

Blue Sun®

**Concentrated Coolant – Antifreeze
for Solar Thermal Energy.**

Technical Documentation.

Updated May 2016.

Carpemar



Properties

Blue Sun[®] is a transparent blue liquid with a propylene glycol concentration of 94%.

It maintains solar circuits in perfect condition for longer periods of time than conventional products due to its antirust organic additives. These products optimise heat transference and so enhances the performance of the installations.

Blue Sun[®] meets with European quality specifications and standards.

It does not contain Nitrite or Amine as these are products that may react to give nitrosamines which are potential carcinogen agents. It does not contain phosphates either as their environmental implications have been questioned.

Blue Sun[®] is miscible with water in all proportions. Its performance is not impaired by hard water and there is no danger of precipitation.

Blue Sun[®] and its dilutions with water have a shelf life of at least two years in airtight containers.

Its blue colour helps to detect leaks.

Homologations:¹

AA-52624A Antifreeze, multi-engine type.

ASTM D 3306 Glycol base engine coolant for automobile and Light-duty Service.

ASTM D 3306 homologation contains the next tests:

ASTM D 5931	Density and Relative Density of Engine Coolant Concentrates and Aqueous Engine Coolants by Digital Density Meter
ASTM D 1177	Freezing Point of Aqueous Engine Coolants
ASTM D 1120	Boiling Point of Engine Coolants
ASTM D 1119	Percent Ash Content of Engine Coolants and Antirusts I
ASTM D 1287	Standard Test Method for pH of Engine Coolants and Antirusts
ASTM D 3634	Standard Test Method for Trace Chloride Ion in Engine Coolants
ASTM D 1123	Water in Engine Coolant Concentrate by the Karl Fischer Reagent Method
ASTM D 1121	Standard Test Method for Reserve Alkalinity of Engine Coolants and Antirusts
ASTM D 1882	Effect of Cooling System Chemical Solutions on Organic Finishes for Automotive Vehicles
ASTM D 1881	Foaming Tendencies of Engine Coolants in Glassware
ASTM D 1384	Corrosion Test for Engine Coolants in Glassware
ASTM D 4340	Corrosion of Cast Aluminium Alloys in Engine Coolants Under Heat-Rejecting Conditions.

¹ Homologations by laboratories of INTA (National Institute of Aerospace Techniques) depending on Ministry of Defense of Spain with document: CL/RPT/7430/006/INTA/10

Technical Data:

Appearance	Transparent Blue Liquid	Visual
Boiling Point	152°C	ASTM D 1120
Freezing Point	-45°C	ASTM D 1177
Density (20°C)	1,04 -1,06 g/ml	ASTM D 1122
Viscosity (20°C)	49,5 mPas	ASTM D 445
pH Concentrate Product	8,5-10,5	ASTM D 1287
pH mixed 50% v/v with distilled water	8-9,5	ASTM D 1287
Water content	max. 5%	ASTM D 1123
Cubic Expansion Coefficient	0,00062 1/K	
Alkaline Reserve	min. 5 ml HCl 0,1N	ASTM D 1121

Attributes

- Prevents circuit damage by freezing.
- Raises boiling point, reducing overheating problems.
- Prevents corrosion of metals widely used in solar circuit.
- Prevents deposits in solar circuit.
- Biodegradable.
- Propylene glycol based non toxic.

Applications

Blue Sun[®] is a concentrated product which must be diluted before use. The minimum concentration to ensure protection from corrosion is 20% (1:5). The recommended maximum is 50% (5:10). This product performs best within the range of 30 and 50% (3:10 and 5:10).

Dilution with distilled or deionised water is recommended where mains water has high hardness or where water is not potable quality or it has more than 100 ppm of chloride content. We advise consideration of legal constraints concerning the water quality used for dilution of solar antifreeze in whichever jurisdiction your business operates.

Corrosion Table:

Mixtures of propylene glycol and water are more corrosive than pure water so additives should be used in order to ensure the integrity of the circuit.

The following table shows the effectiveness of mixtures Blue Sun – Water in inhibiting corrosion according to ASTM D 1384. For a comparative purpose results for water and propylene glycol – water mixtures without additives are presented.

Material	<i>Blue Sun</i> [®] (33% v/v)	Propylene glycol (33% v/v)	Tap Water	ASTM D 3306 Max. Limit
Copper	0,50	4	2	10
Solder	0,14	1095	99	30
Brass	-0,51	5	5	10
Mild Steel	-0,96	214	212	10
Cast Iron	-3,71	345	450	10
Aluminum	2,02	15	110	30

The results above are an average change in weight of coupons in mg. A negative number indicates an increase in weight due to the formation of a stable protective layer on the metal's surface.

In the next table are presented the test under ASTM D 4340:

Material	Product	Result	Max. allowed
Aluminium	<i>Blue Sun</i> [®] (25% v/v)	0,5 mg/cm ² week	1,0 mg/cm ² week

Test description:

ASTM D 1384:

In this test method, specimens of metals typical of those present in engine cooling systems are totally immersed in aerated engine coolant solutions with corrosive water for 336 h at 88°C (190°F). The corrosion inhibitive properties of the test solution are evaluated on the basis of the weight changes incurred by the specimens. Each test is run in triplicate, and the average weight change is determined for each metal.

ASTM D 4340:

In this test method, a heat flux is established through a cast aluminium alloy typical of that used for engine cylinder heads while exposed to an engine coolant under a pressure of 193 kPa (28 psi). The temperature of the aluminium specimen is maintained at 135°C (275°F) and the test is continued for 1 week (168 h). The effectiveness of the coolant for preventing corrosion of the aluminium under heat-transfer conditions (hereafter referred to as heat-transfer corrosion) is evaluated on the basis of the weight change of the test specimen.

Compatibility table:

Blue Sun[®] is compatible with the usual materials of solar circuits. The next table shows plastics, sealants and elastomers compatible with water dilutions of the product in habitual proportions. Data has been gathered in specific bibliography and proprietary tests.

Name	Abbreviation
Butyl rubber	IIR
Cloropropene	CR
Ethylene-propylene-diene rubber	EPDM
Fluorocarbon elastomers	FPM
Natural rubber up to 80°C	NR
Nitrile Rubber	NBR
Polyacetal	POM
Polyamide up to 115°C	PA
Polybutene	PB
Polyethylene high/low density	PE-LD/PE-HD
Polyethylene cross linked	VPE
Polypropylene	PP
Poly (tetrafluoroethylene)	PTFE
Polyvinyl chloride, rigid	PVC h
Silicone Rubber	Si
Styrene-butadiene rubber up to 100°C	SBR
Unsaturated polyester resins	UP

Phenolic resins, plasticized PVC and polyurethane elastomers are not compatible with water mixtures of Blue Sun.

Zinc is not compatible with propylene glycol or their mixtures with water, avoid zinc or galvanized reservoirs.

Filling the Installation:

After pressure testing, which also affords an opportunity to determine the volume of the system from the amount of water used (water meter), the system should be drained and then filled immediately with the antifreeze. Air pockets are to eliminate immediately.

Before filling the systems should be flushed with water to remove traces of flux, especially when chlorine containing flux has been used.



After draining the circuit of old antifreeze, it should be flushed with water in order to clean possible deposits and particles before filling with *Blue Sun*[®]. The product's useful life will be reduced if the system is already corroded. If corrosion is detected, corrective action should be taken before filling up the circuit.

Blue Sun has to be diluted with at least 20% V/V to assure complete metals system corrosion protection. For solar systems the recommended range of dilution is 25 – 50%. Dilutions up to 60% can be achieved in special applications.

Mixtures with other kind of antifreeze should be avoided for possible incompatibilities which would reduce the useful life of the product. For specific compatibilities you can contact our technical department: please email solar@carpemar.com.

Long-term no-load operation of the system should be avoided because this can adversely affect the stability of the heat transfer medium and considerably reduce its service life.

Both *Blue Sun*[®] concentrate and its dilutions with water are stable for at least two years in regular stocks conditions in airtight containers.

Equipment must not be fitted with galvanized heat exchangers, heat reservoirs, tanks or pipes, because propylene glycol can corrode zinc.

To prepare the correct dilution, simply determine the desired freezing temperature to establish the according proportions of antifreeze and water to mix. Choose a vessel of sufficient capacity and stir until a homogenous has been achieved.

The minor surface tension of *Blue Sun*[®] compared with water may make minor damage due to corrosion more apparent.

Heat Resistance:

Sustained temperatures higher than 180°C cause premature ageing of propylene glycol. For solar thermal systems with stagnation temperatures above 180°C it is thus recommended to choose expansion vessels of sufficient size to ensure that the solar antifreeze will be taken up completely in case of stagnation.

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

In the case of not-closed systems or the insert of oxygen (e.g. via valves) the maximum usage temperature is lower.

Precautions:

Blue Sun[®] is a non flammable, non corrosive product, so no special precautions are required. In any case good industrial practices are recommendable.

Avoid contact with eyes, in case of splashing flush with running water for at least 10 minutes. Do not eat or drink, keep away of children.

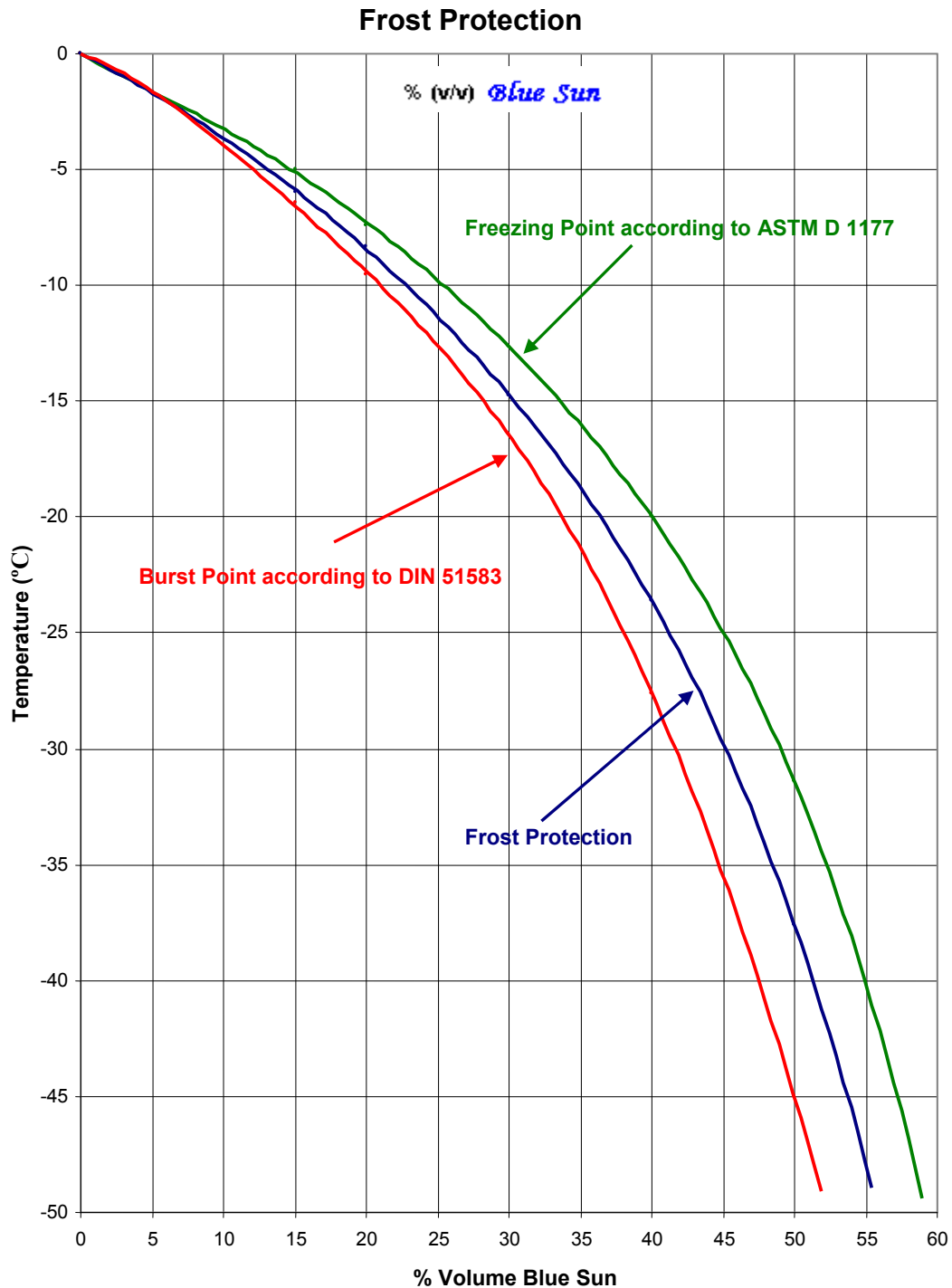
Store in a clean and well-ventilated place. Tightly sealed containers are recommended because of the hygroscopic properties of the product.

Presentation:

Blue Sun[®] is supplied in 1.000 liter. IBC containers, 210 liter non-returnable plastic drums, and in 25 and 10 liter non-returnable plastics drums.

Other volumes are available upon request.

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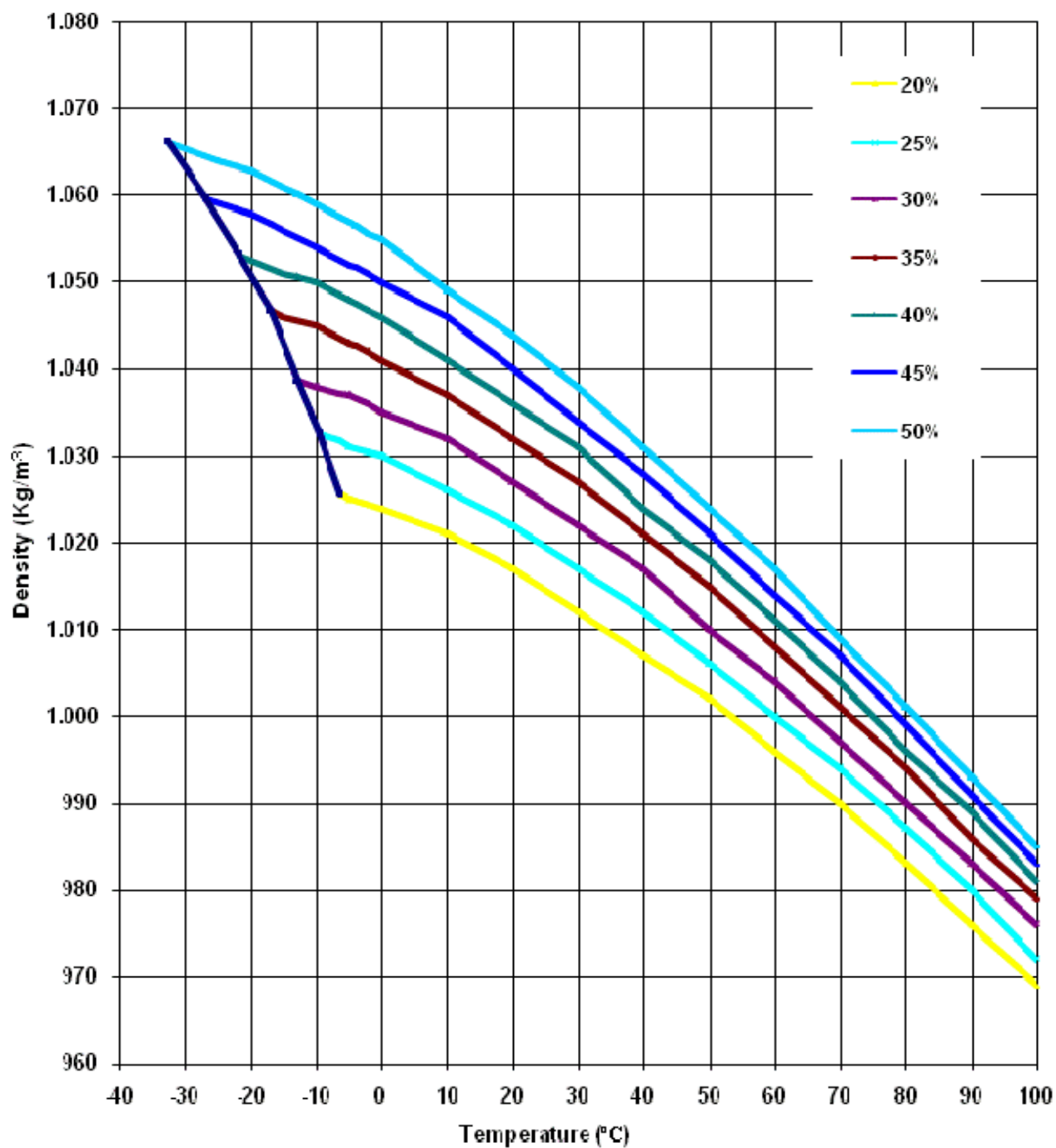


Freezing point according to ASTM D 1177 is the temperature for the first ice crystal formation.

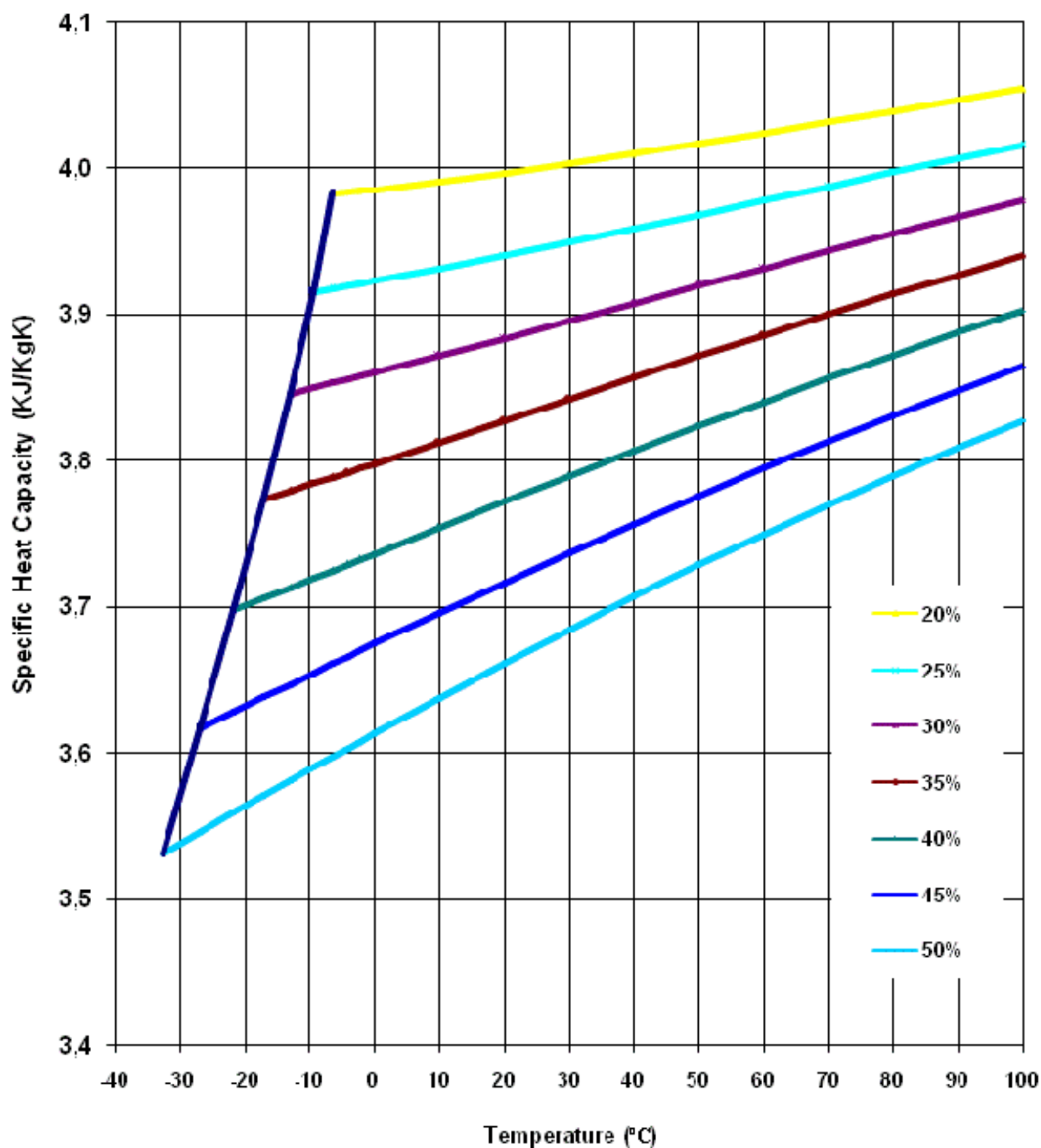
DIN 51583 normative establishes the temperature from the product does not flow and there is danger for the circuit integrity.

Between both temperatures exists a mixture of ice crystals and not-frozen fluid that flows without volume increase, thus, without bursting problems.

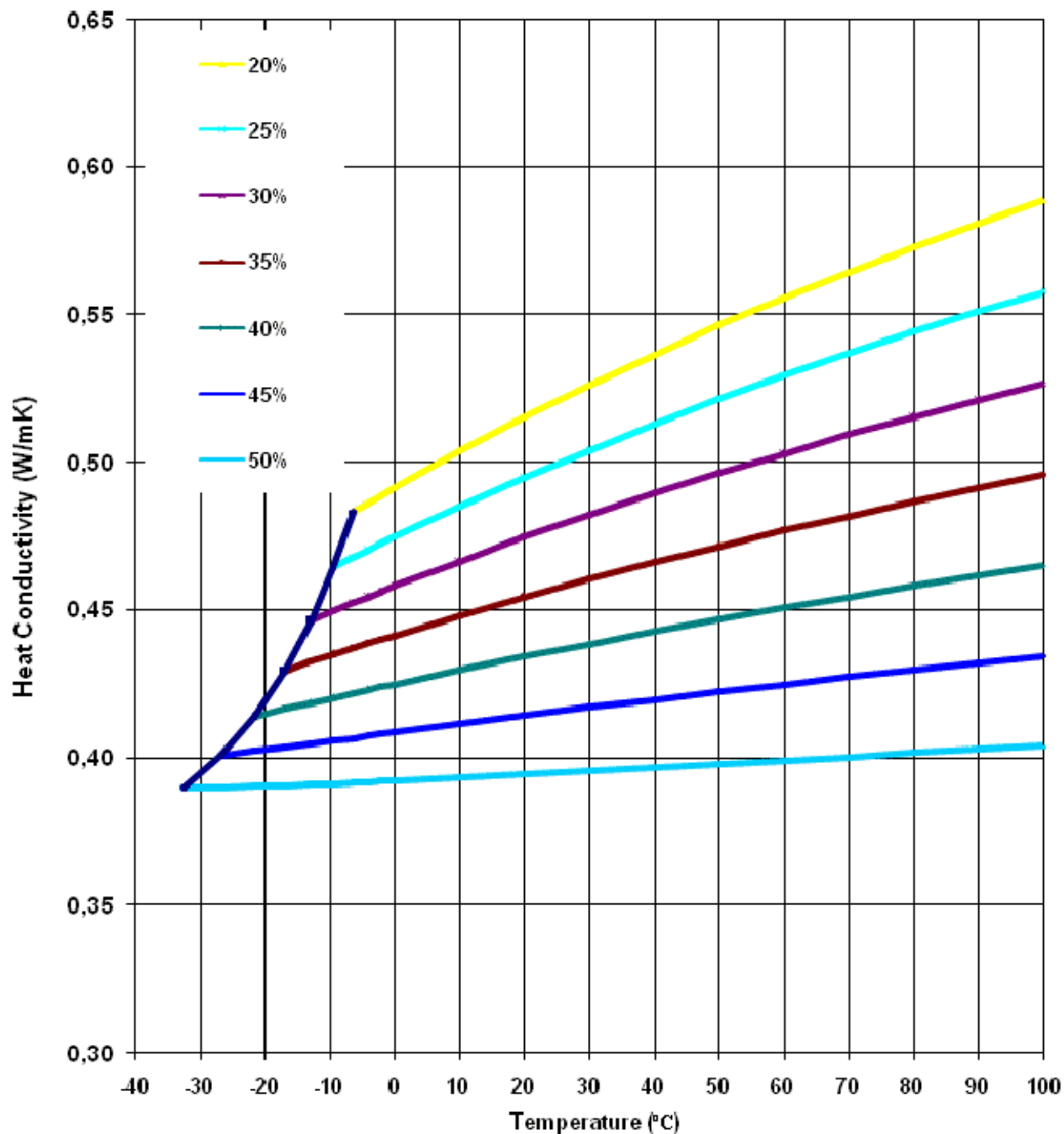
Density .vs. % Blue Sun y T^a



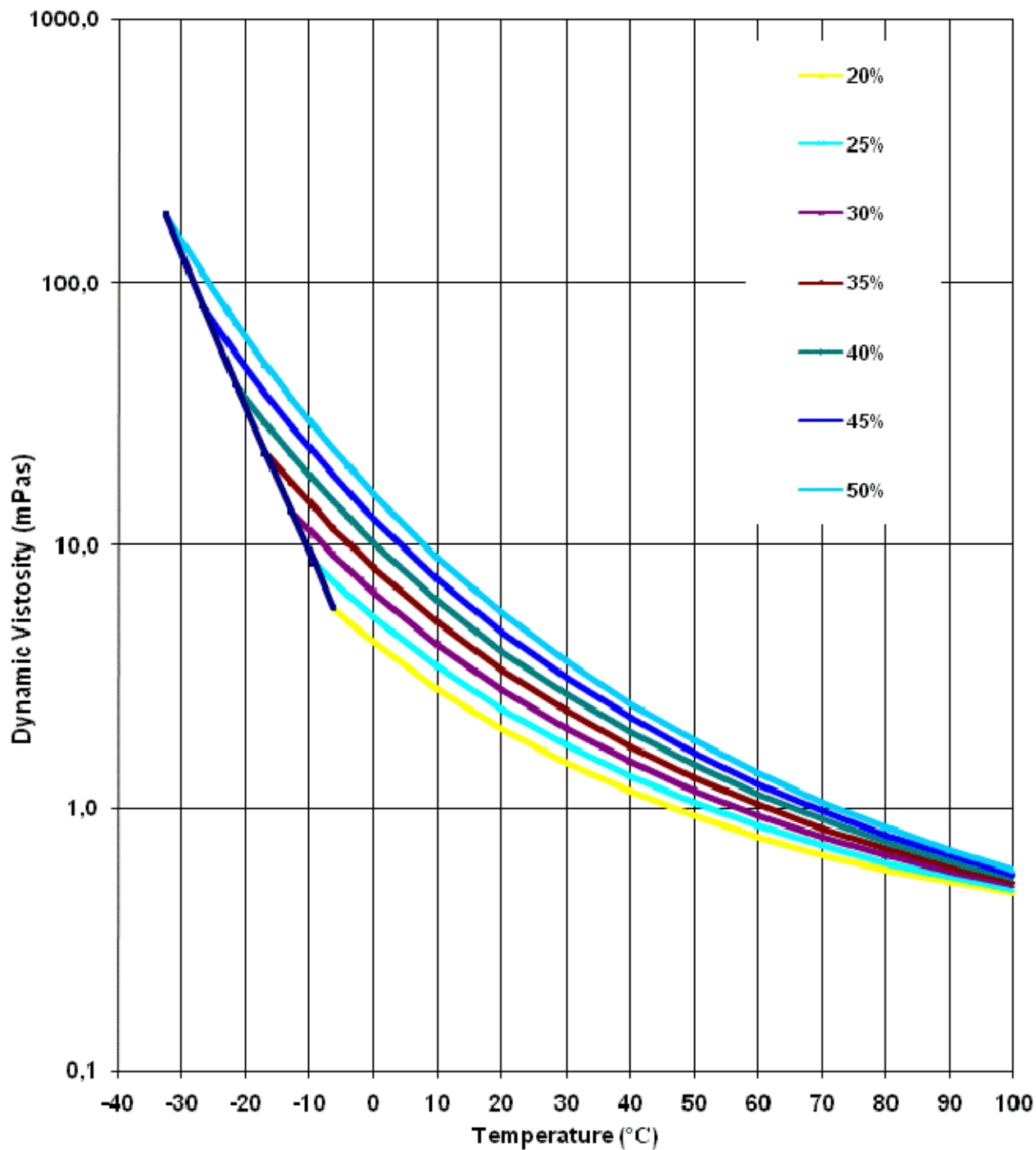
Specific Heat Capacity .vs. % Blue Sun y Tª



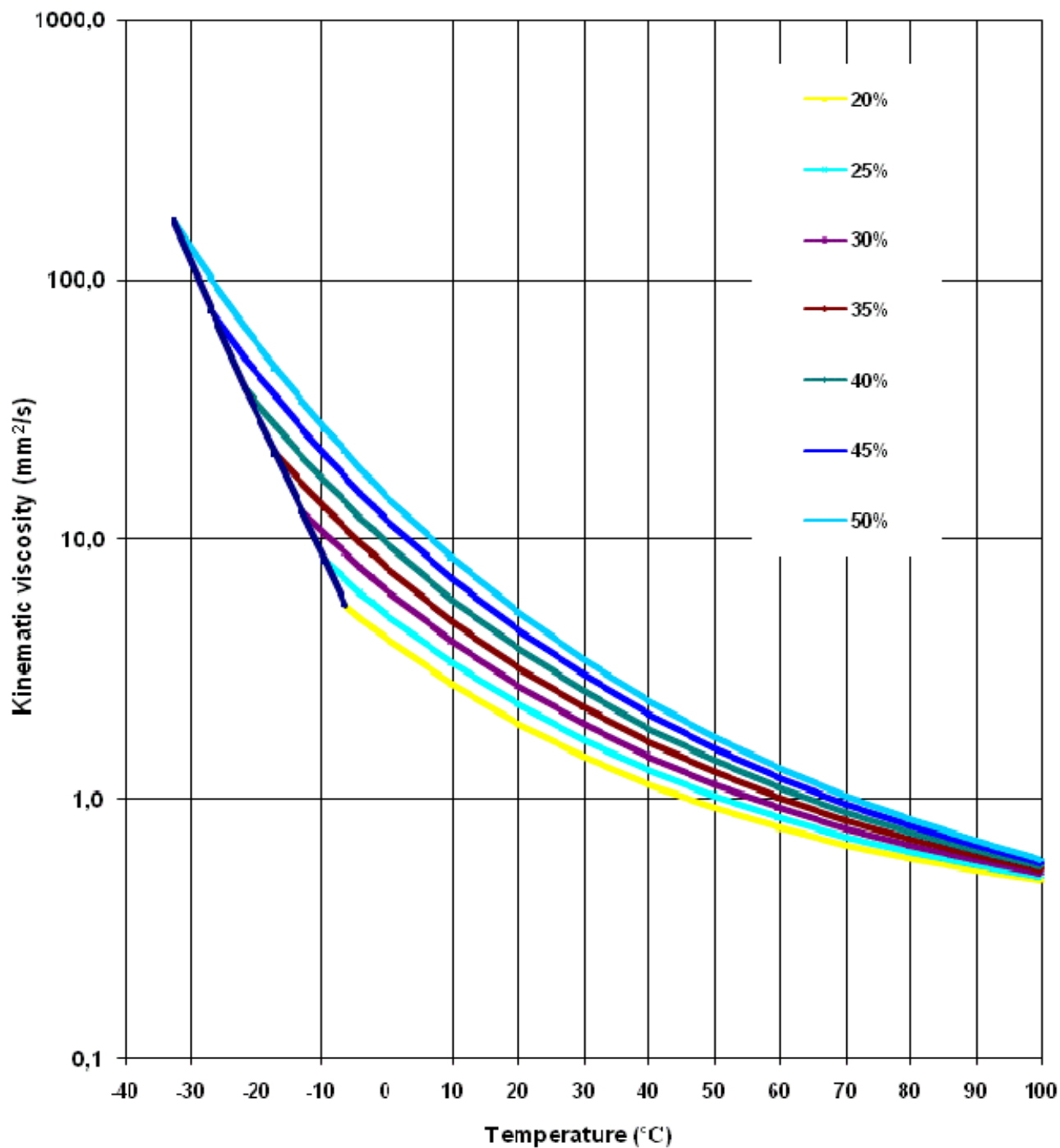
Heat Conductivity .vs. % Blue Sun y T^a



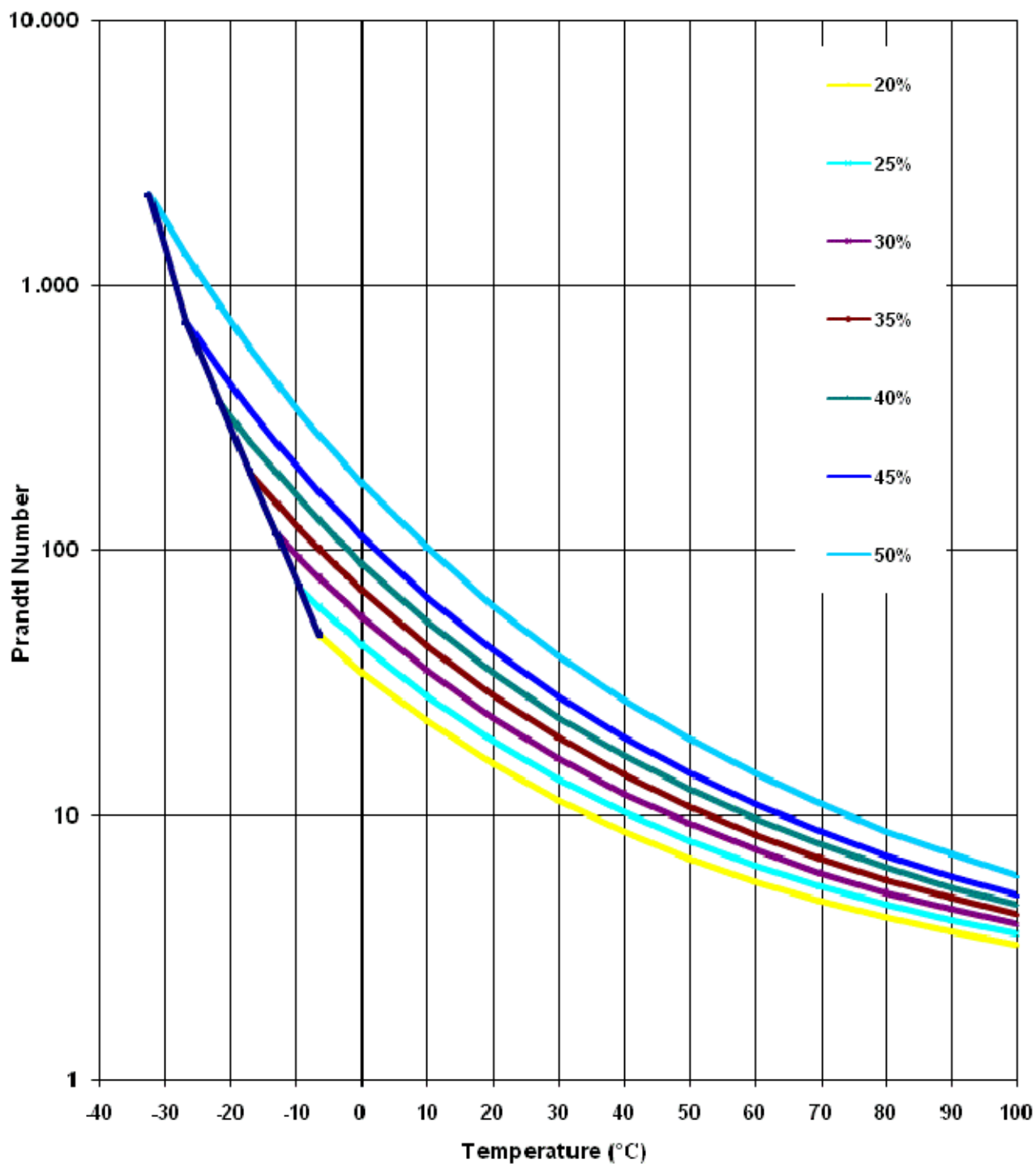
Dynamic Vistosity .vs. % Blue Sun y T^a



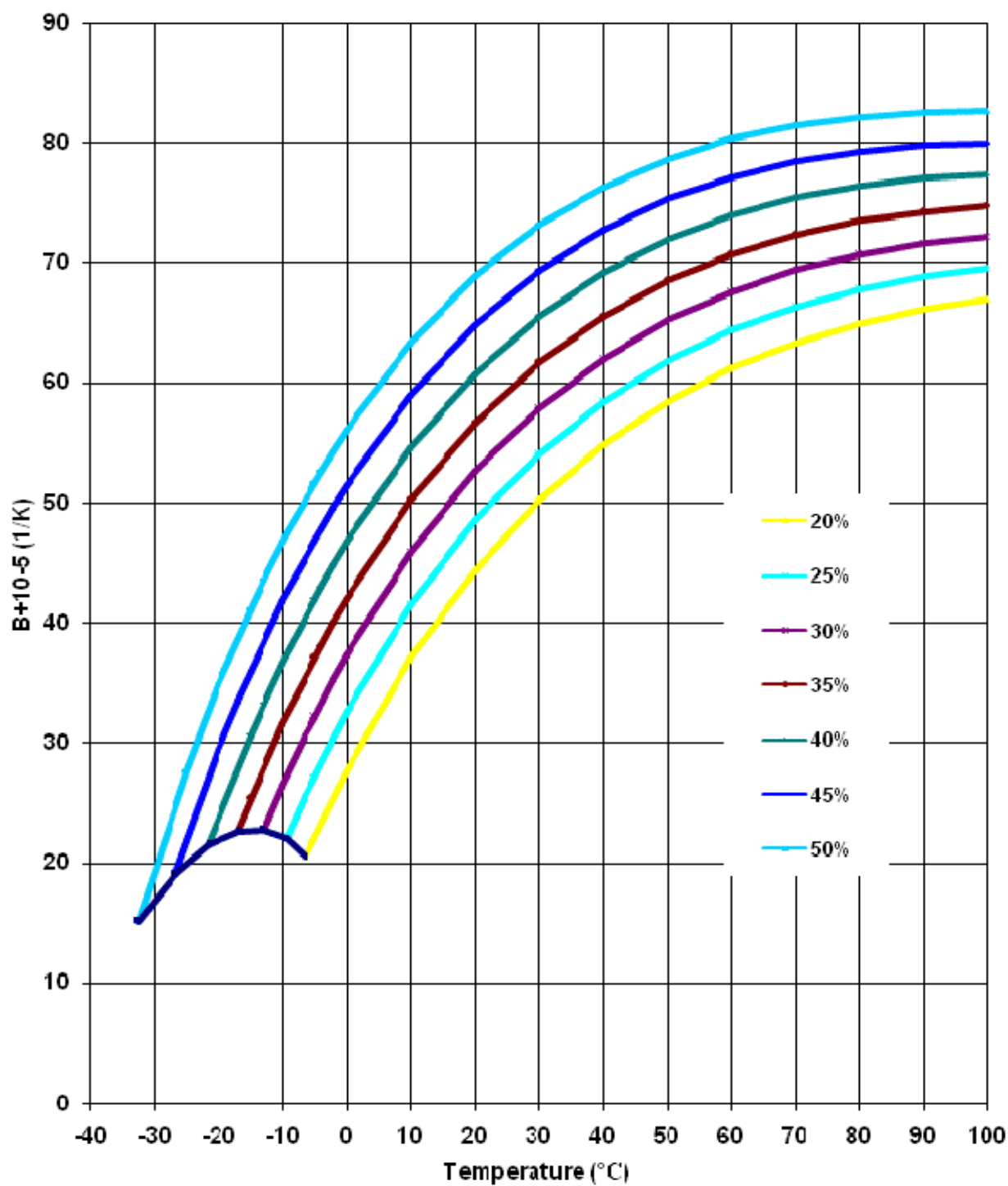
Kinematic viscosity .vs. % Blue Sun y T^a



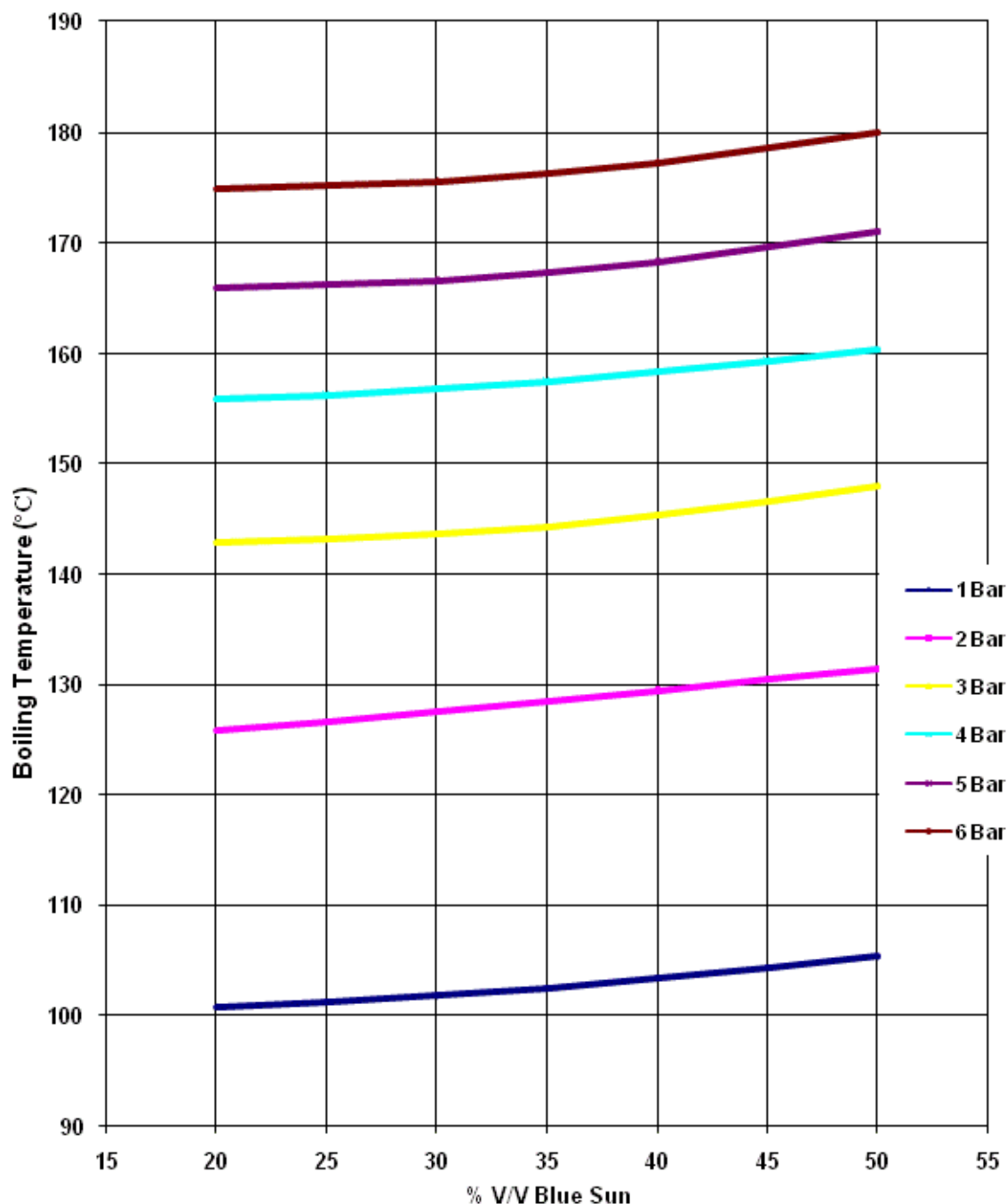
Prandtl Number. vs. Blue Sun y T^a



Cubical Expansion Coefficient .vs. % Blue Suny T^a



Boiling Temperature .vs. % Blue Sun and Pressure



The information contained in this document is based on our current knowledge and experience. This information is presented for good use of the products and it is not part, necessarily, of the technical specifications.

It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed.