



Dow Industrial Solutions  
Heat Transfer Fluids

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# **DOWFROST™, DOWCAL™ N, DOWTHERM™ SR-1, and DOWCAL™ 10**

Inhibited Glycol-based Heat Transfer Fluids for Food Applications

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## Applications and Advantages of Inhibited Glycol Fluids in the Food Industry

Inhibited glycol heat transfer fluids are widely used in the food industry for chilling and freezing food and beverage products. These applications include immersion freezing, cooling liquid foods and fermentation cooling. Inhibited glycols are also used to defrost equipment and dehumidify facilities, with specific applications including refrigeration coil defrosting and humidity control in meat packing operations.

Four Dow heat transfer fluids offer particular utility in food industry applications: DOWFROST® inhibited propylene glycol-based fluid, DOWTHERM® SR-1 inhibited ethylene glycol-based fluid, and in Europe, DOWCAL® N inhibited propylene glycol-based fluid and DOWCAL 10 inhibited ethylene glycol-based fluid. This brochure details the advantages of glycol-based heat transfer fluids, describes the physical and performance properties of DOW inhibited glycol fluids, and highlights some of their many food industry applications.

### Why Inhibited Glycols are the Preferred Heat Transfer Fluids in the Food Industry

Inhibited glycol fluids have successfully demonstrated their ability to upgrade process efficiency, extend equipment life, and improve overall economy while contributing to greater system cleanliness and safety. The following characteristics explain the preference glycols have gained in the food industry.

- The acute oral toxicity of propylene glycol is very low, similar to glycerin. Ethylene glycol is of moderate acute oral toxicity.
- Glycols provide good heat transfer ability and freeze protection with low volatility.
- Properly formulated with inhibitors, glycol fluids combat costly corrosion in heat transfer systems.
- Glycols are practically odorless and colorless, although they are sometimes dyed for easy detection of system leaks.
- Glycol/water solutions (up to 80 percent glycol) are not considered flammable; they have no flash

points when tested under the Tag closed-cup method.

### Why Alternative Heat Transfer Technologies Fall Short

The major applications for inhibited glycol heat transfer fluids in the food industry fall into two broad categories: chilling/freezing of food and beverage products, and defrosting/dehumidifying of equipment and facilities. Alternative heat transfer technologies all have serious drawbacks in these applications.

**Plain water.** Plain water is effective only at temperatures above 33°F (1°C), making it unsuitable for freezing applications and too warm for many chilling processes. Plain water is also a poor choice for chilling/freezing applications due to its corrosivity.

**Uninhibited glycols.** “Straight” glycols oxidize in the presence of air, leading to system corrosion. This makes them unsuitable for many chilling/ freezing and defrosting/dehumidifying applications.

**Alcohol** is sometimes used in defrosting/dehumidifying operations, but it is flammable and volatile.

**Other defrosting methods and processes** – such as hot air/gas, electric and air-dry coil defrosting – consume a great deal of energy, are expensive to operate, interrupt production, and warm cold storage areas. And room air defrost methods require equipment to be shut down while room air melts frost.

### Inhibited Glycol Fluids are the Answer to Important Food Industry Heat Transfer Needs

DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids offer specific advantages in a variety of chilling/freezing and defrosting/dehumidifying applications. These advantages include: The low oral toxicity of DOWFROST and DOWCAL N inhibited propylene glycol-based fluids (DOWTHERM SR-1 and DOWCAL 10 inhibited ethylene glycol-based fluids have moderate oral toxicity). The virtual absence of fluid odor or taste. Low corrosivity. Easy fluid analysis and reinhibition. Fast freezing performance. Dependable temperature

control. Low flammability. No autoignition hazard. Easy regeneration and reconcentration. And, easy system maintenance and operation. These advantages can translate into significant productivity gains and cost savings as the following applications illustrate.

### Chilling/Freezing Cooling Liquid Foods

DOWFROST and DOWCAL N inhibited propylene glycol-based fluids are used extensively by breweries, wineries, dairies and fruit (juice) processors to cool liquid foods during processing. In addition, they are used by restaurants and bars, as well as in vending machines, to cool liquid beverages as they are dispensed.

In beverage processing, a 30-to-45 percent solution of DOWFROST or DOWCAL N fluid is circulated through cooling coils which may be submerged within a tank, or wrapped around it. The fluid provides dependable temperature control and lower temperature capabilities than water, so liquids can be chilled to 33°F (1°C) or lower. In dairy operations, production is increased because milk products can be bottled faster. DOWFROST and DOWCAL N fluids are nonflammable in solution.

### Fermentation Cooling

DOWFROST and DOWCAL N fluids are also used by breweries and wineries to cool fermentation and wort tanks, and for refrigeration of yeast bulk storage tanks. A 30-to-45 percent solution of DOWFROST or DOWCAL N fluid is chilled in a primary refrigeration unit. The chilled fluid is then circulated through coils submerged in – or wrapped around – the tank. DOWFROST and DOWCAL N fluids are low in toxicity and odor, and are virtually tasteless – important benefits since accidental contact with beverage products can occur in cooling operations<sup>1</sup>.

<sup>1</sup>Propylene glycol is regulated by the U.S. Food, Drug and Cosmetic Act. It meets the requirements of the Food Chemicals Codex (FCC) and can be used for direct, as well as indirect, food contact applications. Appropriate regulations should be consulted for full details on the levels permitted in specific food types.

DOWFROST and DOWCAL N fluids will not affect the foaming or fermenting properties of beer or wine. And, the low temperature capabilities of DOWFROST and DOWCAL N fluids permit recovery of CO<sub>2</sub> generated during fermentation. This CO<sub>2</sub> can then be used later in the bottling process.

### **Immersion Freezing of Wrapped Foods**

Considered chemically acceptable by the USDA and complying with U.S. FDA food additive regulations<sup>2</sup>, DOWFROST and DOWCAL N fluids are commonly used for immersion freezing by processors of wrapped meat, poultry, fish, seafood, vegetables, and fruit. Immersion freezing owes its popularity among food processors to its speed and efficiency. Plus, it provides uniform freezing, a particular challenge with irregularly shaped foods. DOWFROST and DOWCAL N fluids provide faster freezing of foods than air or plate freezing, so production rates are increased. The speed with which products are cooled also reduces surface bacteria counts. And frozen product appearance and shelf life are improved.

In a typical immersion freezing process, food is tightly wrapped and sealed in air- and water-tight bags. It is then immersed in a freezing bath [12°F (-11°C)] of 40-to-50 percent DOWFROST or DOWCAL N fluid in solution with water. In some cases, the wrapped foods are carried on a conveyor through freezing equipment where they are sprayed with a solution of cold DOWFROST or DOWCAL N fluid. Food is bathed or sprayed until the proper depth of freeze is achieved, usually 3/8" to 1/2" (10mm to 13mm). Then the food packages are rinsed with water to remove excess glycol and are transported to a freezing room.

### **Packaging Carbonated Beverages**

Sparkling wines, champagne, beer and other carbonated beverages are chilled prior to bottling to prevent loss of carbonation. For some beverages, cold DOWFROST or DOWCAL N fluid is pumped through coils sub-

merged in – or wrapped around – a process tank. In champagne production, inverted bottles of aged champagne are dipped in a chilled bath of DOWFROST or DOWCAL N fluid, freezing the contents in the neck of the bottle. This traps sediment for removal. Consistent product chilling is achieved because system equipment is easy to operate and fluids are easy to maintain and adjust.

### **Plastic Bottle Blow Molding**

DOWFROST and DOWCAL N fluids are widely used by large dairies, other food processors and packaging companies to cool molds used to blow mold plastic bottles. A 30-to-45 percent solution of DOWFROST or DOWCAL N fluid is circulated through the mold for rapid cooling. Because these fluids remain liquid at lower temperatures than plain water, they cool molds faster, increasing production. Faster cooling also allows “flash” to be trimmed more quickly and cleanly, improving product quality.

### **Ice Making**

Ice production plants use DOWFROST and DOWCAL N fluids to freeze water quickly. Steel trays of water are lowered into tanks filled with a refrigerated and agitated 40-to-50 percent solution of DOWFROST or DOWCAL N fluid.

<sup>2</sup>You may need to comply with similar or additional in other countries. Contact your Dow representative for more information.

### **Defrosting/Dehumidifying Refrigeration Coil Defrosting**

In walk-in freezer and chiller units, freezing tunnels, and basket freezer units, moisture from the air can condense on refrigeration coils and a layer of frost can develop. As this frost builds up, compressor motors work harder to maintain proper temperatures and cooling efficiency suffers. To remove condensation from coils and prevent frost formation, cold 35-to-50 percent solutions of DOWFROST or DOWCAL N fluid, or 40-to-50 percent solutions of DOWTHERM SR-1 or DOWCAL 10 fluid, are sprayed directly

on the coil surfaces. This spraying may be continuous or, “as needed.” The glycols mix with condensation from the coils, lowering the freeze point of the water to prevent frost formation.

Because they contain special corrosion inhibitors, DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids minimize coil corrosion. They are also easy to regenerate and reconcentrate, and production need not be interrupted for defrosting procedures to take place. Defrosting systems using DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids are easy to operate and maintain.

### **Humidity Control**

To maintain a constant relative humidity in work and storage areas, meat packers, producers of sausage and processed meats, and slaughterhouses spray DOWFROST, DOWCAL N, DOWTHERM SR-1, or DOWCAL 10 fluid through the air that flows over plant refrigeration coils. The sprayed glycol picks up moisture from the air, and filters dust and other particles. High humidity supports growth of mold and bacteria that cannot be tolerated in these operations. Since DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids are easily reconcentrated, they are very economical in humidity control applications.

## Four Distinct Inhibited Glycol Formulations to Meet Your Specific Heat Transfer Needs

### **DOWFROST™ and DOWCAL™ Inhibited Propylene Glycol Fluids**

DOWFROST™ and DOWCAL™ N fluids have an effective temperature range of -50°F (-45°C) to 250°F (120°C) for continuous use. Below -50°F (-45°C), the increased viscosity of the fluids makes them impractical for use without special equipment. However, the fluids can be used to protect enclosed heat transfer systems from freeze damage at well below -60°F (-50°C). Heat transfer is generally efficient to 0°F (-18°C). See the back of this brochure for physical properties data for DOWFROST and DOWCAL N fluids.

DOWFROST and DOWCAL N fluids are not recommended for use as a direct food additive. However, their low toxicity and virtual absence of odor and taste make them suitable for use in food processing operations where accidental contact with food products could occur. As with any fluid used in food processing, good manufacturing practices are required.

### **Regulatory Status<sup>3</sup> U.S. Department of Agriculture (USDA)**

DOWFROST and DOWCAL N heat transfer fluids are listed as chemically acceptable by the USDA for both defrosting refrigeration coils and for immersion freezing of wrapped meats, poultry, and meat products in plants operated under the federal meat and poultry products inspection program. The compound must be used in a manner that prevents direct or indirect contamination of edible products.

### **Food and Drug Administration (FDA)**

The U.S. FDA clears only individual chemicals, not proprietary products (trademarks). The two ingredients in DOWFROST and DOWCAL N fluids are generally recognized as safe (GRAS) by the FDA as food additives

under Parts 182 and 184 of the Food Additive Regulations. The regulation for propylene glycol is 21 CFR 184.1666; for dipotassium phosphate, 182.6285. The propylene glycol and dipotassium phosphate in DOWFROST and DOWCAL N fluids meet the requirements of these regulations.

Grade A dairies and meat packing establishments sometimes require a letter certifying the appropriate use and quality of DOWFROST and DOWCAL N fluids. Such a letter, along with copies of the acceptance letters from the USDA and a statement of FDA compliance, will be provided to any Dow customer on request.

### **DOWTHERM™ SR-1 and DOWCAL™ 10 Inhibited Ethylene Glycol Fluids**

DOWTHERM™ SR-1 fluid has an effective use temperature range of -60°F (-50°C) to 250°F (120°C). DOWCAL™ 10 fluid has a temperature range of -60°F (-50°C) to 350°F (175°C). Their lower minimum temperatures makes these fluids the preferred medium in the food industry for continuous defrosting of coils in large refrigeration and freezer units where temperatures are too low to use propylene glycol fluids. Because of their moderate oral toxicity, DOWTHERM SR-1 and DOWCAL 10 fluids are not used where direct contact with food products is possible.

Below -60°F (-50°C), the increased viscosity of DOWTHERM SR-1 and DOWCAL 10 fluids makes them impractical for use without special equipment. However, these fluids can be used to protect enclosed heat transfer systems from freeze damage at temperatures below -100°F (-38°C). Heat transfer is generally efficient to -10°F (-23°C). See the back of this brochure for physical properties data for DOWTHERM SR-1 and DOWCAL 10 fluids.

### **Regulatory Status<sup>3</sup> U.S. Department of Agriculture (USDA)**

DOWTHERM SR-1 and DOWCAL 10

fluids are listed as chemically acceptable by the USDA for defrosting refrigeration coils in plants operated under the federal meat and poultry products inspection program. The compound must be used in a manner that prevents direct or indirect contamination of edible products. Ethylene glycol should not be used in applications in which it can be ingested.

Meat packing establishments sometimes require a letter certifying the appropriate use and quality of DOWTHERM SR-1 and DOWCAL 10 fluids. Such a letter, along with copies of the acceptance letter from the USDA, will be provided to Dow customers on request.

### **How Dow Inhibitors Prevent Corrosion that Plain Glycols can Encourage**

DOWFROST and DOWCAL N inhibited propylene glycol fluids and DOWTHERM SR-1 and DOWCAL 10 inhibited ethylene glycol fluids provide corrosion protection that can extend system and equipment life – and reduce costly downtime – without compromising heat transfer performance.

Uninhibited glycols oxidize in the presence of air at elevated temperatures, forming organic acids. These acids can lower the pH of the glycol solution, creating an environment for corrosion.

But the inhibitors in DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids maintain a stable pH by reacting with any organic acids that may be formed. They provide substantial corrosion protection for steel, cast iron, copper, brass, aluminum<sup>†</sup> and solder as demonstrated by

<sup>3</sup>You may need to comply with similar or additional legislation in other countries. Contact your Dow representative for information.

<sup>†</sup>DOWFROST, DOWCAL N, and DOWTHERM SR-1 fluids should not be used with aluminum above 150°F (65°C).

ASTM D1384 corrosion testing.<sup>††</sup>

Table 1 shows the corrosion rates of common metals exposed to DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids, as well as two uninhibited glycol solutions and plain water. The presence of excessive amounts [ $>50$  ppm ( $>50$  mg/kg)] of contaminants such as chlorides, sulfates or ammonia could contribute to corrosion not evident in the tests used to prepare this data.

### Drawbacks of Unbranded Inhibited Glycols

Unbranded or “generic” inhibited glycols can present problems in food industry applications. First, the degree of corrosion protection these fluids provide is often a mystery. Unless the manufacturer or supplier can demonstrate a successful history of use in the food industry, there may be no way of knowing what kind of protection the fluid will provide, and for how long. Furthermore, once the fluid is in use, ongoing inhibitor condition can be difficult to analyze. That means that the fluid could require frequent (and costly)

replacement to assure that corrosion protection is maintained.

In contrast, the specially blended inhibitors in DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids have been proven effective as corrosion deterrents in years of food industry use. And, to assure ongoing corrosion protection, DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids are easily analyzed to determine corrosion inhibitor condition. If the inhibitors are depleted, Dow can supply additional inhibitors – so the fluid is economically reinhibited rather than replaced.

### Dow Provides Complete Fluid Support Services Including Free Analysis

DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids are backed by comprehensive Dow supporting services. With extensive experience in supplying heat transfer fluids to the food industry, Dow technical service personnel can help you design, operate and maintain your thermal fluids system for maxi-

um productivity and economy. For systems containing 250 gallons of fluid or more (or more than 10,000 liters in Europe), Dow offers free fluid analysis. Typically performed on an annual basis, the analysis includes determination of current fluid inhibitor and glycol levels, plus Dow’s recommendations for maintaining proper corrosion protection and thermal performance capabilities. Dow also provides assistance to operators of smaller systems so that they can conduct their own on-site fluid analyses.

### Call for More Information

Call the number for your area listed on the back of this brochure for complete engineering and operating information for DOWFROST, DOWCAL N, DOWTHERM SR-1, or DOWCAL 10 fluids, or to receive specific technical assistance.

<sup>††</sup>DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 fluids are not recommended for use with galvanized steel. The zinc in the galvanized coating could react with inhibitor components, thus precipitating out of the fluid and causing fouling as well as inhibitor depletion.

**Table 1: Corrosion Test Results/Weight Loss in Milligrams (mils penetration per year)**

	Water	Ethylene Glycol	DOWTHERM SR-1	DOWCAL 10	Propylene Glycol	DOWFROST	DOWCAL N
<b>Copper</b>	2 (0.08)	4 (0.16)	3 (0.12)	3 (0.12)	4 (0.16)	3 (0.12)	3 (0.12)
<b>Solder</b>	99 (3.14)	1780 (56.5)	4 (0.13)	4 (0.13)	1095 (34.7)	1 (0.03)	1 (0.03)
<b>Brass</b>	5 (0.23)	11 (0.46)	3 (0.12)	3 (0.12)	5 (0.20)	4 (0.16)	4 (0.16)
<b>Mild Steel</b>	212 (9.69)	974 (44.5)	1 (0.04)	1 (0.04)	214 (9.80)	1 (0.04)	1 (0.04)
<b>Cast Iron</b>	450 (21.2)	1190 (55.7)	3 (0.13)	3 (0.13)	345 (16.2)	3 (0.15)	3 (0.15)
<b>Aluminum</b>	110 (13.2)	165 (19.8)	4 (0.44)	4 (0.44)	15 (1.80)	+2 (+0.26)	+2 (+0.26)

Samples with a “+” showed weight gain

ASTM D1384 – 190°F (88°C) for two weeks, 30% by volume glycol, air bubbling

**Table 2: Typical Physical Properties<sup>††</sup> of DOWFROST, DOWCAL N, DOWTHERM SR-1, and DOWCAL 10 Fluids**

		DOWFROST In- hibited Propylene Glycol	DOWCAL N In- hibited Propylene Glycol	DOWTHERM SR-1 Inhibited Ethylene Glycol	DOWCAL 10 Inhibited Ethylene Glycol
<b>Useful Operating Temperature</b>		-45°C (-50°F) to 120°C (250°F)	-45°C (-50°F) to 120°C (250°F)	-50°C (-60°F) to 120°C (250°F)	-50°C (-60°F) to 175°C (350°F)
<b>Freezing Point, °C (°F)</b>	<b>50%</b>	-28 (-34)	-28 (-34)	-34 (-37)	-34 (-37)
<b>Viscosity mPa(s) (cps)</b>	<b>50% at 5°C (40°F) 80°C(180°F) 120°C (250°F) 175°C (350°F)</b>	13.77 (14.2) 1.12 (1.1) 0.60 (0.59) N/A	13.77 (14.2) 1.12 (1.1) 0.60 (0.59) N/A	6.63 (6.8) 0.98 (0.94) 0.53 (0.52) N/A	6.54 (6.8) 0.97 (0.94) 0.52 (0.52) 0.28 (0.27)
<b>Thermal Conductivity W/(m)(K) [Btu/hr. • ft.<sup>2</sup>](°F/ft.)</b>	<b>50% at 5°C (40°F) 80°C (180°F) 120°C (250°F) 175°C (350°F)</b>	0.353 (0.204) 0.382 (0.221) 0.380 (0.219) N/A	0.353 (0.204) 0.382 (0.221) 0.380 (0.219) N/A	0.368 (0.212) 0.411 (0.238) 0.417 (0.241) N/A	0.369 (0.212) 0.413 (0.238) 0.418 (0.241) 0.406 (0.233)
<b>Specific Heat kJ/(kg)(K) [Btu/(lb. • °F)]</b>	<b>50% at 5°C (40°F) 80°C (180°F) 120°C (250°F) 175°C (350°F)</b>	3.478 (0.830) 3.767 (0.902) 3.921 (0.937) N/A	3.478 (0.830) 3.767 (0.902) 3.921 (0.937) N/A	3.223 (0.770) 3.512 (0.842) 3.667 (0.878) N/A	3.218 (0.762) 3.510 (0.835) 3.665 (0.872) 3.880 (0.925)
<b>Specific Gravity</b>	<b>15/15°C (60/60°F)</b>	1.050-1.060	1.050-1.060	1.1250-1.1350	1.125-1.135
<b>Flash Point Concentrate Pensky-Martens Closed-cup (PMCC) Tag Closed-cup Aqueous Solutions up to 80% Glycol Pensky-Martens Closed-cup (PMCC)</b>		101°C (214°F)   No Flash Point	101°C (214°F)   No Flash Point	  111°C (232°F)  No Flash Point	120°C (250°F)   No Flash Point

<sup>††</sup>Typical properties, not to be construed as specifications.

Note: Specified concentrations are based on volume percent.

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