



**DOWCAL N, DOWCAL 20 and DOWCAL 10  
Heat Transfer Fluids**

Product Profiles for Process Designers and System Operators



# DOWCAL Fluids

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## Meet DOWCAL Heat Transfer Fluids

DOWCAL\* heat transfer fluids are formulated, industrially inhibited propylene and ethylene glycol-based fluids designed to provide high levels of performance and protection in a wide range of applications. The fluids are clear, pale yellow liquids.

DOWCAL N heat transfer fluid is an economical, high quality fluid designed for a temperature range of -45°C to +120°C. The low acute oral toxicity of propylene glycol and of its special inhibitors makes DOWCAL N fluid particularly suitable for indirect food and beverage chilling and freezing applications.

Both ingredients of DOWCAL N fluid are generally recognized as safe by the U.S. Food and Drug Administration (FDA) as food additives under Part 182 and Part 184 of the Food Additive Regulations. DOWCAL N fluid is, therefore, an appropriate and safe heat transfer medium for use in food plants.

DOWCAL 20 heat transfer fluid is an economical, high quality fluid designed for a temperature range of -45°C to +120°C. Under certain conditions, DOWCAL 20 fluid can be used at temperatures up to

160°C. The low acute oral toxicity of propylene glycol makes DOWCAL 20 fluid particularly suitable for applications where toxicity is a concern.

DOWCAL 10 heat transfer fluid is an economical, high quality ethylene glycol-based fluid designed for a temperature range of -50°C to +120°C, but under certain conditions, DOWCAL 10 fluid can be used at temperatures up to 170°C.

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**Table 1**  
**Key features of DOWCAL Fluids**

	<b>DOWCAL N</b>	<b>DOWCAL 20</b>	<b>DOWCAL 10</b>
Freeze protection	X	X	X
Corrosion protection in hot and cold systems	X	X	X
FDA-approved safe food additive	X		
Compatibility with commonly used elastomers	X	X	X
Confirmed biodegradability	X	X	X
Long fluid life	X	X	X
Prevention of scale formation with hard water		X	X
Low maintenance cost	X	X	X
Heat transfer efficiency	X	X	
Cost-effectiveness	X	X	X
Protection against bacterial growth	X	X	X

## **Advantages of DOWCAL Heat Transfer Fluids**

Aren't all heat transfer fluids the same? Absolutely not. Heat transfer fluids must address a wide range of often vastly different process-specific needs. Selection of the wrong product for a given application may cause damage once filled into the system. When the first leak occurs as the result of corrosion or gasket decomposition, major equipment overhauls are usually unavoidable. That's why it pays to carefully select a heat transfer fluid. Dow offers a full range of heat transfer fluids with technological support for any application.

As a Dow customer, you have direct access to the market-place leader's heat transfer expertise and highly diversified industry experience. In other words, when you properly choose a DOWCAL heat transfer fluid, you have the assurance that it will do the job long-term without jeopardizing the integrity of the equipment in which it is used. Dow specialists will assist to make sure our product is exactly what you need.

DOWCAL fluids can improve process efficiency, reduce costs, or both. DOWCAL fluids offer maximum protection against frost and corrosion. If the concentration of DOWCAL fluid in the loop remains constant, the properties remain unchanged even after many years of use.

## Typical Applications of DOWCAL Fluids

DOWCAL N fluid is an ideal propylene glycol-based heat transfer fluid for defrosting, de-icing, chilling and freezing applications, specifically in the food industry, and for many other heat exchange systems.

DOWCAL 20 fluid is an excellent propylene glycol-based heat transfer fluid for heating, ventilating and air conditioning (HVAC) systems, sprinkler equipment, refrigeration warehouse floor heaters, and many other heat exchange systems, as well as solar panels.

DOWCAL 10 fluid is an excellent ethylene glycol-based heat transfer fluid for heating, ventilating, and air conditioning (HVAC) systems, solar panels, heat pumps, and many other heat exchange systems.

### Applications for DOWCAL fluids include:

#### *Defrosting and de-icing*

##### **Refrigeration coil defrosting**

When moisture from the air condenses on the refrigeration coils of walk-in freezers and chillers, the result is frost build-up with a corresponding loss in refrigeration efficiency. Sprayed directly onto the coils, DOWCAL N fluid will prevent frost formation and, because it is hygroscopic, DOWCAL N fluid also absorbs condensation.

##### **Conveyor roller de-icing**

The conveyors in food freezing tunnels are often affected by frost formation on rollers and other moving parts. DOWCAL N fluid offers an ideal remedy; sprayed directly onto the rollers, it absorbs free moisture, lowers the freeze point of water, prevents frost build-up and protects the rollers against corrosion.

##### *Chilling, freezing, secondary cooling*

##### **Cooling liquid foods**

Because of its outstanding performance features, DOWCAL N fluid is widely used in the beverage industry to cool products such as beer, wine, milk, and juices.

##### **Fermentation cooling**

Breweries and wineries use DOWCAL N fluid to cool fermentation and wort tanks.

The fluid's anti-corrosive properties safeguard the integrity of the piping systems.

##### **Packaging of carbonated beverages**

For cost-effectiveness reasons, DOWCAL N fluid is used to chill carbonated beverages such as sparkling wines, champagne and beer prior to bottling. This prevents unwanted loss of carbonation.

##### **Immersion freezing of wrapped foods**

In the food industry, products sealed in airtight and watertight pouches are immersion-frozen in DOWCAL N fluid baths. This method is popular because it is fast and efficient while ensuring uniform freezing.

##### **Ice skating rinks**

For ice skating rinks, solutions containing DOWCAL 10 or DOWCAL 20 fluid are chilled by refrigeration equipment and then circulated through a network of pipes beneath the rink floor. The cold solution causes a layer of water to freeze into a smooth sheet of ice. Used in ice rinks, DOWCAL fluids provide fast freezing, lower operating and maintenance costs, as well as excellent corrosion protection for metal pipes.

## Typical Applications of DOWCAL Fluids, *continued*

### **Phase-change HVAC systems**

HVAC systems based on salt hydrate mixtures for cold storage are becoming more and more popular due to their compactness and flexibility in terms of heat release or absorption. DOWCAL 20 fluid is ideal for heat transport to and from such systems.

### **Process chilling**

The chemical, petrochemical, and food industries use secondary cooling for chilling purposes or to remove heat generated during processing. DOWCAL 10 fluid is often used for process chilling because it is nonflammable in aqueous solutions and features low corrosivity. DOWCAL 10 fluid is not recommended for applications in the food and beverage sector. A propylene glycol-based product — DOWCAL N fluid — is available for processes which may involve accidental or inadvertent food contact.

### *Secondary heat transfer*

#### **Snow melting systems**

A snow melting system basically consists of a network of pipes or tubing embedded in concrete or asphalt. A solution of heated DOWCAL 20 and water is circulated through the pipes in order to remove snow and ice from bridges, service areas, roads, and sidewalks. DOWCAL 20 fluid can usually be left in the system for years while maintaining complete corrosion protection.

#### **Batch processing systems**

In batch processing environments, reactors must be cooled and heated. Because of its wide temperature range, DOWCAL 20 fluid can be used in both hot and cold loops.

#### **Floor heating**

Massive damage can be inflicted on warehouse floors due to frost heaving. This risk is reduced by embedding a grid of tubing in the soil beneath the floor and heating it with a solution of DOWCAL 20 fluid.

#### **Solar units**

Solar energy is used in industrial and commercial markets for heating purposes. Inside the collector, a solution of DOWCAL 20 fluid absorbs solar heat which is then transported to areas where the energy can be used to heat water or air.

#### **Process/pipeline tracing**

DOWCAL 10 fluid is used to keep process fluids at a constant temperature and to prevent freezing. Compared to conventional steam tracing, tracing using DOWCAL 10 fluid offers better temperature control over a wider range, eliminates waste disposal problems, and requires less maintenance.

#### **Heat recovery**

Many industries operate heat recovery systems to improve the overall thermal efficiency of their processes. In this application, DOWCAL 10 fluid collects waste heat, which would otherwise be expelled to the environment, and pumps it to places where this thermal energy can be put to use.

**Table 2**  
**Technical data**

Delivery specifications	DOWCAL N	DOWCAL 20	DOWCAL 10
Density at 20°C, g/cm <sup>3</sup>	1.045-1.055	1.045-1.055	1.124-1.134
Reserve alkalinity (min.), ml	10	8	10
Water content (max.), wt %	4	4	4
pH			
50% vol. in water	9-10	7.2-8.2	7.6-8.2
33% vol. in water	8.8-9.8	7.0-8.0	7.9-8.4
Freezing point, °C (min.)			
50% vol. in water	-30	-30	-33
40% vol. in water	-20	-20	-25
Flash point (PMCC), °C	101	101	120

**Table 3**  
**Typical physical data**

	DOWCAL N	DOWCAL 20	DOWCAL 10
Composition, wt %			
Propylene glycol	95.5	94	—
Ethylene glycol	—	—	94
Inhibitors and water	4.5	6	6
Boiling range at 1013 mbar, °C	±170	±170	170
Viscosity at 20°C dynamic, mPa·s	55-80	55-80	12-32
Viscosity at 20°C kinematic, mm <sup>2</sup> /s	50-75	50-75	10-30
Refractive index n <sub>D</sub> 20°C	1.432	1.434	1.433
Specific heat at 20°C, kJ/kg·K	2.45	2.33	2.33
Thermal conductivity at 20°C, W/m·K	0.22	0.21	0.27
Pour point, approximately, °C	±50	±50	-42
Specific electrical conductivity at 20°C (33% vol. in demin. water), mS/cm	2.3	3.1	4.3

## Facts on Corrosion Protection

DOWCAL fluids protect commonly used metals and alloys in cooling and heating systems, reducing maintenance costs and extending the life of the process equipment. The following table shows the comparatively low corrosion of widely used metals caused by DOWCAL fluid/water mixtures in comparison with water and uninhibited propylene glycol or ethylene glycol/water mixtures. The results were derived from tests performed according to the widely known ASTM 1384 corrosion test method and represent the weight loss of the materials in milligrams per specimen due to corrosion (ASTM D 1384, 88°C for 2 weeks, glycol concentration 30% by volume, air bubbling).

DOWCAL fluid/water mixtures retain excellent anticorrosion performance when diluted up to 30% vol. Further dilution is not recommended.

DOWCAL fluid/water mixtures can dissolve zinc when hot and should therefore not be used in galvanized pipelines. At service temperatures in excess of 65°C, DOWCAL fluids should not be used in systems with exposed aluminum components.

DOWCAL N fluid can be mixed with local tap water if the available water is extremely soft.

Otherwise, demineralized or distilled water should be used. Due to a special chelating agent which prevents scaling, DOWCAL 20 and DOWCAL 10 fluids can be mixed with local tap water. However, demineralized water is recommended. The tap water should not contain more than 25 ppm chlorides and total hardness should not exceed 100 ppm. This is particularly significant if systems contain aluminum or aluminum alloy components. If water of adequate quality is not available, Dow can supply ready-to-use solutions of DOWCAL fluids.

**Table 4**  
**Metal weight loss due to corrosion, in milligrams**

	DOWCAL N & 20 and water	Propylene glycol and water	Water only	DOWCAL 10 and water	Ethylene glycol and water
Copper	3	4	2	3	4
Solder	1	1095	99	4	1780
Brass	4	5	5	3	11
Mild steel	1	214	212	1	974
Cast iron	3	345	450	3	1190
Aluminum	+2	15	110	4	165

Samples with a "+" showed weight gain

## Facts on Toxicity and Biodegradability

DOWCAL N fluid is based on propylene glycol which is generally recognized by the United States Food and Drug Administration (FDA) as a safe food additive. In the USA, its ingredients are approved by the FDA under Part 182 of the Food Additive Regulations. The regulation for propylene glycol is found at 21 CFR 184.1666. The FDA clears only individual ingredients, not proprietary products. DOWCAL N is further listed by the U.S. Department of Agriculture (USDA) as well as by the relevant German regulatory authorities as chemically acceptable for use in closed systems in food processing plants.

For DOWCAL N and DOWCAL 20 fluids, the oral LD50 for rats is 21,000 to 33,700 mg/kg.

Propylene glycol is also relatively harmless to the skin as it is not absorbed in toxic amounts. At room temperature or less, the product's vapour pressure keeps vapour concentrations minimal. The concentrations attained if propylene glycol is heated or sprayed as an aerosol may be sufficient to cause irritation and other effects.

DOWCAL fluid/water mixtures show no acute harmful effects on fish and bacteria in concentrations up to 1000 mg/l. DOWCAL N and DOWCAL 10 fluids contain no amines and nitrites, so harmful products such as nitrosamines are not formed.

DOWCAL fluids are readily biodegradable (BOD greater than 60%). It is therefore possible to biologically degrade DOWCAL fluid/water mixtures in a biological sewage plant provided this is acceptable under the relevant legal provisions on water and waste.

For additional information, please refer to the relevant Material Safety Data Sheet.

**Table 5**  
**Biodegradability of DOWCAL fluids**

	DOWCAL N and 20	DOWCAL 10
Total oxygen demand (TOD) for propylene glycol (PG)	1.68 gram O <sub>2</sub> /gram PG	—
Total oxygen demand (TOD) for ethylene glycol (EG)	—	1.29 gram O <sub>2</sub> /gram EG
Biological oxygen demand (BOD)		
After 5 days	1.11 gram O <sub>2</sub> /gram PG	0.78 gram O <sub>2</sub> /gram EG
After 10 days	1.22 gram O <sub>2</sub> /gram PG	1.06 gram O <sub>2</sub> /gram EG
After 20 days	1.42 gram O <sub>2</sub> /gram PG	1.15 gram O <sub>2</sub> /gram EG
The rate of degradation as defined by BOD/TOD		
5 days	66%	60%
10 days	73%	82%
20 days	85%	89%

## Facts on Flammability and Fire Hazards

When mixed with water in concentrations of up to 80%, DOWCAL fluids are non-flammable since they have no measurable flash points. Thus,

they pose no fire hazard in most applications. The following flashpoint and firepoint values apply to pure DOWCAL fluids.

**Table 6**  
**Flash and Ignition Points of DOWCAL fluids**

	DOWCAL N and 20	DOWCAL 10
Flashpoint (DIN 51758)	101°C	120°C
Ignition temperature (DIN 51794)	420°C	435°C

## Facts on Compatibility with Plastics and Rubbers

The plastics and elastomers listed are suitable for components likely to come into contact with DOWCAL fluid/water mixtures. Information on unlisted materials can be obtained from any Dow sales office.

Polyethylene (soft / hard)	LDPE/HDPE
Polypropylene	PP
Polyvinylchloride (hard)	PVC
Polyester cross-linked	UP
Butyl rubber	IIR
Fluorocarbon rubber (Viton®)	FPM
Polytetrafluoroethylene	PTFE
Polyamides	PA
Ethylene – Propylene – Diene rubber	EPDM
Nitrile – Butadiene rubber†	NBR
Polychlorobutadiene	CR
Styrene Butadiene rubber up to 100°C <sup>††</sup>	SBR
Natural rubber up to 80°C	NR

† Up to 40°C for DOWCAL N fluid.  
††Up to 100°C for DOWCAL N fluid.

## Facts on Handling, Storage and Disposal

When handling DOWCAL fluids avoid ingestion and practice reasonable caution.

When stored in original drums, DOWCAL fluids will meet sales specification requirements for a period of at least 24 months from date of shipment. Continued storage beyond the designated

shelf life does not necessarily make the fluid unsuitable for use. Dow offers a fluid analysis service in such cases.

No special storage precautions are needed. However, zinc is not resistant to undiluted DOWCAL fluids. Therefore, exposure of zinc or zinc coatings to pure DOWCAL fluids should be avoided.

Spent DOWCAL fluid/mixtures can be disposed of in a special waste incineration plant or biological sewage treatment plant in accordance with local requirements.

## Preparing Systems for Use of DOWCAL Fluids

When preparing new equipment for systems using DOWCAL heat transfer fluids, it is good practice to remove oil, grease or protective coatings which may have been applied during fabrication, construction or storage. To do this, it is best to explicitly follow the equipment manufacturer's recommendations. Before any cleaning procedure the system should be free of all foreign matter and debris. Chemical cleaning of new systems can be performed with a 1 to 2 wt % solution of water and trisodium phosphate. After cleaning the system, it must be thoroughly flushed with clean soft water prior to adding DOWCAL fluids.

After pressure-testing with water or a DOWCAL fluid/water mixture, systems should be left in the filled state to avoid pitting at the liquid/air phase boundary. If systems which have been filled with water or DOWCAL fluid/water mixtures need to be drained and cannot be refilled within a few days, they should be thoroughly rinsed and dried.

When changing from another heat transfer fluid to DOWCAL fluid, systems should be carefully cleaned to remove all traces of the previous fluid and any deposits which may be present. In replacing brine solutions, special care should be taken to remove all scale and corrosion deposits that may have built up.

It is particularly important to remove calcium deposits and chlorides. Residual calcium will react with and deplete the DOWCAL inhibitor, reducing the product's corrosion protection capability. Chlorides are potentially corrosive to the system if present at high levels.

For large or severely corroded systems, it is recommended that a professional cleaning organization be consulted.

When changing from another propylene glycol-based heat transfer fluid, compatibility of the fluid with DOWCAL N or DOWCAL 20 fluid should be checked. Similarly, if changing from another ethylene glycol-based fluid, compatibility with DOWCAL 10 fluid should be checked. If the fluids are compatible and if the system is still in proper condition, the fluid can easily be replaced or filled up with a DOWCAL fluid.

Like all other fluids, solutions containing DOWCAL fluids expand as temperatures increase. Expansion tanks are commonly used in systems containing DOWCAL fluids.

Although DOWCAL fluids are completely miscible with water in all proportions, it is recommended that—when the water is added separately—the system be filled with about two thirds of the calculated amount of water before adding DOWCAL fluid. The system can be topped up with the remaining water. Local tap water is only acceptable if it is very soft. Otherwise, demineralized water, boiler condensate or distilled water should be used.

### Expansion factor

To determine the volume required for expansion use the following formula:

$$\Delta V = \frac{\rho(T_{LOW}) - \rho(T_{HIGH})}{\rho(T_{HIGH})} \times V$$

where:  $\rho(T_{LOW})$  = the density at the lowest anticipated temperature

$\rho(T_{HIGH})$  = the density at the highest anticipated temperature

## **Comparing DOWCAL Fluids**

While DOWCAL N is based on propylene glycol, DOWCAL 10 fluid is based on ethylene glycol. DOWCAL 20 also contains the non-toxic propylene glycol as the basic product but due to its extended corrosion inhibitor package it is better suited for those non-food and beverage applications where DOWCAL N is not really necessary.

DOWCAL N and DOWCAL 20 fluids should be given preference in applications in the food and beverage industry — whenever the heat transfer fluid can get into contact with the consumable product or humans. Detailed information on all three products is available at a local Dow sales office or via your distributor of DOWCAL fluids.

## **Technical Support and Assistance**

Experience confirms that DOWCAL fluids can be used in installations for many years. However, the concentration of DOWCAL fluid and the product's functional performance should be checked at intervals of one to two years. A 500 ml sample is sufficient for the analysis. This service is available from your distributor of DOWCAL fluids. Call the number for your area on the back of this brochure for the identity of the distributor nearest you. Free annual fluid analysis for systems containing more than 10,000 liters of pure DOWCAL fluid.

Send fluid samples to:  
Dow Benelux NV  
Testing Lab for DOWCAL Fluids  
Oude Maasweg 4  
3197 KJ Rotterdam-Botlek  
The Netherlands

Technical support can be obtained from Dow's qualified specialists. Also, a diskette is available with detailed information on system design and other relevant data. Please turn to the back cover of this brochure to find the toll-free number of the Dow Customer Information Group.

## **Put DOWCAL Fluids to Work**

If you would like to know more about the cost-effectiveness, performance features and suitability of Dow heat transfer fluids for your application, please do not hesitate to contact us. You can rely on Dow for expertise and thorough understanding of heat exchange systems in all major industries.

**TABLE 7**  
**Physical Properties for DOWCAL N Fluid**

Propylene Glycol wt %	Propylene Glycol vol %	DOWCAL N wt %	DOWCAL N vol %	Freezing Point °C	Boiling Point <sup>†</sup> °C	Refractive Index 20°C
0.0	0.0	0.0	0.0	0	100	1.333
5.0	4.8	5.2	5.0	-2	100	1.339
10.0	9.6	10.5	10.1	-3	100	1.344
15.0	14.5	15.7	15.2	-5	100	1.350
20.0	19.4	20.9	20.3	-7	101	1.356
21.0	20.4	22.0	21.4	-8	101	1.358
22.0	21.4	23.0	22.4	-8	101	1.359
23.0	22.4	24.1	23.5	-9	101	1.360
24.0	23.4	25.1	24.5	-9	101	1.361
25.0	24.4	26.2	25.5	-10	101	1.364
26.0	25.4	27.2	26.6	-10	101	1.364
27.0	26.4	28.3	27.6	-11	101	1.365
28.0	27.4	29.3	28.7	-11	102	1.366
29.0	28.4	30.4	29.7	-12	102	1.367
30.0	29.4	31.4	30.8	-13	102	1.369
31.0	30.4	32.5	31.8	-13	102	1.370
32.0	31.4	33.5	32.9	-14	102	1.371
33.0	32.4	34.6	33.9	-15	102	1.372
34.0	33.5	35.6	35.1	-16	102	1.373
35.0	34.5	36.6	36.1	-16	103	1.375
36.0	35.5	37.7	37.2	-17	103	1.376
37.0	36.5	38.7	38.2	-18	103	1.377
38.0	37.5	39.8	39.3	-19	103	1.378
39.0	38.5	40.8	40.3	-20	103	1.379
40.0	39.6	41.9	41.5	-21	104	1.380
41.0	40.6	42.9	42.5	-22	104	1.381
42.0	41.6	44.0	43.6	-23	104	1.383
43.0	42.6	45.0	44.6	-24	104	1.384
44.0	43.7	46.1	45.8	-26	104	1.385
45.0	44.7	47.1	46.8	-27	104	1.386
46.0	45.7	48.2	47.9	-28	104	1.387
47.0	46.8	49.2	49.0	-29	104	1.388
48.0	47.8	50.3	50.1	-31	105	1.389
49.0	48.9	51.3	51.2	-32	105	1.390
50.0	49.9	52.4	52.3	-34	106	1.392
51.0	50.9	53.4	53.3	-35	106	1.393
52.0	51.9	54.5	54.3	-37	106	1.394
53.0	53.0	55.5	55.5	-38	106	1.395
54.0	54.0	56.5	56.5	-40	106	1.396
55.0	55.0	57.6	57.6	-42	106	1.397
56.0	56.0	58.6	58.6	-43	106	1.398
57.0	57.0	59.7	59.7	-45	107	1.399
58.0	58.0	60.7	60.7	-47	107	1.400
59.0	59.0	61.8	61.8	-49	107	1.401
60.0	60.0	62.8	62.8	-51	107	1.402
65.0	65.0	68.1	68.1	-51	108	1.407
70.0	70.0	73.3	73.3	-51	110	1.411
75.0	75.0	78.5	78.5	-51	114	1.416
80.0	80.0	83.8	83.8	-51	119	1.420
85.0	85.0	89.0	89.0	-51	128	1.424
90.0	90.0	94.2	94.2	-51	138	1.428
95.5	95.5	100.0	100.0	-51	167	1.432

<sup>†</sup>Boiling point at 1.013 bar  
DOWCAL N = 95.5 wt % PG

**Table 8**  
**Physical Properties for DOWCAL 20**

Propylene Glycol wt %	Propylene Glycol vol %	DOWCAL 20 wt %	DOWCAL 20 vol %	Freezing Point °C	Boiling Point <sup>†</sup> °C	Refractive Index 20°C
0.0	0.0	0.0	0.0	0	100	1.333
5.0	4.8	5.3	5.1	-2	100	1.339
10.0	9.6	10.6	10.2	-3	100	1.345
15.0	14.5	16.0	15.4	-5	100	1.352
20.0	19.4	21.3	20.6	-7	101	1.358
21.0	20.4	22.3	21.7	-8	101	1.359
22.0	21.4	23.4	22.8	-8	101	1.360
23.0	22.4	24.5	23.8	-9	101	1.362
24.0	23.4	25.5	24.9	-9	101	1.363
25.0	24.4	26.6	26.0	-10	101	1.364
26.0	25.4	27.7	27.0	-10	101	1.365
27.0	26.4	28.7	28.1	-11	101	1.366
28.0	27.4	29.8	29.1	-11	102	1.368
29.0	28.4	30.9	30.2	-12	102	1.369
30.0	29.4	31.9	31.3	-13	102	1.370
31.0	30.4	33.0	32.3	-13	102	1.371
32.0	31.4	34.0	33.4	-14	102	1.372
33.0	32.4	35.1	34.5	-15	102	1.374
34.0	33.5	36.2	35.6	-16	102	1.375
35.0	34.5	37.2	36.7	-16	103	1.376
36.0	35.5	38.3	37.8	-17	103	1.377
37.0	36.5	39.4	38.8	-18	103	1.378
38.0	37.5	40.4	39.9	-19	103	1.379
39.0	38.5	41.5	41.0	-20	103	1.381
40.0	39.6	42.6	42.1	-21	104	1.382
41.0	40.6	43.6	43.2	-22	104	1.383
42.0	41.6	44.7	44.3	-23	104	1.384
43.0	42.6	45.7	45.3	-24	104	1.385
44.0	43.7	46.8	46.5	-26	104	1.386
45.0	44.7	47.9	47.6	-27	104	1.387
46.0	45.7	48.9	48.6	-28	104	1.388
47.0	46.8	50.0	49.8	-29	104	1.390
48.0	47.8	51.1	50.9	-31	105	1.391
49.0	48.9	52.1	52.0	-32	105	1.392
50.0	49.9	53.2	53.1	-34	106	1.393
51.0	50.9	54.3	54.1	-35	106	1.394
52.0	51.9	55.3	55.2	-37	106	1.395
53.0	53.0	56.4	56.4	-38	106	1.396
54.0	54.0	57.4	57.4	-40	106	1.397
55.0	55.0	58.5	58.5	-42	106	1.398
56.0	56.0	59.6	59.6	-43	106	1.399
57.0	57.0	60.6	60.6	-45	107	1.400
58.0	58.0	61.7	61.7	-47	107	1.401
59.0	59.0	62.8	62.8	-49	107	1.402
60.0	60.0	63.8	63.8	-51	107	1.403
65.0	65.0	69.1	69.1	-51	108	1.408
70.0	70.0	74.5	74.5	-51	110	1.413
75.0	75.0	79.8	79.8	-51	114	1.418
80.0	80.0	85.1	85.1	-51	119	1.422
85.0	85.0	90.4	90.4	-51	128	1.426
90.0	90.0	95.7	95.7	-51	138	1.430
94.0	94.0	100.0	100.0	-51	166	1.434

<sup>†</sup>Boiling point at 1.013 bar  
DOWCAL 20 = 94.0 wt % PG

**Table 9**  
**Physical Properties for DOWCAL 10**

Ethylene Glycol wt %	Ethylene Glycol vol %	DOWCAL 10 wt %	DOWCAL 10 vol %	Freezing Point °C	Boiling Point† °C	Refractive Index 20°C
0.0	0.0	0.0	0.0	0	100	1.333
5.0	4.4	5.3	4.7	-1	101	1.338
10.0	8.9	10.6	9.5	-3	101	1.343
15.0	13.6	16.0	14.5	-5	102	1.349
20.0	18.1	21.3	19.3	-8	103	1.354
21.0	19.2	22.3	20.4	-8	103	1.355
22.0	20.1	23.4	21.4	-9	103	1.356
23.0	21.0	24.5	22.3	-10	103	1.357
24.0	22.0	25.5	23.4	-10	104	1.359
25.0	22.9	26.6	24.4	-11	104	1.360
26.0	23.9	27.7	25.4	-11	104	1.361
27.0	24.8	28.7	26.4	-12	104	1.362
28.0	25.8	29.8	27.4	-13	105	1.363
29.0	26.7	30.9	28.4	-13	105	1.364
30.0	27.7	31.9	29.5	-14	105	1.365
31.0	28.7	33.0	30.5	-15	106	1.366
32.0	29.6	34.0	31.5	-15	106	1.367
33.0	30.6	35.1	32.6	-16	106	1.369
34.0	31.6	36.2	33.6	-17	106	1.370
35.0	32.6	37.2	34.7	-18	107	1.371
36.0	33.5	38.3	35.6	-19	107	1.372
37.0	34.5	39.4	36.7	-19	107	1.373
38.0	35.5	40.4	37.8	-20	108	1.374
39.0	36.5	41.5	38.8	-21	108	1.375
40.0	37.5	42.6	39.9	-22	108	1.377
41.0	38.5	43.6	41.0	-23	108	1.378
42.0	39.5	44.7	42.0	-24	109	1.379
43.0	40.5	45.7	43.1	-25	109	1.380
44.0	41.5	46.8	44.1	-26	109	1.381
45.0	42.5	47.9	45.2	-28	109	1.382
46.0	43.5	48.9	46.3	-29	110	1.383
47.0	44.5	50.0	47.3	-30	110	1.385
48.0	45.5	51.1	48.4	-31	110	1.386
49.0	46.6	52.1	49.6	-33	111	1.387
50.0	47.6	53.2	50.6	-34	111	1.388
51.0	48.6	54.3	51.7	-35	111	1.389
52.0	49.6	55.3	52.8	-36	112	1.391
53.0	50.6	56.4	53.8	-38	112	1.392
54.0	51.6	57.4	54.9	-39	112	1.393
55.0	52.7	58.5	56.1	-41	113	1.394
56.0	53.7	59.6	57.1	-43	113	1.395
57.0	54.7	60.6	58.2	-44	114	1.396
58.0	55.7	61.7	59.3	-46	114	1.398
59.0	56.8	62.8	60.4	-47	115	1.399
60.0	57.8	63.8	61.5	-48	116	1.400
65.0	62.8	69.1	66.8	-51	119	1.405
70.0	68.3	74.5	72.7	-51	122	1.410
75.0	73.6	79.8	78.3	-51	125	1.415
80.0	78.9	85.1	83.9	-47	129	1.420
85.0	84.3	90.4	89.7	-37	134	1.424
90.0	89.7	95.7	95.4	-30	146	1.429
94.0	94.0	100.0	100.0	-19	168	1.433

† Boiling point at 1.013 bar  
DOWCAL 10 = 94.0 wt % MEG

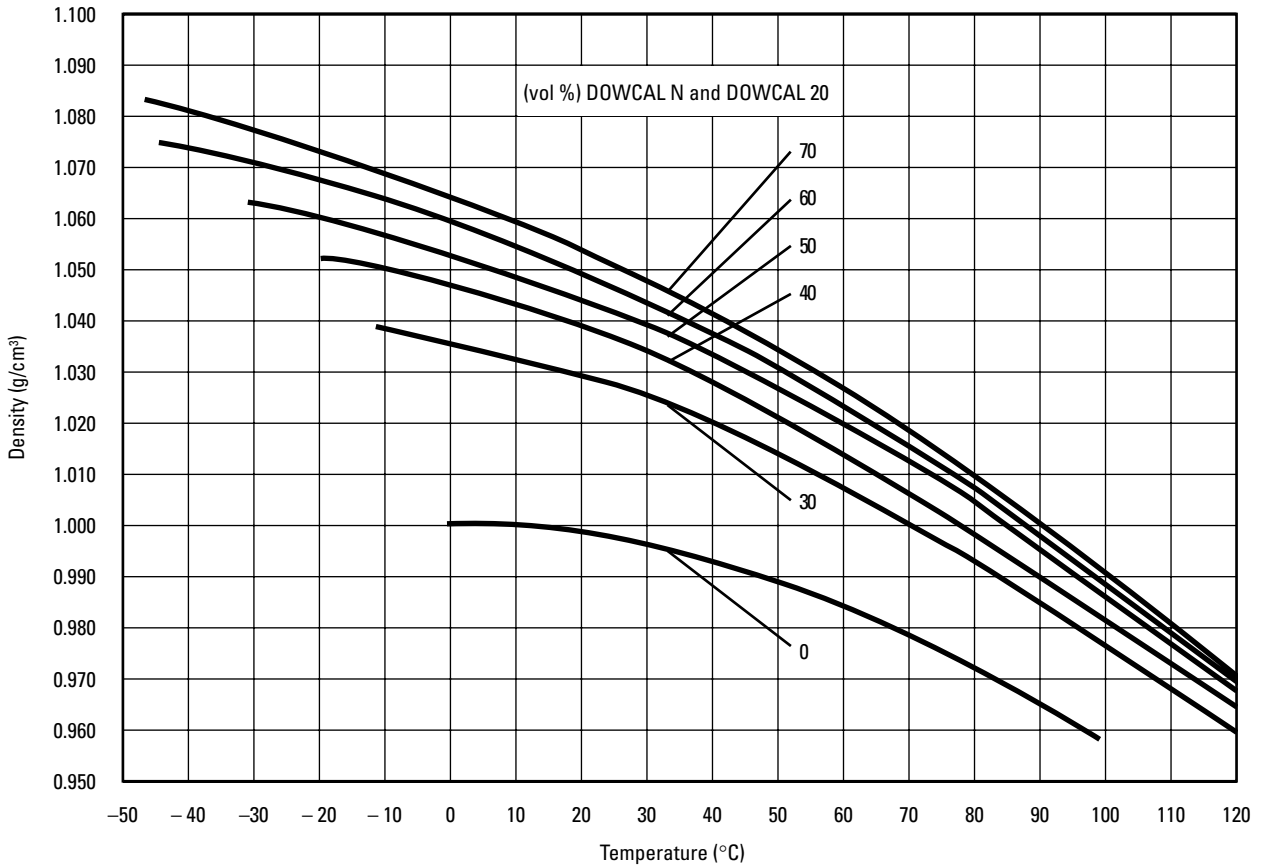
**Table 10**  
**Density of DOWCAL N and DOWCAL 20 fluids [g/cm<sup>3</sup>]**

Temperature °C	Volume of DOWCAL N and DOWCAL 20				
	30%	40%	50%	60%	70%
-40				1.0735	1.0806
-30			1.0628	1.0705	1.0771
-20		1.0515	1.0598	1.0671	1.0732
-10	1.0392	1.0484	1.0563	1.0631	1.0688
0	1.0361	1.0449	1.0523	1.0586	1.0638
10	1.0325	1.0407	1.0477	1.0536	1.0584
20	1.0283	1.0361	1.0426	1.0481	1.0524
30	1.0237	1.0310	1.0370	1.0421	1.0460
40	1.0185	1.0254	1.0309	1.0355	1.0391
50	1.0129	1.0192	1.0243	1.0285	1.0316
60	1.0067	1.0125	1.0172	1.0209	1.0237
70	1.000	1.0053	1.0096	1.0129	1.0152
80	0.9928	0.9976	1.0014	1.0043	1.0063
90	0.9851	0.9894	0.9927	0.9952	0.9968
100	0.9769	0.9807	0.9835	0.9856	0.9869
110	0.9681	0.9714	0.9738	0.9755	0.9764
120	0.9589	0.9616	0.9636	0.9649	0.9654

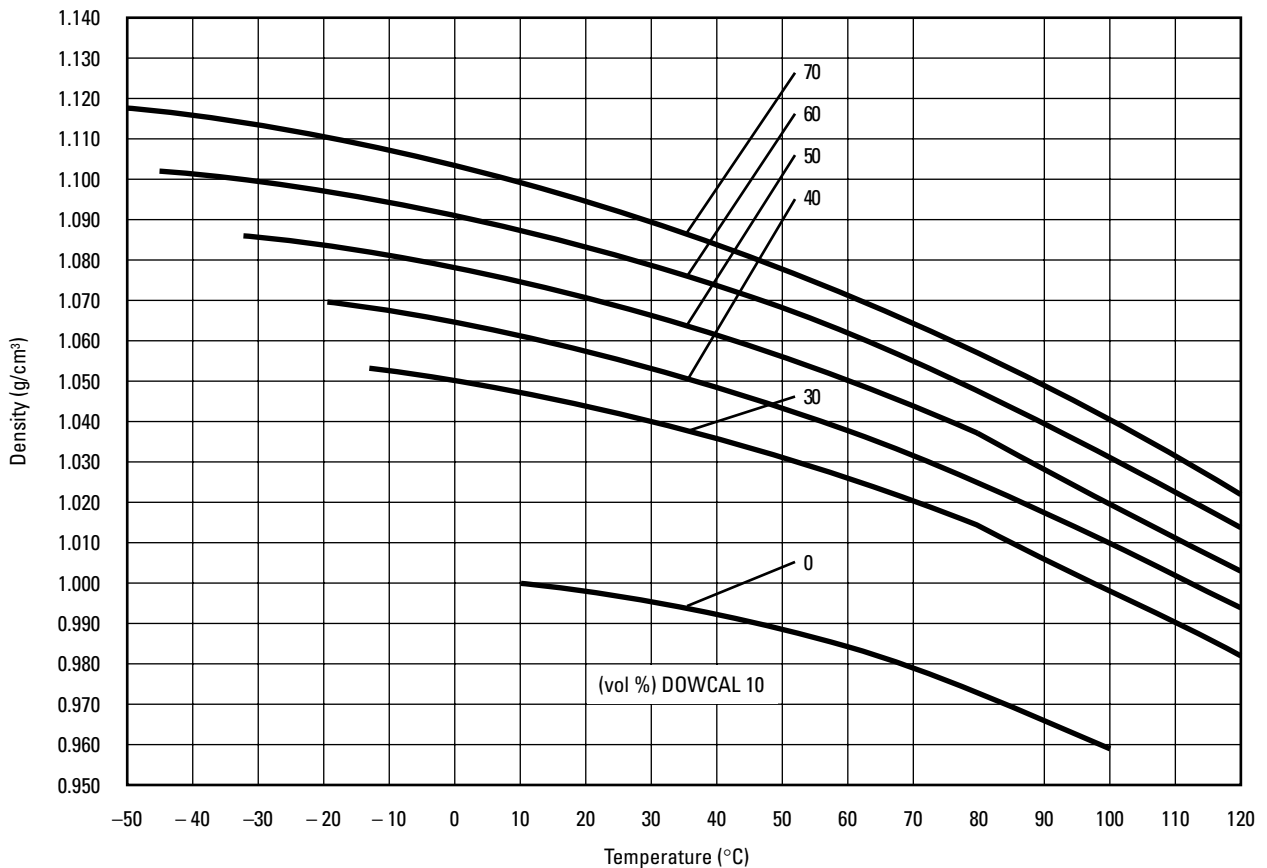
**Table 11**  
**Density of DOWCAL 10 [g/cm<sup>3</sup>]**

Temperature °C	Volume of DOWCAL 10				
	30%	40%	50%	60%	70%
-40				1.1026	1.1163
-30			1.0867	1.1007	1.1141
-20		1.0703	1.0846	1.0983	1.1114
-10	1.0532	1.0680	1.0820	1.0954	1.1082
0	1.0507	1.0652	1.0789	1.0920	1.1045
10	1.0477	1.0620	1.0754	1.0882	1.1004
20	1.0442	1.0582	1.0713	1.0838	1.0957
30	1.0403	1.0540	1.0668	1.0790	1.0906
40	1.0358	1.0492	1.0618	1.0737	1.0850
50	1.0309	1.0440	1.0563	1.0679	1.0788
60	1.0255	1.0383	1.0503	1.0616	1.0722
70	1.0196	1.0321	1.0438	1.0548	1.0652
80	1.0132	1.0255	1.0369	1.0476	1.0576
90	1.0063	1.0183	1.0294	1.0398	1.0495
100	0.9990	1.0107	1.0215	1.0316	1.0410
110	0.9911	1.0025	1.0131	1.0229	1.0320
120	0.9828	0.9939	1.0042	1.0137	1.0224

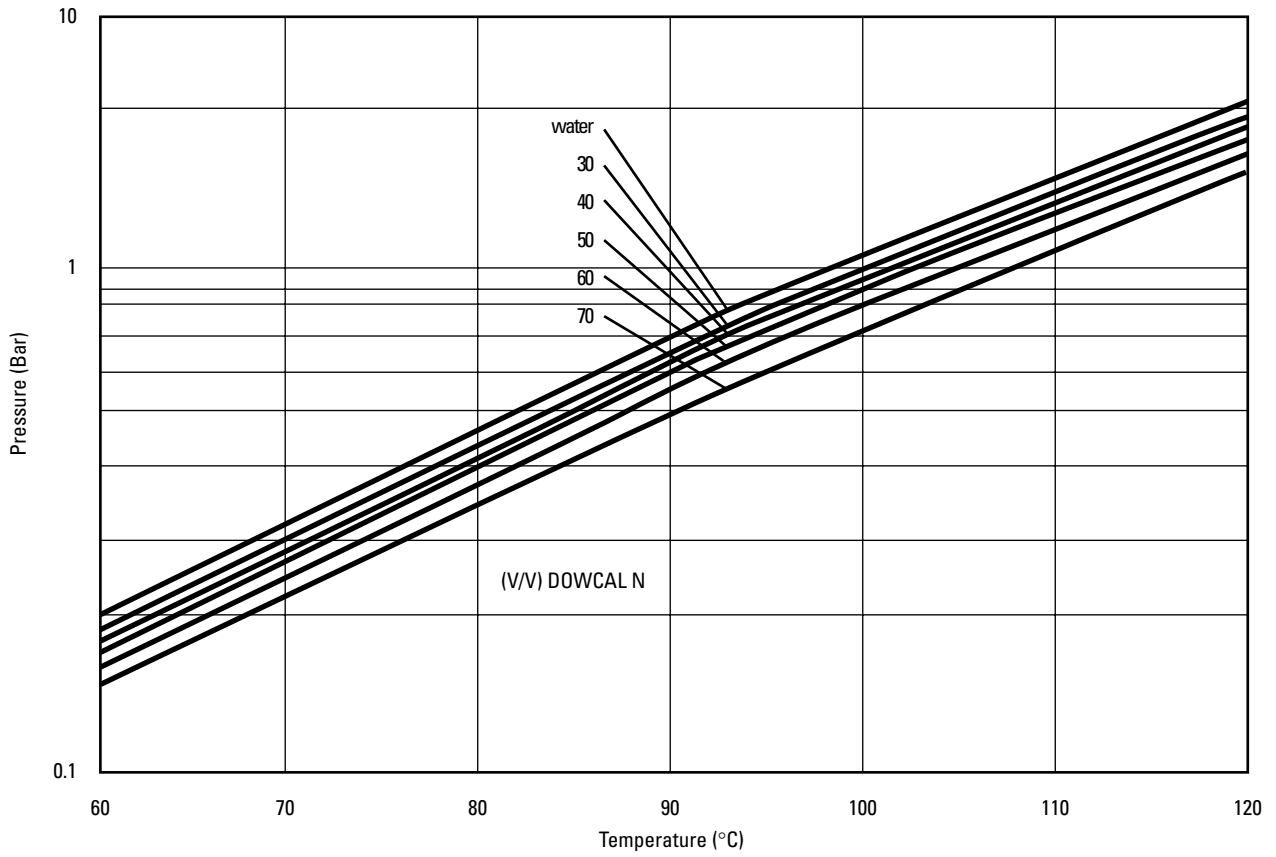
**Figure 1**  
Density of aqueous solutions of DOWCAL N and DOWCAL 20 fluids



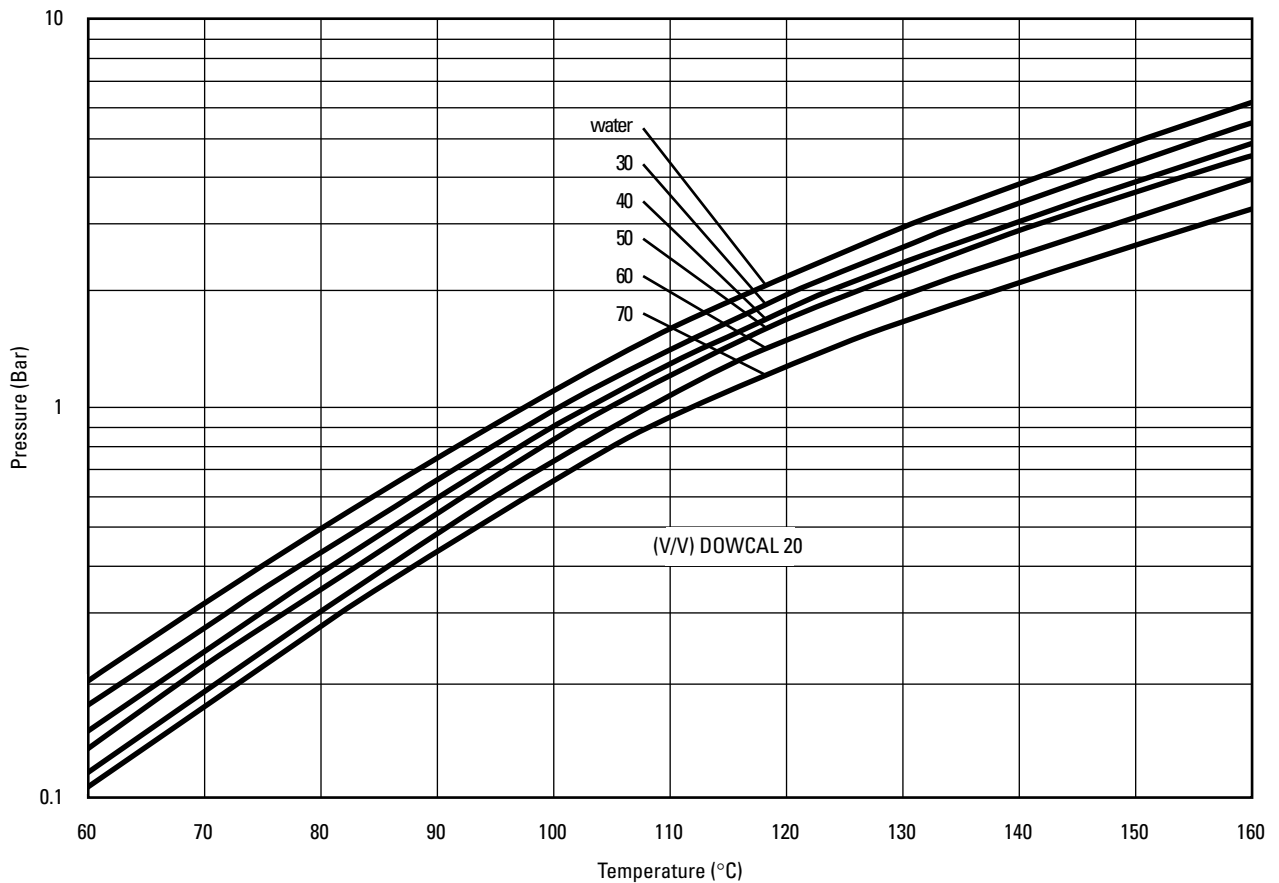
**Figure 2**  
Density of aqueous solutions of DOWCAL 10 fluid



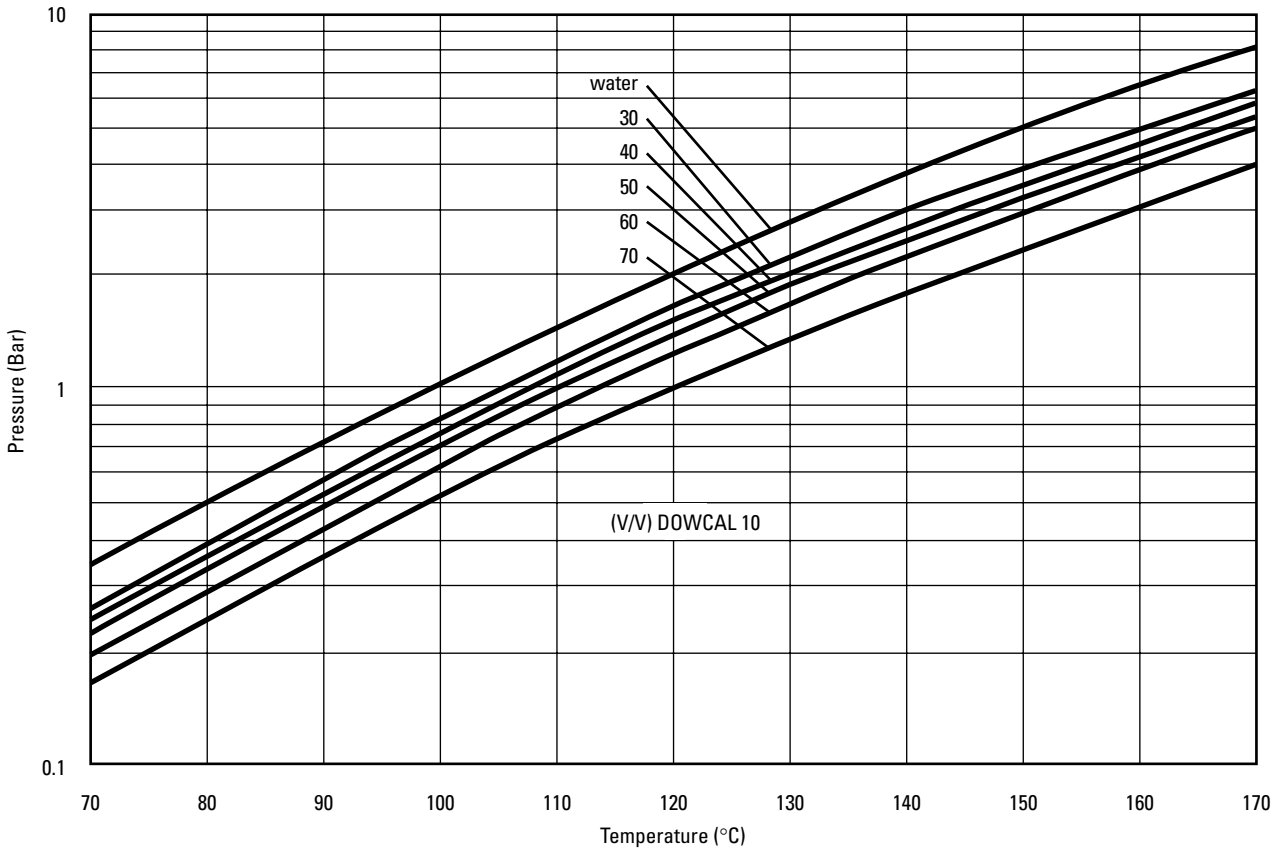
**Figure 3**  
Vapour pressure over aqueous solutions of DOWCAL N



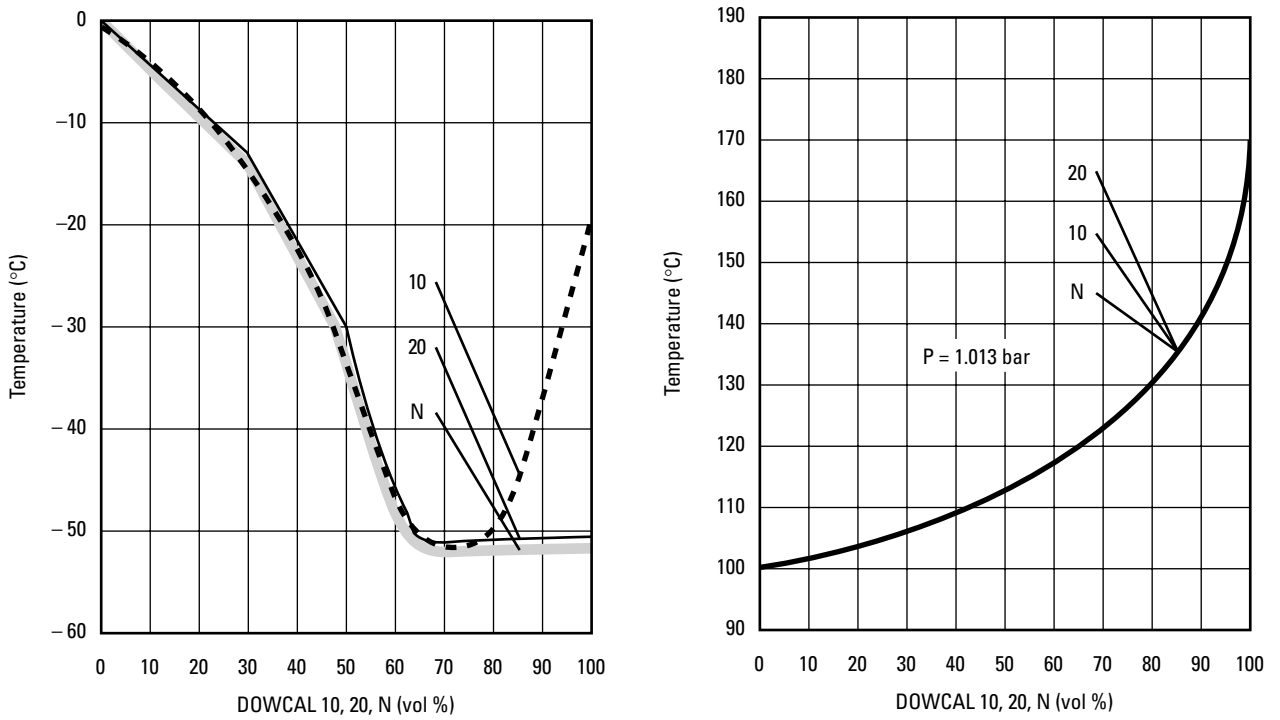
**Figure 4**  
Vapour pressure over aqueous solutions of DOWCAL 20



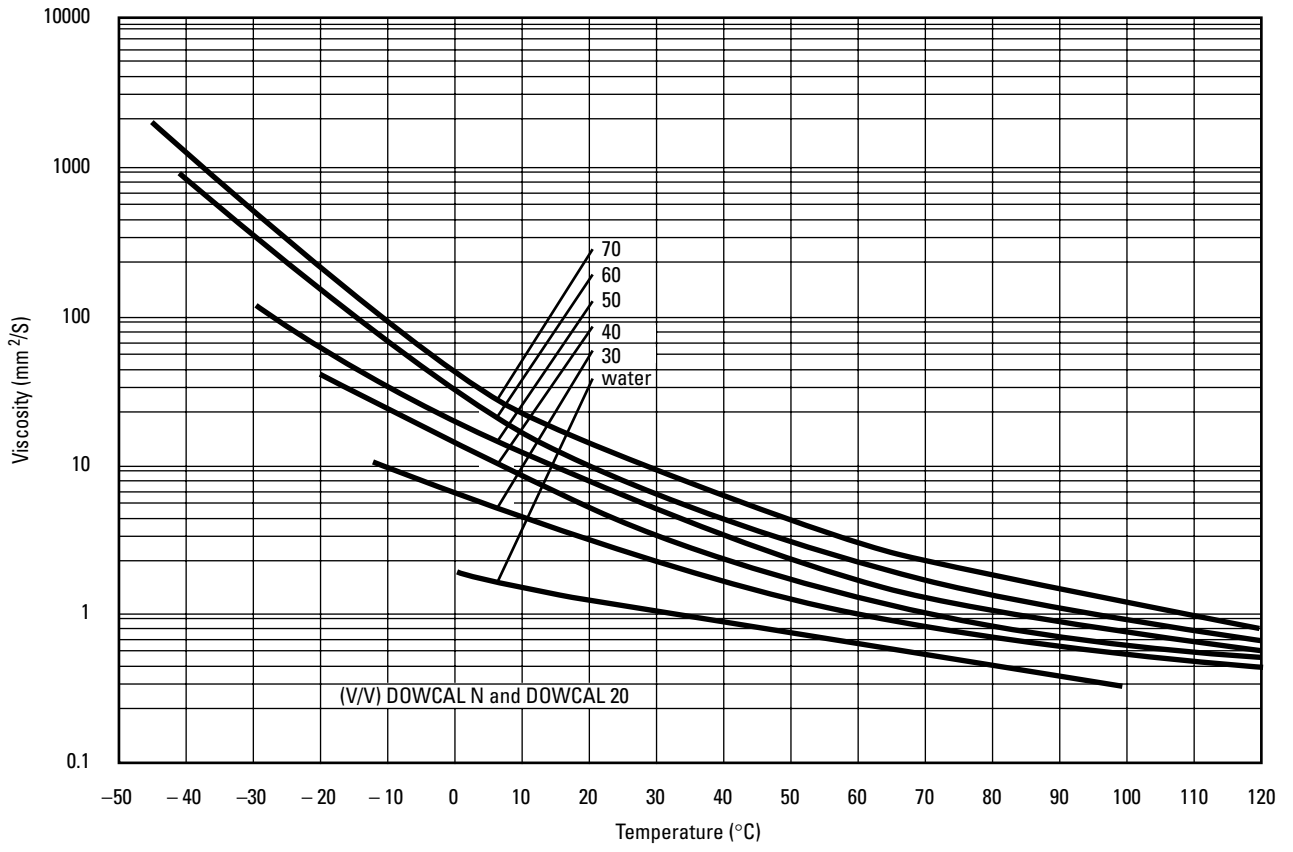
**Figure 5**  
**Vapour pressure over aqueous solutions of DOWCAL 10**



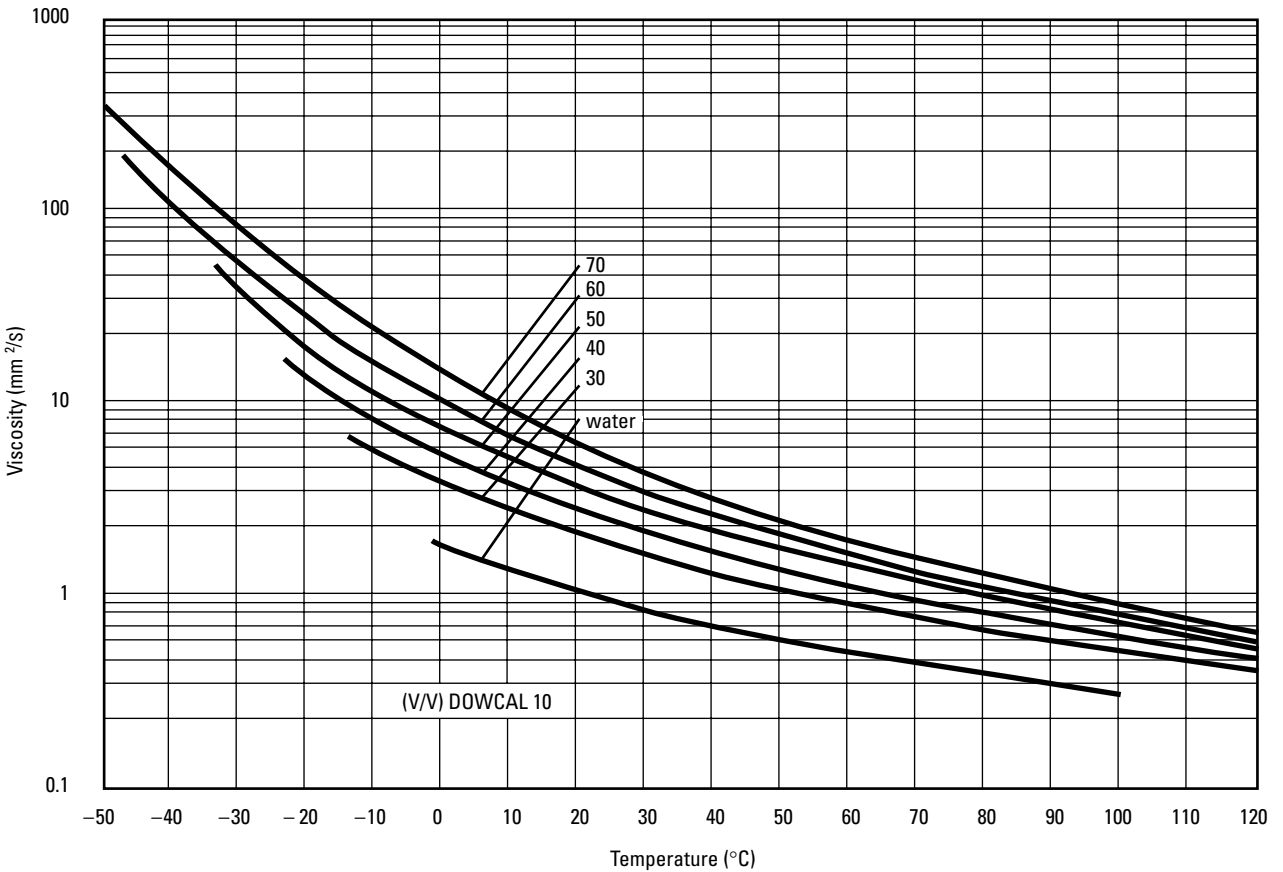
**Figure 6**  
**Boiling points (right) and Freezing points (left) of aqueous solutions of DOWCAL fluids**



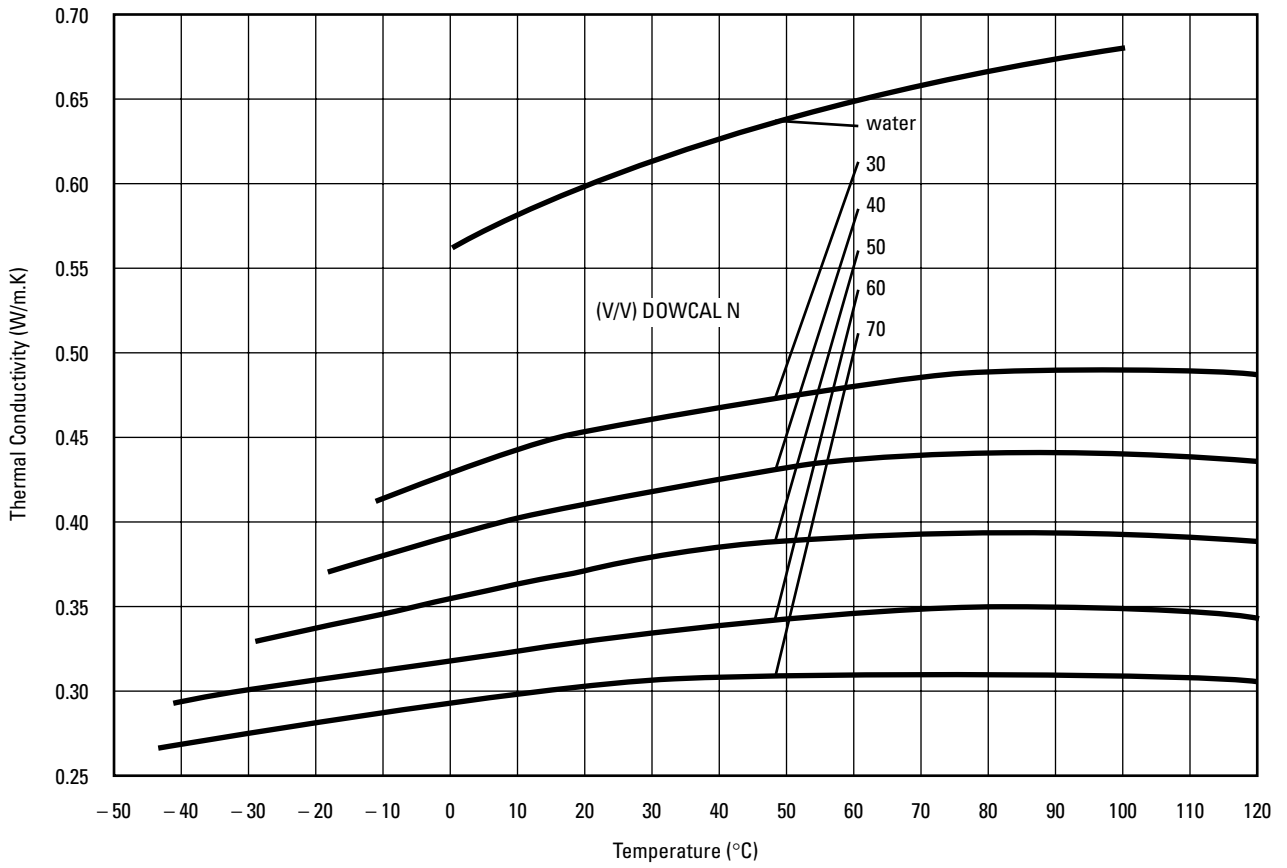
**Figure 7**  
Kinematic viscosity of aqueous solutions of DOWCAL N and DOWCAL 20 fluids



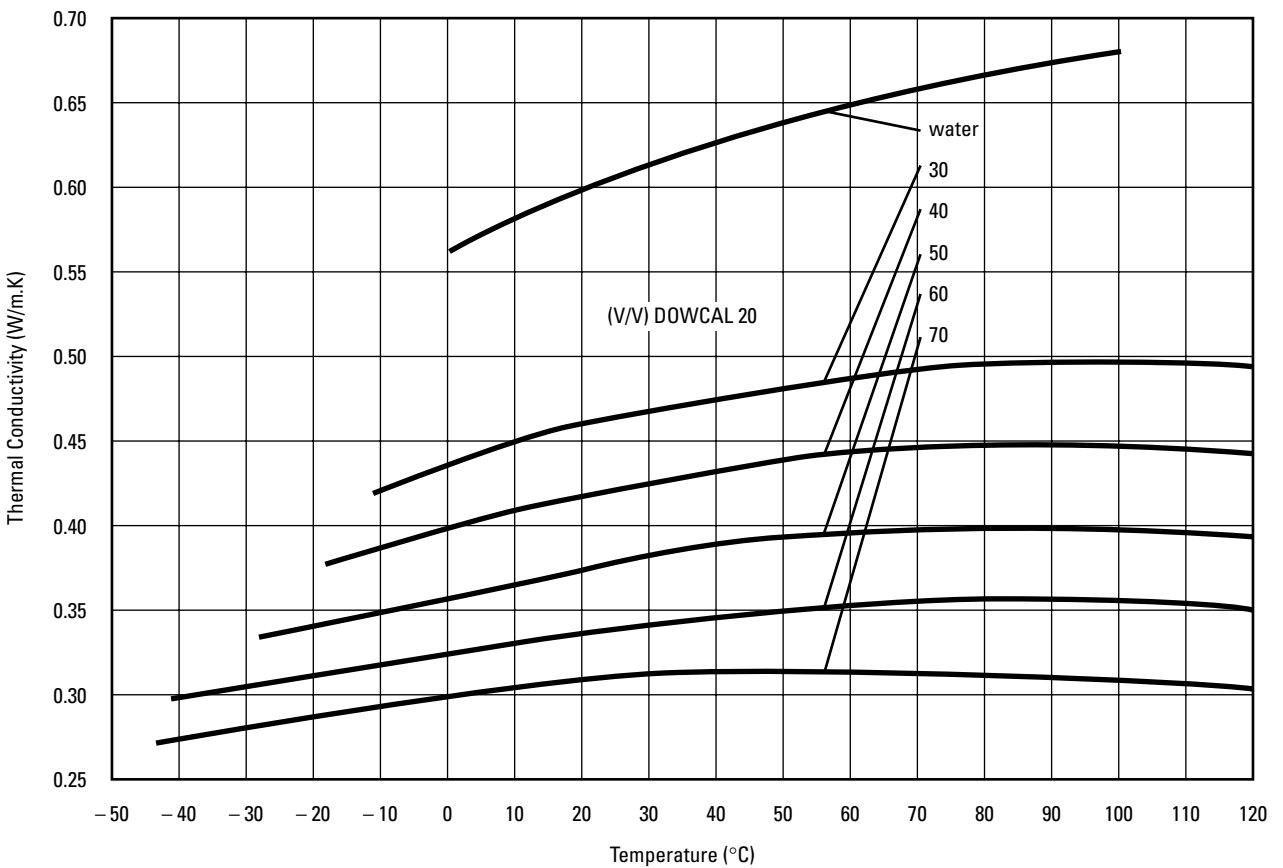
**Figure 8**  
Kinematic viscosity of aqueous solutions of DOWCAL 10 fluid



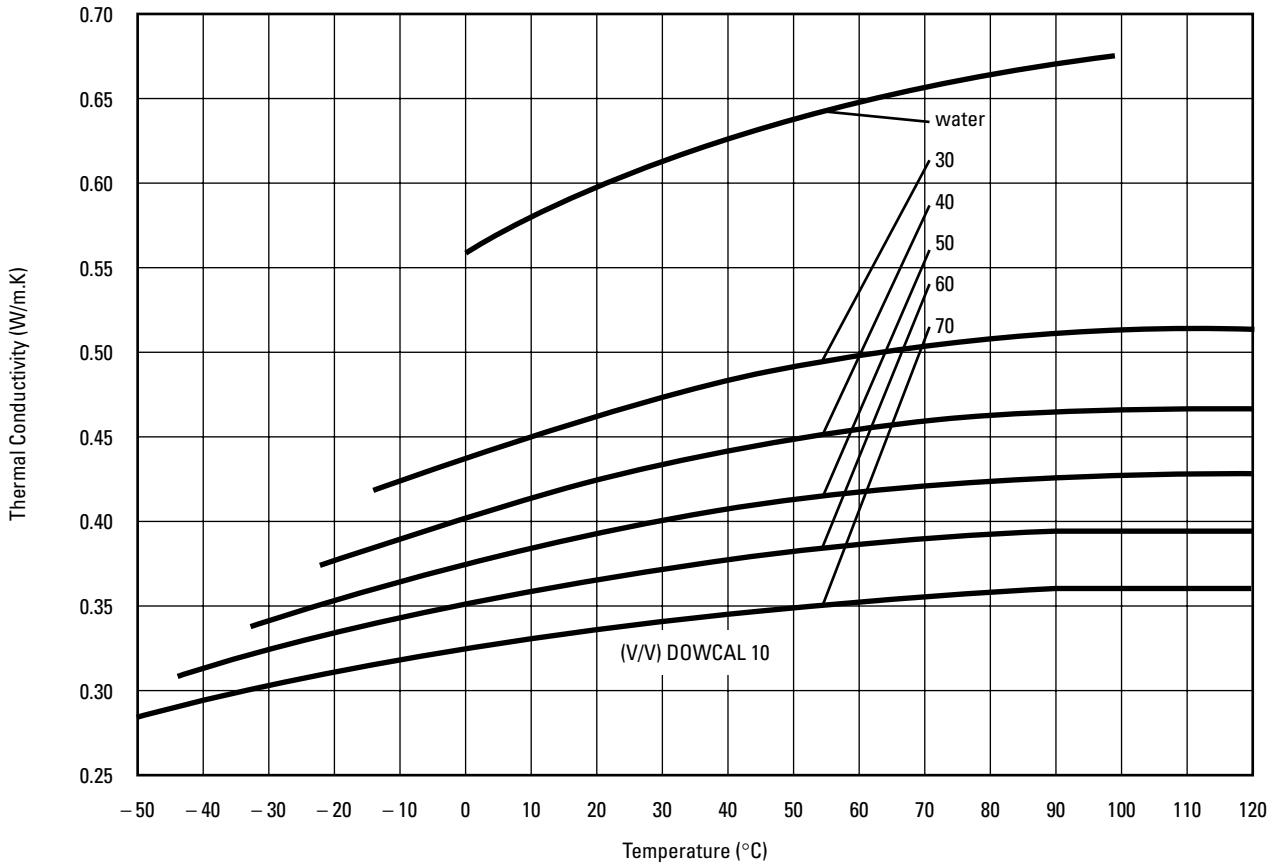
**Figure 9**  
**Thermal conductivity of aqueous solutions of DOWCAL N fluid**



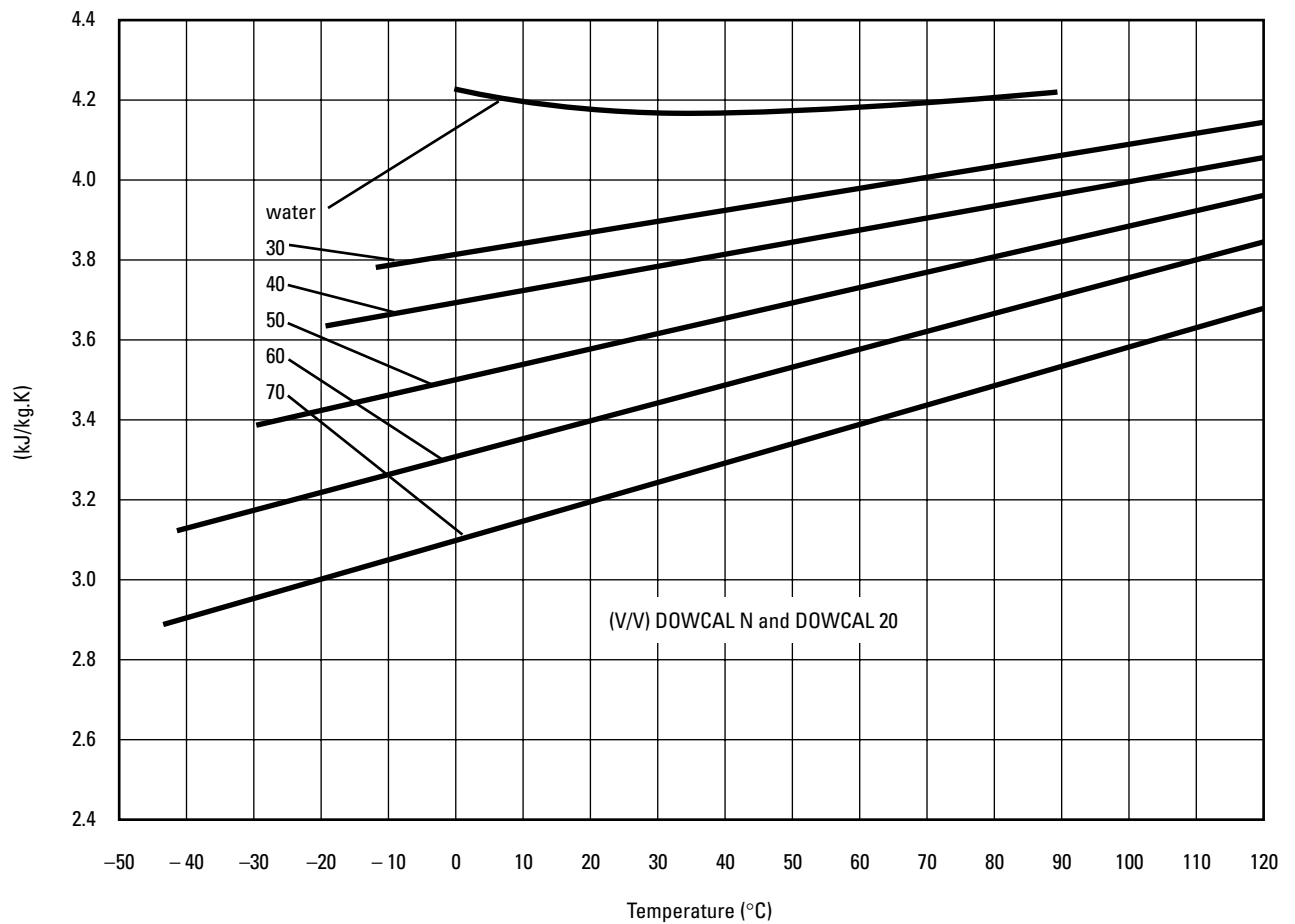
**Figure 10**  
**Thermal conductivity of aqueous solutions of DOWCAL 20 fluid**



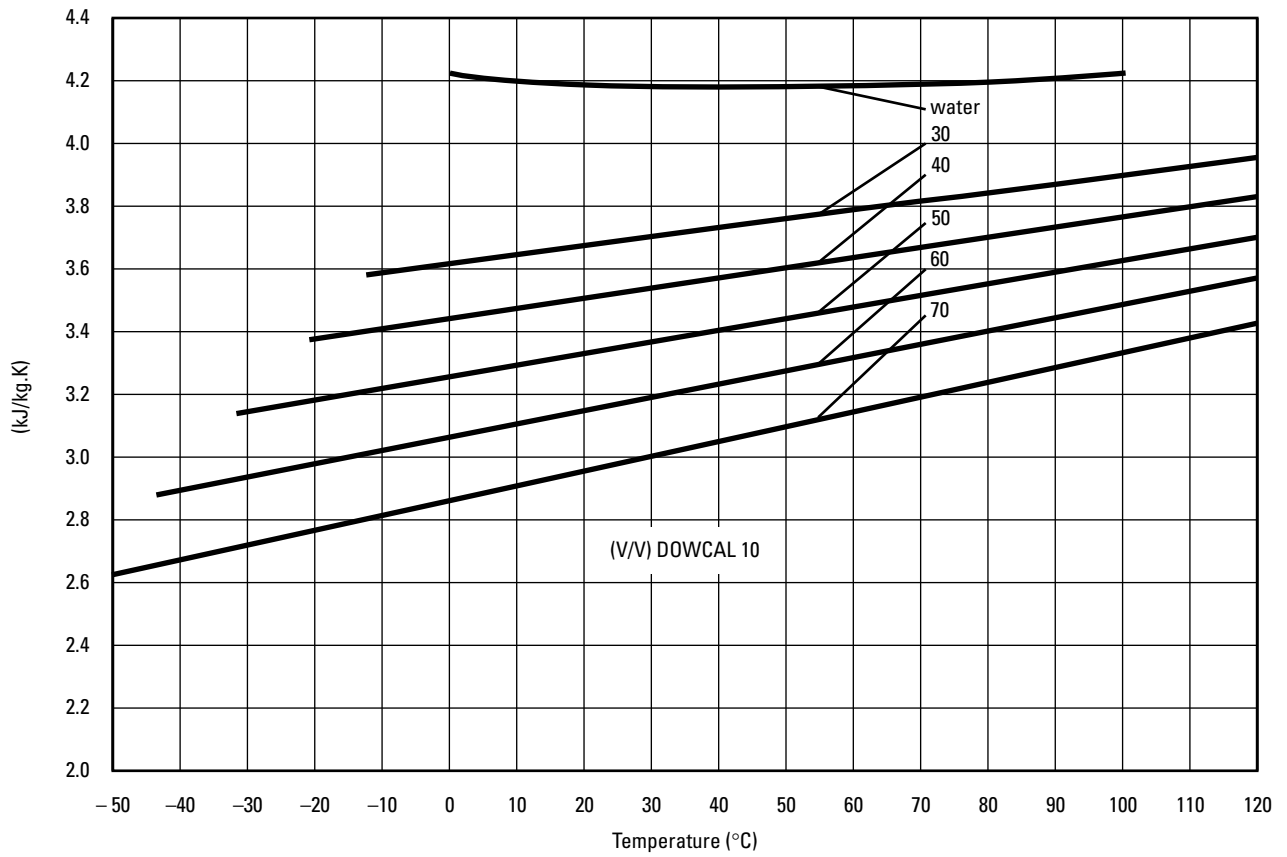
**Figure 11**  
**Thermal conductivity of aqueous solutions of DOWCAL 10 fluid**



**Figure 12**  
**Specific heat of aqueous solutions of DOWCAL N and DOWCAL 20 fluids**



**Figure 13**  
**Specific heat of aqueous solutions of DOWCAL 10 Fluid**



**DOWCAL N, DOWCAL 20 and DOWCAL 10**  
**Heat Transfer Fluids**

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