



HVAC OVERVIEW GUIDE

**DOWTHERM, DOWFROST,
and DOWCAL**

Heat Transfer Fluids



*Freeze and Corrosion Protection and Efficient
Heat Transfer for Water-Based Heating
& Air Conditioning, Thermal Energy Storage,
and Other HVAC Applications*

Why Your Water-based HVAC System Needs a Fluid That Provides the Best Protection and Performance

If you design, install, or operate a water-based heating or air conditioning system, there is a lot riding on your heat transfer fluid.

Protection against freeze damage—If your system is exposed to freezing temperatures, your fluid must provide protection against winter freeze-up, and resulting burst pipes and other damage to system components. Without this protection, you can face catastrophic damage to building contents, untimely system shutdowns, and the high cost of installing replacement parts.

Protection against corrosion—But freeze protection isn't the only reason to choose the right fluid. There is also the ever-present threat of corrosion damage in your system's circulating system...caused by water and made even worse by improperly inhibited glycol fluids. Although corrosion damage may not result in catastrophic failure, it can be every bit as costly. If allowed to occur unchecked, corrosion in your system can reduce operating efficiency. What's more, it can lead to extended system shut downs and significant expense for system cleaning and other maintenance, as well as replacement of damaged components.

Protection against inefficient operation —Using the wrong fluid can also affect system performance. For example, using a glycol-water solution that is not optimized to your system's requirements can increase pumping energy requirements and affect overall system efficiency. And, the ability of a thermal energy storage system to efficiently build ice during non-peak hours and provide chilled water for air conditioning during peak hours can depend on selection of the proper fluid.

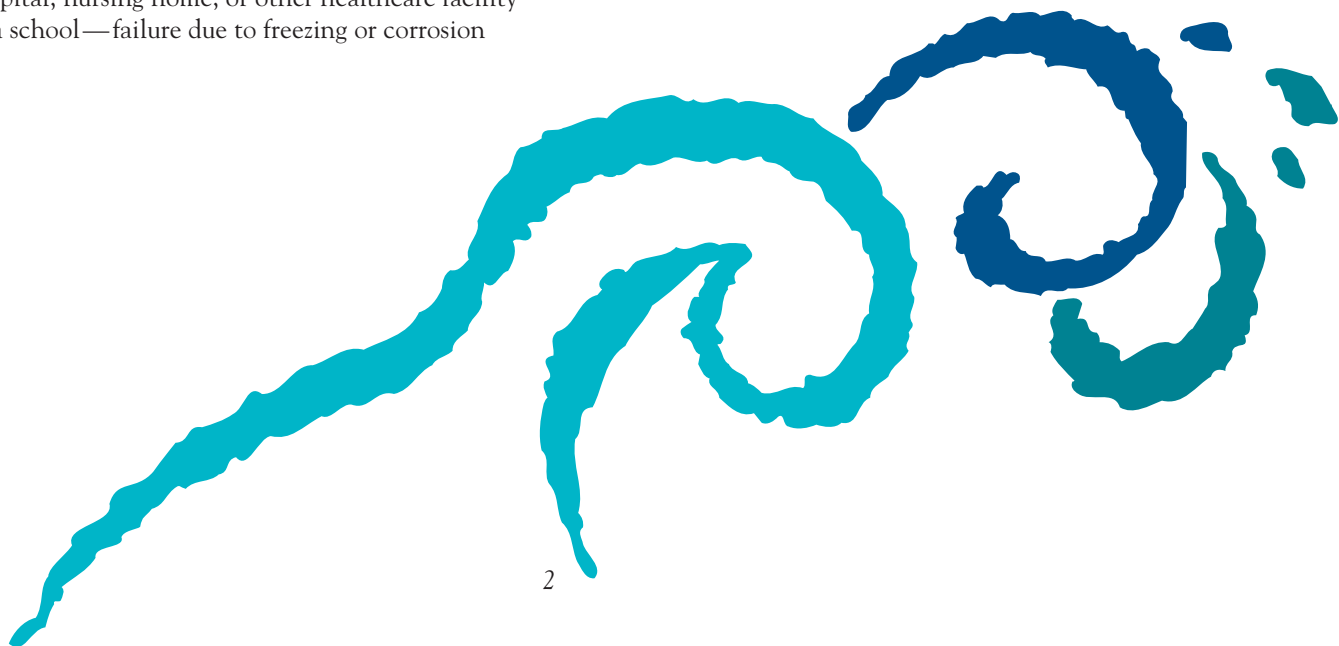
Protection for occupant health and safety—If your system serves a hospital, nursing home, or other healthcare facility—or even a school—failure due to freezing or corrosion

damage can be a significant threat to the health and well-being of patients, students and other occupants. What's more, if the proper heat transfer fluid is not used, some systems—such as ground source heat pumps and hydronic heating systems—may pose a threat to drinking water supplies and to human health if system failure leads to a leak into the environment.

Protection against financial loss—The cost to repair or replace damaged system components can be small compared to the other potential costs associated with system failure. Building occupants may suffer hours of discomfort and building contents can be damaged or ruined should you experience a freeze- or corrosion-related failure. Severe business problems such as computer failure are possible, valuable records can be lost, and rental income can be adversely affected. You may even face the threat of liability suits due to these damages.

Protection for your reputation and future business—If you design, install, or maintain heating or air conditioning systems, your reputation and your chances for repeat and referral business depend on long-lasting, trouble free system performance. And if you own or manage buildings, your ability to attract and retain tenants and maintain lease revenues depends on your ability to deliver a comfortable, productive environment without incurring unnecessary expenses for system maintenance, repairs, and replacement.

Clearly, choosing the right heat transfer fluid is one of the most important measures you can take to protect your water-based HVAC system and your business.



DOWTHERM, DOWFROST, and DOWCAL Fluids Provide the Optimum Combination of HVAC System Protection and Performance

Your initial investment in a heat transfer fluid for a water-based HVAC system pales beside the cost of chillers, pumps, piping, and other hardware components. But your system's performance, longevity, and long-term cost may well depend on which heat transfer fluid you choose.

That's why you need a fluid that's designed to stand up to the rigors of HVAC service, protect your system against freeze and corrosion, and provide efficient heat transfer for years with minimal maintenance. For water-based HVAC systems of all descriptions, only a DOWTHERM*, DOWFROST*, or DOWCAL*¹ fluid will do.

Dow offers a full range of industrially inhibited, glycol-based heat transfer fluids specially formulated for demanding HVAC service. Included are fluids offering outstanding freeze and corrosion protection, excellent heat transfer efficiency, and optimal economy in closed-loop heating and air conditioning, thermal energy storage (TES), ground source heat pump, and other water-based HVAC systems.

*Trademark of The Dow Chemical Company

¹ DOWCAL fluids available only in Europe

HVAC Applications for Dow Glycol-based Fluids

- Closed-loop, Water-based Heating & Air Conditioning
- Thermal Energy Storage (TES)
- Ground Source Heat Pumps
- Hydronic Heating
- Solar Heating
- Skating Rinks
- Fire Sprinkler Systems

APPLICATION PROFILE

Joe Louis Arena, home of the Detroit Red Wings National Hockey League club, and a leading venue for ice shows and figure skating competitions, achieves a world-class ice surface with DOWTHERM SR-1 inhibited ethylene glycol fluid.

A Full Family of Glycol-based Fluid Options

DOWTHERM, DOWFROST, and DOWCAL glycol-based heat transfer fluids include both ethylene glycol-based (EG) fluids, which are specified when maximum heat transfer efficiency and economy are essential, and propylene glycol-based (PG) fluids for use when drinking water safety and other health concerns require the use of a PG fluid.

Each Dow fluid is specially formulated for HVAC service with heavy-duty industrial inhibitor packages that prevent corrosion, a leading cause of system damage and a potential source of huge expense. A unique dispersant additive in all Dow glycol-based fluids, except DOWFROST and DOWCAL N fluids, prevents precipitation of sediment and resulting fouling due to water hardness, a safeguard against under-deposit corrosion.

A Note on Dilution Water Quality

For long-term, maintenance-free operation, Dow fluids should only be diluted with demineralized water that has been distilled, deionized, or passed through a reverse osmosis process to remove potentially troublesome minerals and salts. This is especially important when using DOWFROST or DOWCAL N fluids which do not contain Dow's dispersant additive to prevent precipitation of sediment due to water hardness.

Good quality water contains only minute traces of calcium (<50 ppm), magnesium (<50 ppm), chloride (<25 ppm), and sulfate (<25 ppm), and less than 100 ppm of total hardness as CaCO₃. If good quality water is unavailable for your installation, prediluted solutions of Dow fluids are available from Dow.

Because Dow offers the most comprehensive range of fluid options, we are uniquely equipped to thoroughly and fairly assess your specific performance and economic requirements and recommend the best fluid to meet your needs.

Ethylene Glycol vs. Propylene Glycol

An ethylene glycol-based fluid—such as DOWTHERM SR-1, DOWTHERM 4000, or DOWCAL 10 fluid—is usually the first choice for HVAC service because EG-based fluids are less viscous than propylene glycol fluids, which translates into superior heat transfer efficiency and better low temperature performance.

However in some cases, the potential for contact with ground water or other potable water supplies, or government regulations, call for use of a propylene glycol-based fluid. Propylene glycol fluids—such as DOWFROST HD, DOWFROST, DOWCAL 20, or DOWCAL N fluid—feature low acute oral toxicity compared to the moderate oral toxicity of ethylene glycol-based fluids. These PG-based fluids can be used successfully in most systems as long as design requirements are met.

Here's a summary of our family of fluids including performance information and noteworthy applications:

DOWTHERM SR-1

With a recommended operating range of -60°F (-50°C) to 250°F (120°C), this inhibited ethylene glycol-based fluid is the most widely used fluid for freeze and burst protection for heating and air conditioning systems. A specially formulated inhibitor package provides excellent corrosion protection for common metals used in HVAC systems. The inhibitors are easily maintained, long-lasting, and replenishable, which means intervals between fluid changeouts are extended and long-term fluid expense is minimized. DOWTHERM SR-1 fluid has lasted more than 20 years in properly maintained systems.

APPLICATION PROFILE

The Los Angeles County Jail received a \$1.3 million incentive from the Los Angeles Department of Water and Power when the 2.3 million square foot facility installed a Thermal Energy Storage (TES) system using DOWTHERM SR-1 fluid.

DOWTHERM 4000

DOWTHERM 4000 inhibited ethylene glycol-based fluid (along with DOWCAL 10 fluid in Europe) features the highest recommended maximum use temperature of any glycol fluid (350°F/175°C) and typical solutions remain pumpable at temperatures as low as -60°F (-50°C). The special industrial inhibitor package in DOWTHERM 4000 fluid provides excellent protection against corrosion in HVAC service.

DOWFROST HD

This inhibited propylene glycol-based fluid is recommended for use in systems where incidental contact with potable water is possible, or where a propylene glycol-based fluid is required by government regulation. The recommended use temperature range is -50°F (-45°C) to 325°F (160°C). A specially formulated corrosion inhibitor package provides a high level of protection for all common metals found in HVAC systems. Enhanced protection for copper components makes DOWFROST HD fluid the preferred propylene glycol-based fluid for HVAC applications. Ground source heat pump systems are a major application for DOWFROST HD due to the fluid’s low acute oral toxicity.

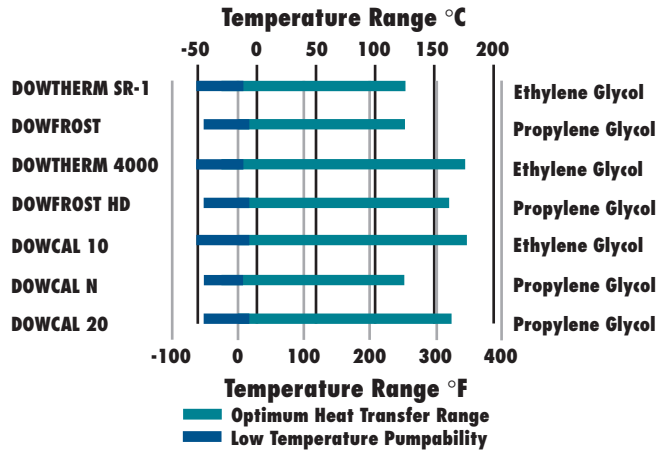
DOWFROST

DOWFROST inhibited propylene glycol-based fluid is also used where incidental contact with potable water is possible or where use of a propylene glycol fluid is required by government regulation. DOWFROST fluid has a recommended use temperature range of -50°F (-45°C) to 250°F (120°C) and features a special industrial inhibitor package designed to prevent corrosion in HVAC service.

DOWCAL 10

This inhibited ethylene glycol-based fluid, available only in Europe, is used in water-based HVAC systems operating between -50°C (-60°F) and 175°C (350°F) to provide

**DOWTHERM, DOWFROST, and DOWCAL
Inhibited Glycol-based Heat Transfer Fluids**



At appropriate concentrations, these fluids will provide burst protection to -100°F (-73°C).

freeze, burst, and corrosion protection. The fluid contains a special industrial inhibitor package designed for easy analysis and restoration to ensure long fluid life.

DOWCAL N

Available only in Europe, DOWCAL N fluid is an inhibited propylene glycol-based fluid that is low in acute oral toxicity and widely used to depress freeze points and protect against corrosion in HVAC systems operating between -45°C (-50°F) and 120°C (250°F). It contains a special industrial inhibitor package that protects against system damage.

DOWCAL 20

DOWCAL 20 inhibited propylene glycol-based fluid, available only in Europe, is capable of operating at higher temperatures than other propylene glycol fluids. It is low in acute oral toxicity and may be used in systems operating from -45°C (-50°F) to 160°C (325°F). A specially formulated inhibitor package prevents corrosion of common materials found in HVAC systems.



Product Descriptions for DOWTHERM, DOWFROST, and DOWCAL Inhibited Glycol-based Heat Transfer Fluids

	DOWTHERM SR-1	DOWTHERM 4000	DOWCAL 10	DOWFROST	DOWFROST HD	DOWCAL 20	DOWCAL N
	Inhibited Ethylene Glycol	Inhibited Ethylene Glycol	Inhibited Ethylene Glycol ¹	Inhibited Propylene Glycol	Inhibited Propylene Glycol	Inhibited Propylene Glycol ¹	Inhibited Propylene Glycol ¹
Composition, % by Weight							
Glycols	96	92	94	96	94	94	96
Inhibitors & Water	4	8	6	4	6	6	4
Color	Fluorescent Pink	Fluorescent Orange	Pale Yellow ²	Colorless	Fluorescent Yellow	Pale Yellow ²	Pale Yellow ²
Specific Gravity at 60/60°F (15/15°C)	1.125–1.135	1.130–1.144	1.125–1.135	1.050–1.060	1.053–1.063	1.050–1.060	1.050–1.060
pH of Solution Containing 50% Glycol	9.0–9.6	8.5–9.0	7.6–8.2	9.0–10.0	9.5–10.5	7.2–8.2	9.0–10.0
Reserve Alkalinity, Minimum	11.0 ml	25.0 ml	10.0 ml	10.0 ml	15.0 ml	8.0 ml	10.0 ml

¹Available only in Europe
²Color available on request



Why Dow Industrially Inhibited Glycol-based Fluids Outperform Other Fluids in HVAC Service

When you compare DOWTHERM, DOWFROST, and DOWCAL fluids to other heat transfer options, there really is no comparison. Dow glycol-based fluids are industrial heat transfer formulations designed to perform better under HVAC service conditions. As a result they provide more certain freeze and corrosion protection, optimum heat transfer efficiency and the best economics over the life of your system.

Protection Against Costly Freeze And Corrosion Damage

HVAC system freeze-up can result in burst coils, damaged pipes, damage to building structures and contents, as well as occupant discomfort. DOWTHERM, DOWFROST and DOWCAL fluids provide freeze protection to -60°F (-50°C) and system burst protection to -100°F (-73°C), assuring that your system is protected in the coldest winter climates. What's more, the ability of these fluids to depress the freeze point of water makes them ideal for ice-building thermal energy storage systems.

Corrosion Protection You Can Bank On

Corrosion damage in your HVAC system can mean unscheduled system shut downs, high maintenance expense, component replacement, and reduced system life. With Dow industrially inhibited fluids, you can control harmful corrosion so your system operates better and lasts longer.

The inhibitors in DOWTHERM, DOWFROST and DOWCAL fluids are specially formulated to passivate metal surfaces to guard against acid attack. These inhibitors also neutralize any organic acids that form as a result of glycol oxidation, further protecting system components. The inhibitors in Dow fluids prevent corrosion without fouling system components as some inhibitors can. What's more, the condition of Dow inhibitors is easily monitored. And, with proper inhibitor maintenance, Dow fluids can last up to 20 years or more...sparing you the high cost of frequent fluid replacement.

The Heat Transfer Efficiency You Need

Solutions of DOWTHERM, DOWFROST, and DOWCAL fluids are only slightly more viscous than plain water, so installation of these glycol solutions should not compromise the efficiency of your system. In fact the low temperature operating capabilities of these fluids can, in some cases, improve system operating efficiency.

Lower Fluid Maintenance Costs And Longer Fluid Life

Dow's easily maintained industrial fluid formulations extend intervals between inhibitor replenishment, reduce fluid changeouts, and lower overall fluid cost for the life of your HVAC system. The industrial inhibitor packages used in Dow glycol-based fluids contain only the highest quality ingredients and are backed by detailed analytical and performance data, which means the fluids are easily analyzed and maintained.

Free Annual Fluid Analysis

For systems containing 250 gallons (in Europe, systems larger than 10,000 liters) or more of Dow fluid, Dow offers free annual fluid analysis to ensure that your system's freeze and corrosion protection are properly maintained. Self-testing instruments are available for operators of smaller systems (not available in Europe).

APPLICATION PROFILE

The US Antarctic Program's McMurdo Station turned to DOWFROST inhibited propylene glycol-based fluid to protect the station's radiant heating and potable water systems from freezing temperatures as low as -60°F (-50°C).

Why Alternative Fluid Options Are Not Really Options At All

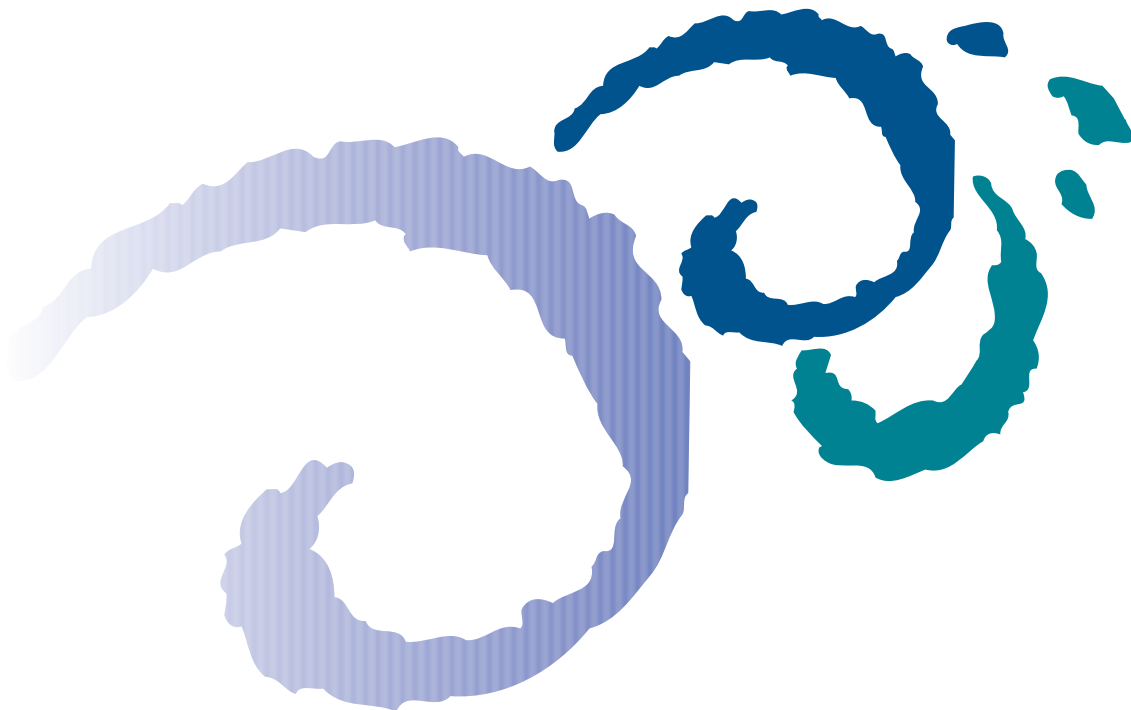
Although you may be tempted by so-called “bargain” fluid alternatives, these fluids may not provide adequate protection for your HVAC system and can end up costing you far more than the initial fluid price. Are you considering any of the following fluid alternatives? If so, be sure to consider the risks they involve.

Plain water—Plain water has a relatively narrow operating range...it freezes at 32°F (0°C) and it boils at 212°F (100°C). When the temperature drops below freezing, water freezes and expands, which can result in broken pipes, ruptured heat exchangers, and cracked valves. Water also encourages corrosion. Seasonal draining can increase the corrosion threat because of the effect of oxygen on damp pipes.

Uninhibited glycols—Uninhibited glycols are sometimes selected for freeze protection because they carry a lower price tag than inhibited products. But “plain” glycols can actually increase the threat of corrosion in your system because glycols produce organic acids. If left in solution, these acids lower system pH. If they are not neutralized, the corrosion rate of ethylene glycol on iron is more than 2.5 times greater than plain water.

Unbranded inhibited glycol fluids—The degree of corrosion protection provided by these fluids is often a mystery because the fluids are usually supplied with little or no supporting analytical or performance data. Without detailed product data, you can never be sure if you have adequate freeze and corrosion protection. What’s more, the fluids cannot be analyzed or properly maintained. So, you are compelled to replace your fluid frequently to ensure that your system remains protected over time.

Automotive antifreeze—Automotive antifreeze products are formulated with silicate-based corrosion inhibitors that are well-suited to protect aluminum components in automotive engines but can actually be harmful to your HVAC system. In HVAC systems, where flow tends to be less turbulent, the silicates in automotive antifreeze can coat and foul heat transfer surfaces and plug the system, reducing energy efficiency. Silicate-based inhibitors can also significantly shorten the life of pump seals. Finally, manufacturers of automotive antifreeze recommend replacing their fluids every two or three years. In contrast, Dow fluids—which contain inhibitors designed to protect the metals commonly used in HVAC systems—can last 20 years or more with proper maintenance.



HVAC Applications for DOWTHERM, DOWFROST and DOWCAL Fluids

Freeze And Corrosion Protection For Water-Based Heating And Air Conditioning Systems



Protecting closed-loop, water-based HVAC systems from freeze or burst damage is essential if those systems are exposed to cold temperatures. Failure to properly protect against system freeze-up can have serious consequences.

Cracked pipes or other damaged components not only mean expensive repairs, but can also mean hours of discomfort for building occupants; loss of rental income; damage to the building structure; ruined office equipment, furnishings or other goods; and—in the case of systems in hospitals or nursing homes—a potential threat to the health or even the lives of patients. If you are an architect, an engineer, an HVAC contractor, or a facilities manager, system freeze-up can also damage your professional reputation, costing you the business of a current customer as well as potential referral business.

These costly problems can be avoided by using a DOWTHERM, DOWFROST, or DOWCAL fluid to protect against system freeze-up. Solutions of these Dow fluids can be blended to provide precisely the level of freeze or burst protection your system requires...with freeze protection down to -60°F (-50°C) and burst protection below -100°F (-73°C). The table on this page indicates the concentrations of Dow fluids required to maintain freeze or burst protection at various temperatures.

Freeze Protection

Freeze protection is important in systems that must operate all winter, requiring that the fluid remain pumpable and circulating at low temperatures. Freeze protection is also necessary if the system offers inadequate volume for expansion of an ice/slush fluid mixture. Systems required to start up following prolonged winter shutdowns may also be candidates for freeze protection. And the fluid in any system that must be protected in the event of power or pump failure should contain sufficient glycol for freeze protection.

Concentrations of DOWTHERM, DOWFROST, and DOWCAL Fluids Required to Provide Freeze Protection and Burst Protection at Various Temperatures

Temp., °F (°C)	Volume Percent Glycol Concentration Required			
	For Freeze Protection		For Burst Protection	
	DOWTHERM, DOWCAL 10 Fluids	DOWFROST, DOWCAL 20 & N Fluids	DOWTHERM, DOWCAL 10 Fluids	DOWFROST, DOWCAL 20 & N Fluids
20 (-7)	16%	18%	11%	12%
10 (-12)	25	29	17	20
0 (-18)	33	36	22	24
-10 (-23)	39	42	26	28
-20 (-29)	44	46	30	30
-30 (-34)	48	50	30	33
-40 (-40)	52	54	30	35
-50 (-46)	56	57	30	35
-60 (-51)	60	60	30	35

Note: These figures are examples only and may not be appropriate to your situation. Generally, for an extended margin of protection, you should select a temperature in this table that is at least 5°F (3°C) lower than the expected lowest ambient temperature. Inhibitor levels should be adjusted for solutions of less than 20% glycol. Contact Dow for information on specific cases or further assistance.

Ice storage systems, fire sprinkler systems, hydronic heating systems, and other systems requiring constant or intermittent winter operation all require freeze protection. The required concentration of glycol to achieve freeze protection is generally higher than for burst protection and depends on the operating conditions of the system and the lowest ambient temperature likely to be encountered.

For freeze protection, choose a glycol solution concentration that will prevent the formation of ice crystals at a temperature at least 5°F (3°C) colder than the lowest expected ambient temperature.

APPLICATION PROFILE

The Columbus Center at the Center for Marine Biotechnology of the University of Maryland is saving more than \$97,500 annually with a TES system using DOWTHERM SR-1 fluid from Dow.

Burst Protection

Burst protection is called for when a system is inactive during the winter and there is adequate space for expansion of an ice/slush mixture. When system burst protection is desired, glycol requirements are lower. A concentration capable of maintaining the fluid in an ice/slush mixture is sufficient. A 30% (by volume) solution of ethylene glycol and a 35% solution of propylene glycol fluid is usually adequate. While not pumpable, this ice/slush mixture will not cause system damage so long as there is room for expansion. Burst protection is suitable for chilled water systems, lawn sprinkler systems, and other systems that are dormant in the winter.

Corrosion Protection

Corrosion is a major contributor to high maintenance and operating expense in water-based HVAC systems. The need for corrosion protection goes hand-in-glove with the need for freeze or burst protection because system corrosion can actually be caused or accelerated by your freeze protection fluid. Water itself is highly corrosive and will severely damage many metals over time. Plain glycols are even more corrosive than water. That's why only inhibited glycol-based fluids should be used.

But even selecting an inhibited fluid does not ensure that your system is adequately protected against corrosion. DOWTHERM, DOWFROST, and DOWCAL fluids are industrially inhibited fluids specially formulated for HVAC service. This means that the inhibitors in Dow fluids are designed to protect the metals commonly found in HVAC systems and to provide optimum protection under typical HVAC system flow and other operating conditions.

To ensure proper corrosion protection in HVAC systems operating above 40°F (4°C), a minimum 30% concentration of DOWTHERM SR-1, DOWFROST, and DOWCAL N fluids is recommended. DOWTHERM 4000, DOWFROST HD, DOWCAL 10, and DOWCAL 20 fluids can be used at concentrations as low as 20% due to the higher concentration of inhibitors in these fluids. If a lower concentration will be used, consult with a Dow technical representative to determine if supplemental inhibitors should be added to your fluid. Use of good quality dilution water is critical at low fluid concentrations because some inhibitor can precipitate out of solution with any impurities present in the water. This loss of inhibitor can reduce the level of corrosion protection, decrease heat transfer efficiency, and leave piping and other components open to possible corrosion attack.

The level of corrosion protection you get with Dow fluids is documented by supporting data and the condition of the fluid inhibitors can be periodically analyzed to ensure that protection is adequately maintained. Dow's analytical support program, including free annual analysis for operators of systems containing more than 250 gallons (systems larger than 10,000 liters in Europe) of Dow fluids, makes it easy to maintain the optimum level of protection in your system.

Corrosion Test Results/Weight Loss in Milligrams (mils penetration per year)

	Water	Ethylene Glycol	DOWTHERM SR-1	DOWTHERM 4000	DOWCAL 10	Propylene Glycol	DOWFROST HD	DOWFROST	DOWCAL N	DOWCAL 20
Copper	2 (0.08)	4 (0.16)	3 (0.12)	2 (0.08)	3 (0.12)	4 (0.16)	1 (0.04)	3 (0.12)	3 (0.12)	1 (0.04)
Solder	99 (3.14)	1780 (56.5)	4 (0.13)	4 (0.13)	4 (0.13)	1095 (34.7)	2 (0.06)	1 (0.03)	1 (0.03)	2 (0.06)
Brass	5 (0.23)	11 (0.46)	3 (0.12)	2 (0.08)	3 (0.12)	5 (0.20)	2 (0.08)	4 (0.16)	4 (0.16)	2 (0.08)
Mild Steel	212 (9.69)	974 (44.5)	1 (0.04)	1 (0.04)	1 (0.04)	214 (9.80)	1 (0.04)	1 (0.04)	1 (0.04)	1 (0.04)
Cast Iron	450 (21.2)	1190 (55.7)	3 (0.13)	5 (0.23)	3 (0.13)	345 (16.2)	1 (0.05)	3 (0.15)	3 (0.15)	1 (0.04)
Aluminum	110 (13.2)	165 (19.8)	4 (0.44)	+1 (+0.12)	4 (0.44)	15 (1.80)	+3 (+0.36)	+2 (+0.26)	+2 (+0.26)	+3 (0.36)

Samples with a "+" showed weight gain

ASTM D1384 – 190°F (88°C) for 2 weeks, 30% by volume glycol, air bubbling

Ice Storage For Thermal Energy Storage (TES)



While there are many technologies available for thermal energy storage (TES) systems, ice storage has become the primary choice for the large-scale air conditioning environments where TES is most suited. Ice storage systems make and store ice during non-peak electrical use periods such as overnight or on weekends, then use the stored cold to provide air conditioning during the day when electrical loads and energy costs are at their peak.

Inhibited glycol-based heat transfer fluids — including DOWTHERM SR-1, DOWCAL 10, DOWFROST HD, and DOWCAL 20 fluids, in particular — have replaced brine solutions such as potassium chloride in TES applications because of the severe corrosiveness of salt solutions and resulting system damage.

DOWTHERM SR-1 and DOWCAL 10 inhibited ethylene glycol-based fluids and DOWFROST HD and DOWCAL 20 inhibited propylene glycol fluids offer the freeze-point depression capability and low temperature pumpability necessary to efficiently build ice in TES service. In addition, these Dow fluids contain heavy-duty industrial inhibitor packages that protect system piping and components against corrosion. The long fluid life and minimal maintenance requirements of these Dow fluids help ensure long-term system reliability, a critical factor in ensuring overall cost and energy savings.

Dow fluids are used in both of the two most common types of ice storage systems: ice-on-pipe systems and encapsulated ice systems. Ice-on-pipe systems consist of coils of plastic or metal tubing immersed in a tank of water. A chilled solution of glycol and water is circulated through the tubes to build ice on the outer surfaces during off-peak hours. When air conditioning is needed, the same solution is circulated through the tubes, carrying heat from the building to melt the ice. This chills the glycol-based solution which continues to circulate, cooling the building. Encapsulated ice systems operate similarly except the glycol solution is circulated through a tank filled with containers of water. Ice forms in the containers and is later melted by the glycol solution when cooling is needed.

Obtaining Optimum Heat Transfer Efficiency

If you are weighing the performance of a glycol-based fluid against plain water, you may be concerned about the potential for lost system efficiency with the glycol fluid. However, the fact is, use of a glycol solution in an HVAC system has relatively little effect on how well your system performs as long as the fluid type was taken into account during system design or the system was designed to operate with a cushion of excess capacity. In cases where there is no excess capacity, modest system modifications will compensate for any capacity loss resulting from the introduction of the glycol fluid into the system.

For example, if a glycol fluid is introduced into an air conditioning system formerly operating with plain water, any decline in capacity will probably not be noticed by building occupants as long as the system was designed with excess capacity. If the system is already nearing its design load, introduction of a glycol-based fluid may aggravate the situation. However, any problems will be noticed only on the hottest days.

In cases where increased pressure drop and a resulting decline in the capacity of the system is a problem, a two-step remedy can be employed. First, flow of solution through the system should be reduced in order to return the pressure drop to its original value. This will have the beneficial side effect of reducing pump horsepower requirements and energy consumption. Next, reduce the chiller operating temperature to lower the fluid temperature into the coil. Reducing the chiller operating temperature compensates for the reduction in fluid flow and returns the coil capacity to its original level.

In some cases, shifting the cooling burden from pumps to chiller can actually improve the overall efficiency of the system. Unlike pumps, chillers only use energy in proportion to system load. And, new developments in chillers have led to increased energy efficiency.

TES With Dow Fluids

To prevent chiller freeze-ups and permit the manufacture of ice, fluid solutions used in TES systems must provide sufficient reduction in the freezing point of the solution. To make ice, DOWTHERM SR-1, DOWCAL 10, DOWFROST HD, and DOWCAL 20 fluids are usually chilled to between 20°F and 26°F (-7°C and -3°C). Specifying 25% solutions of these fluids yields freezing points below 14°F (-10°C) for DOWTHERM SR-1 and DOWCAL 10 fluids and 16°F (-9°C) for DOWFROST HD and DOWCAL 20 fluids, providing an adequate margin of safety below the system's normal operating temperature to protect against chiller freeze-up.

Since TES systems do not operate above 40°F (4°C) (where marginal loss of inhibitor potency can occur), 25% solutions can be safely used without sacrificing corrosion protection. Note that use of good quality dilution water is especially critical at low fluid concentrations because impurities in the water can cause some inhibitor to precipitate out of solution. This precipitation reduces the level of corrosion protection, decreases heat transfer efficiency, and leaves piping and other components open to possible corrosion attack.

Freeze Protection And Heat Transfer For Ground Source Heat Pumps



Ground source heat pump (GSHP) systems are a year-round, energy efficient heating and cooling solution for applications ranging from private residences to larger scale public and commercial buildings. GSHPs are water-based, closed loops that transfer the heat of the earth to a building heat pump in the winter and transfer the heat of the building to the relative cool of the earth in summer months.

Regardless of the size of the system, an efficient, high performance heat transfer fluid is an essential part of any GSHP system. In climates where temperatures drop below freezing, there is a need for freeze protection as well as efficient heat transfer. DOWFROST HD and DOWCAL 20 fluids are leading choices for GSHP service.

Drawbacks of Methanol

Although methanol is sometimes specified for GSHP service, this fluid has some significant drawbacks. First, with a flash point of 54°F (12°C), methanol is highly flammable, posing a danger to installers and to building occupants should a leak occur. Second, due to its flammability, methanol is classified as a hazardous waste upon disposal under the U.S. Resource Conservation Recovery Act (and it may be subject to similar regulations in other nations). Third, methanol is characterized as high in both acute oral and inhalation toxicity, which means installer and building occupant exposure must be tightly controlled. Regulations in many areas actually prohibit the use of methanol in ground systems. Finally, because methanol is often sold as an industrial commodity it is not necessarily formulated with an industrial inhibitor package to prevent system corrosion.

Advantages of Dow Fluids

In contrast to methanol, DOWFROST HD and DOWCAL 20 fluids are propylene glycol formulations that are low in acute oral and inhalation toxicity and have no measurable flash points because they are mixed in solutions with water. Both Dow fluids feature industrial inhibitor packages designed to protect metals commonly used in HVAC systems. DOWFROST HD and DOWCAL 20 fluids, in particular, are noted for the additional protection they provide for copper which is commonly used in GSHP system tubing and heat exchangers.

APPLICATION PROFILE

The Sacramento (California) Traffic Court installed a TES system using DOWTHERM SR-1 fluid and shifted electricity consumption for the 94 million square foot building to off peak hours when energy rates are as much as 50% lower.

The handling, environmental, regulatory, and corrosion protection advantages of using DOWFROST HD or DOWCAL 20 inhibited propylene glycol-based fluids do not come at the expense of heat transfer efficiency. In GSHP service, a maximum level of freeze protection of 25°F (-4°C) is required. Concentrations of 20% to 25% DOWFROST HD or DOWCAL 20 fluid are used depending upon the level of freeze protection required. At these concentrations, the heat transfer efficiency of these glycol fluids compares very favorably to plain water or methanol. Pumping horsepower requirements of Dow inhibited glycol-based fluids are about equal to those of methanol.

DOWFROST HD and DOWCAL 20 fluids provide the handling advantages of a propylene glycol fluid, excellent heat transfer efficiency, long-term system freeze and corrosion protection, low maintenance operation, lower long-term fluid cost, and greater overall peace of mind at an initial fluid cost usually less than 2% of the overall installed system cost.

Freeze And Corrosion Protection For Hydronic/Radiant Floor Heating Systems



Long popular in Europe, hydronic (water) heating systems are becoming an increasingly attractive alternative to hot air systems for residential heating applications throughout North America and other global areas as well. Hydronic heating systems consist of a boiler, a pump to circulate the heated water, a water distribution network, and a series of radiating surfaces located throughout the home.

As in other HVAC applications, the need for freeze and corrosion protection is an important consideration when selecting a heat transfer fluid for a hydronic heating system. DOWTHERM, DOWFROST and DOWCAL inhibited glycol-based fluids offer industrial strength

protection necessary to protect these systems and ensure long, trouble-free service. In systems where contact with drinking water is possible, a fluid with low acute oral toxicity, such as DOWFROST, DOWFROST HD, DOWCAL 20, or DOWCAL N fluid, is recommended.

Heat Transfer For Solar Collection Systems



DOWTHERM, DOWFROST and DOWCAL fluids are also used in solar collection heating systems to extract solar heat and transfer it to heat buildings or water supplies. DOWTHERM

4000 and DOWCAL 10 fluids are especially useful in this application because they remain thermally stable to 350°F (175°C) and can even tolerate temperatures as high as 400°F (200°C) for brief periods. For domestic solar systems, DOWFROST HD and DOWCAL 20 fluids are preferred due to the low acute oral toxicity of these propylene glycol-based fluids.

Other Applications



Dow inhibited glycol-based heat transfer fluids are also widely used in a variety of other water-based systems, including skating rinks, fire hydrants, and sprinkler systems. In skating rink

systems, for example, sub-freezing temperatures are maintained by circulating DOWTHERM SR-1 or DOWCAL 10 fluid throughout a network of pipes imbedded in the concrete floor beneath the ice. In contrast to calcium chloride solutions sometimes used in these installations, Dow inhibited fluids are not corrosive, plus they help to lubricate pumps and are virtually maintenance-free.



Dow Fluids Come Complete with a Full Package of Support

Whatever your HVAC application, the Dow heat transfer specialists can provide the support you need to design, operate and maintain your system to achieve optimum performance and economy. Just contact the Dow representative in your area for assistance. Our package of support includes...

- System design consultation to ensure maximum cost-efficiency.
- Unbiased fluid selection assistance to help you choose the right fluid for your system.
- Assistance in establishing optimum glycol and inhibitor concentrations.
- Pre-diluted fluid solutions if you cannot obtain good quality water in your area.
- Fluid installation assistance and operational troubleshooting should you need it.
- Free annual fluid analysis for systems containing 250 gallons (10,000 liters in Europe) or more of Dow fluid.
- Self-test kits for analysis of smaller systems (not available in Europe).

Free Software Program Helps System Designers Evaluate And Select The Right Fluid

To streamline and improve the accuracy of your fluid selection process, order the free FLUIDFILE* software program from Dow. The program provides complete facts about the entire family of Dow fluids including DOWTHERM and DOWFROST inhibited glycol-based fluids (DOWCAL fluids in Europe) as well as DOWTHERM synthetic organic fluids. The program also provides information about SYLTHERM† silicone fluids manufactured by Dow Corning Corporation. This highly accurate, user-friendly engineering tool is based on Windows‡ software, which means choosing the right heat transfer fluid is now easier than ever.

*Trademark of The Dow Chemical Company

† Trademark of Dow Corning Corporation

‡ Trademark of Microsoft Corporation

Request Additional Dow Product And Applications Literature

For more information about heat transfer fluids available from Dow and their applications, just call the number for your area listed on the back of this brochure and request the appropriate brochure listed below:

- Engineering Guide for DOWTHERM Ethylene Glycol-based Heat Transfer Fluids
- Engineering Guide for DOWFROST Propylene Glycol-based Heat Transfer Fluids
- DOWCAL 10 (Product Brochure)
- DOWCAL 20 (Product Brochure)
- DOWCAL N (Product Brochure)
- Fluid Specification Sheets, DOWTHERM & DOWFROST Fluids
- Mechanical Contractor's Guide to Dow Fluids
- Thermal Energy Storage Applications Brochure
- HVAC FOCUS Newsletter, Fall '96: *Thermal Energy Storage & Glycol Fluids*
- HVAC FOCUS Newsletter, Winter '97: *Ground Source Heat Pumps & PG Fluids*

Or review Dow fluids data and download fluid product sheets from our Home Page on the World Wide Web:

<http://www.dow.com/heattrans>

APPLICATION PROFILE

Four Lincoln, Nebraska, elementary schools will save \$3.8 million over 20 years with ground coupled heat pump (ground source heat pump) systems using DOWFROST propylene glycol-based fluid.

The Full Family of Dow Glycol-based Heat Transfer Fluids

Fluid	Temp. Range, °F (°C)			Recommended Water-based HVAC Applications						
	HVAC System Burst Protection	HVAC System Freeze Protection	Max Recom. Oper. Temp.	System Freeze & Corrosion Protection	Thermal Energy Storage (TES)	Ground Source Heat Pumps	Hydronic Heating Systems	Solar Heating Systems	Skating Rink Systems	Fire Sprinkler Systems
Ethylene Glycol-based Fluids										
DOWTHERM SR-1	<-100 (-73)	<-60 (<-52)	250 (121)	∂	■		●	■	∂	∂
DOWTHERM 4000	<-100 (-73)	<-60 (<-52)	350 (175)	∂	∂		■	∂	■	■
DOWCAL 10	<-100 (-73)	<-60 (<-52)	350 (175)	∂	∂		■	∂	■	■
Propylene Glycol-based Fluids										
DOWFROST	<-100 (-73)	<-60 (<-52)	250 (120)	●	●	●	■	●	■	■
DOWFROST HD	<-100 (-73)	<-60 (<-52)	325 (160)	∂	∂	∂	∂	■	∂	●
DOWCAL N	<-100 (-73)	<-60 (<-52)	250 (120)	●	●	●	■	●	■	■
DOWCAL 20	<-100 (-73)	<-60 (<-52)	325 (160)	∂	∂	∂	∂	■	∂	●

∂ Outstanding ■ Excellent ● Good



HVAC OVERVIEW GUIDE

DOWTHERM, DOWFROST, and DOWCAL Heat Transfer Fluids



For further information, call...

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In Europe: +31 20691 6268 • Fax: +31 20691 6418

In The Pacific: +886 22 547 8731 • Fax: +886 22 713 0092

In Other Global Areas: 1-517-832-1556 • Fax: 1-517-832-1465

<http://www.dow.com/heattrans>

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Published May 1998.

NOTE: SYLTHERM heat transfer fluids are manufactured by Dow Corning Corporation and distributed by The Dow Chemical Company.

