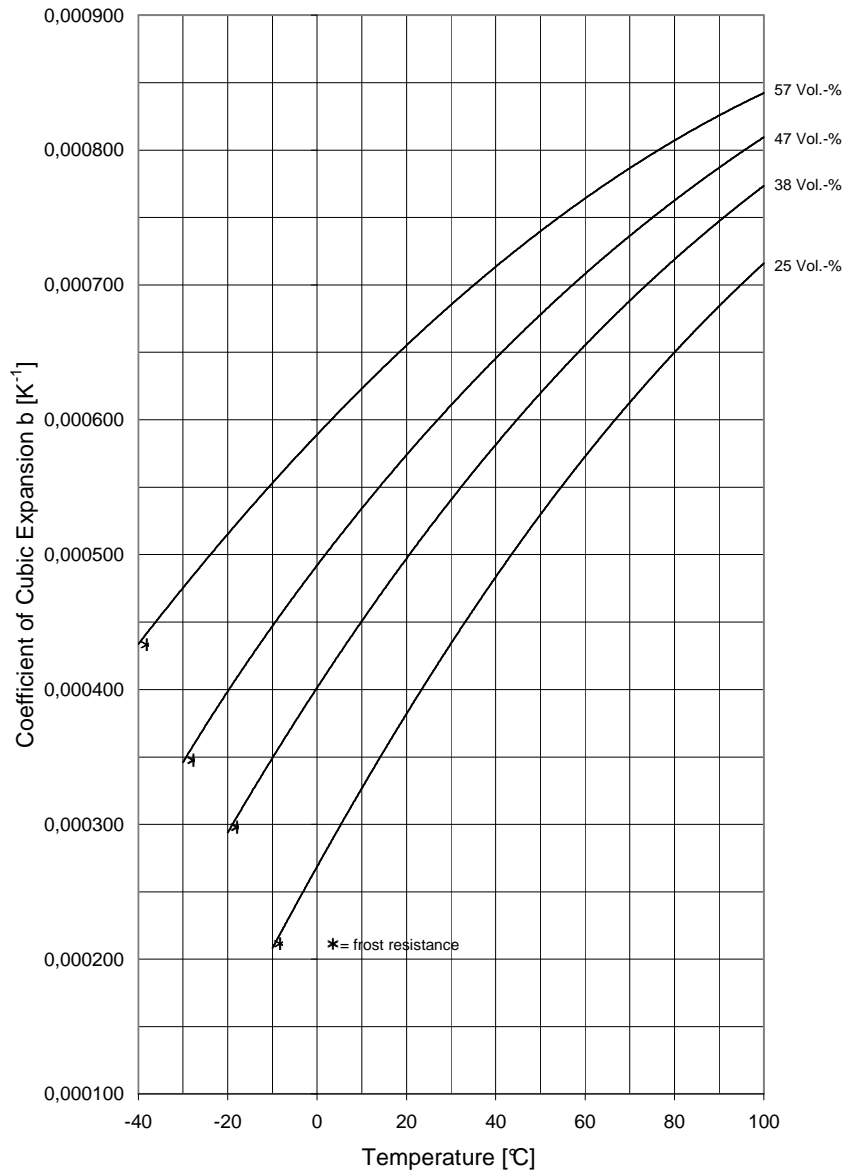
Thermal Conductivity

of Antifrogen L-water mixtures of different concentrations



Coefficient of Cubic Expansion
of Antifrogen L-water mixtures of different concentrations

Antifrogen® L



Example:

By how much does $V_0 = 100$ l of a 38 % (v/v) Antifrogen L/water mixture expand on heating from $t_0 = -10$ °C to $t_1 = +80$ °C?

$$\Delta t = t_1 - t_0 = +80 - (-10) = 90 \text{ °C}$$

$$t_{\text{advantage}} = t_0 + \frac{\Delta t}{2} = -10 + \frac{90}{2} = +35 \text{ °C}$$

$$\beta_{t_{\text{advantage}}} \text{ (aus Kurve für 38\% (V/V))} = 0,00057$$

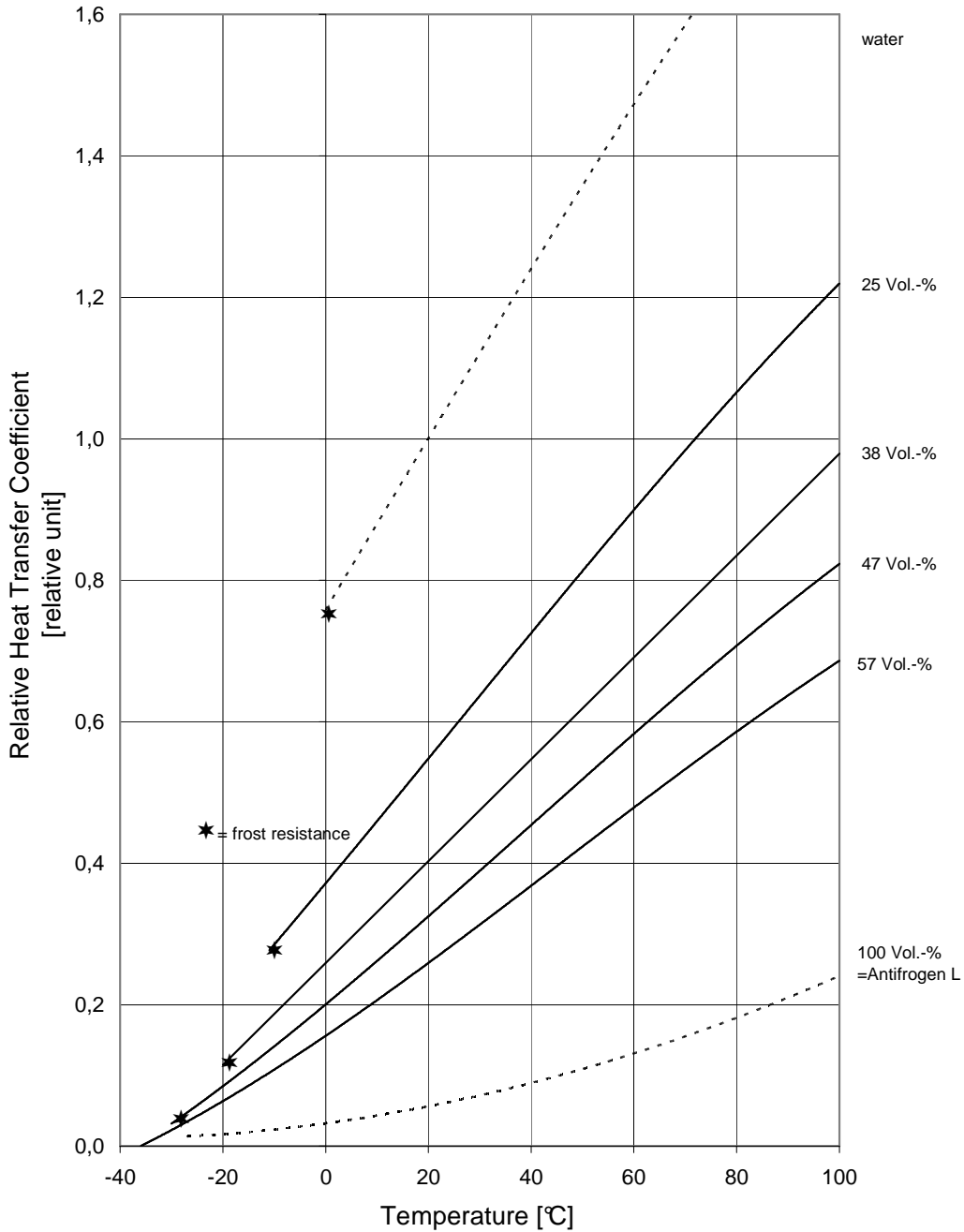
$$\Delta V = \beta_{t_{\text{advantage}}} \cdot \Delta t \cdot V_0 = 0,00057 \cdot 90 \cdot 100$$

$$= 5.13 \text{ l increase in volume}$$

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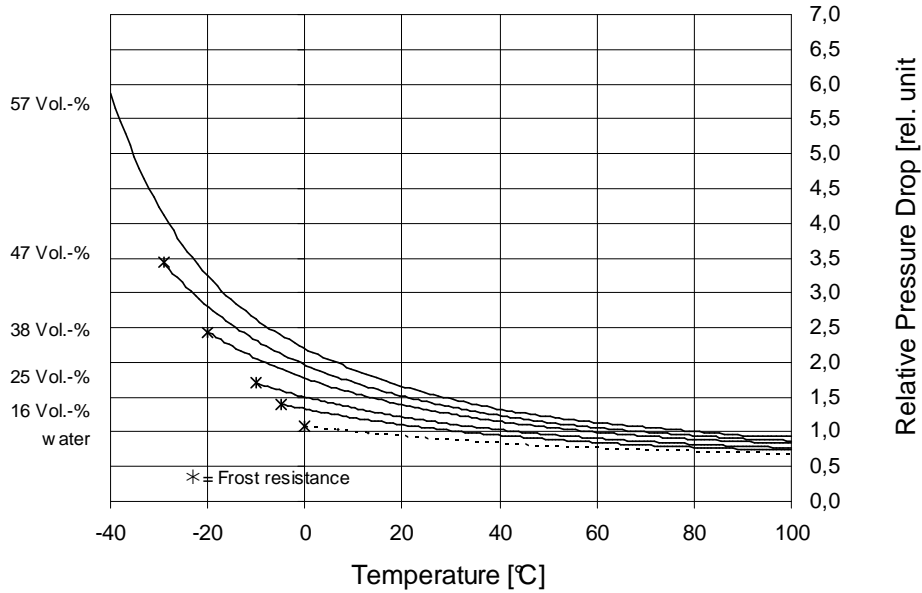
Relative Heat Transfer Coefficient

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



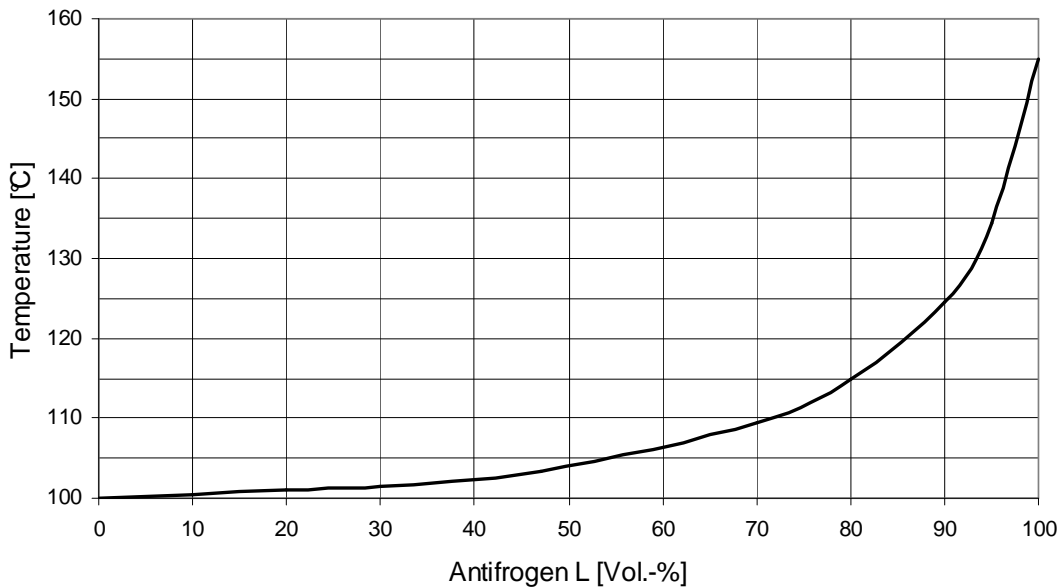
Relative Pressure Drop

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



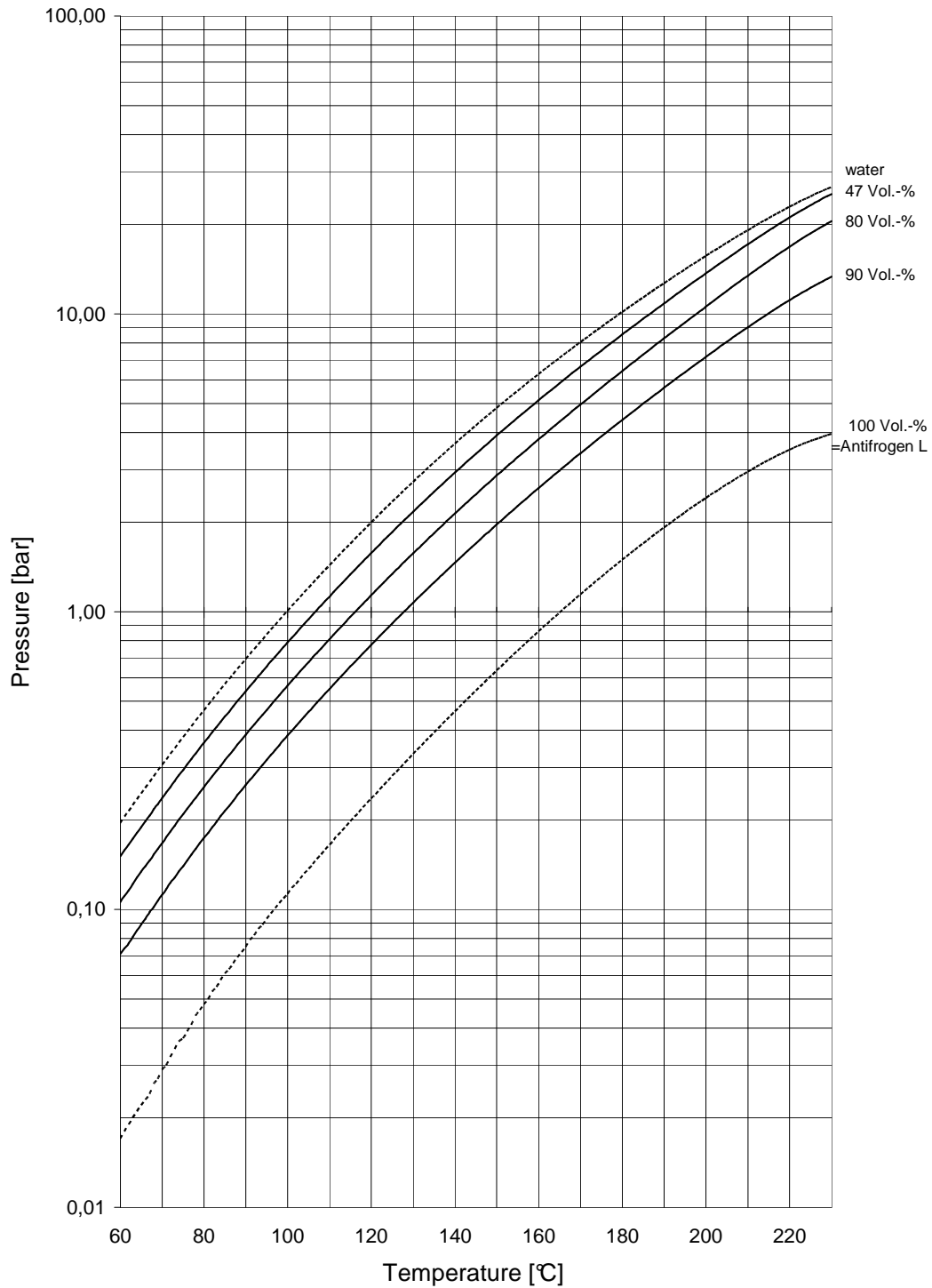
Boiling Points

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



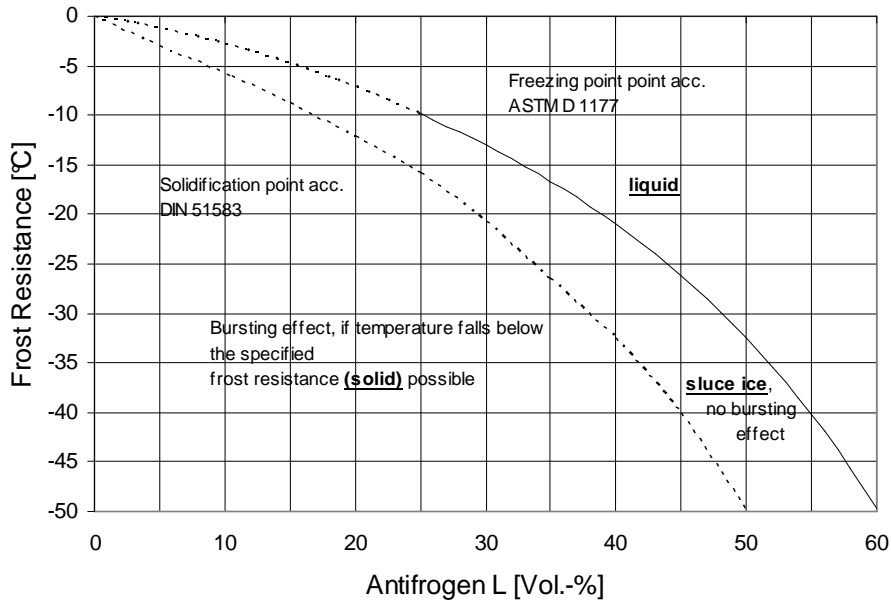
Vapor Pressure

for Antifrogen L-water mixtures as a function of temperature



Frost Resistance

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



This information is based on our present state of know-ledge 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.

Issued in April 2011

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