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## DOWCAL™ Geothermal Fluids

### Improved Performance & Safety for Geothermal Heat Pumps

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**Geothermal Coils:** Eight feet underground, this coil serves as part of a geothermal system enabled by Dow technology to heat and cool homes, schools and businesses.

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#### Enabling Confidence in Geothermal

As the market for geothermal systems continues to expand, the importance of choosing the right heat transfer fluid has also increased. **DOWCAL™ eGEO** (ethylene glycol-based) and **DOWCAL™ pGEO** (propylene glycol-based) geothermal fluids, part of a new generation of application-specific heat transfer fluids from The Dow Chemical Company, were developed to provide geothermal heat pump installers and their customers with greater confidence and peace of mind.

DOWCAL™ geothermal fluids were designed to overcome the drawbacks of alternative fluids, providing greater assurance that geothermal systems will repay their initial investment costs in energy savings and in years of reliable, safe and economical operation. DOWCAL™ geothermal fluids offer reduced viscosity, increased heat capacity and thermal conductivity, and take advantage of the excellent heat transfer properties of water over a temperature range of -50°C to 175°C.

#### Expert Technical Support & Fluid Analysis

As a Dow customer, you have direct access to our industry leading heat transfer expertise, including our in-depth and highly diversified application experience. Dow heat transfer specialists will help you select the exact fluid you require, then work with you to properly install and optimize fluid operation for best results.

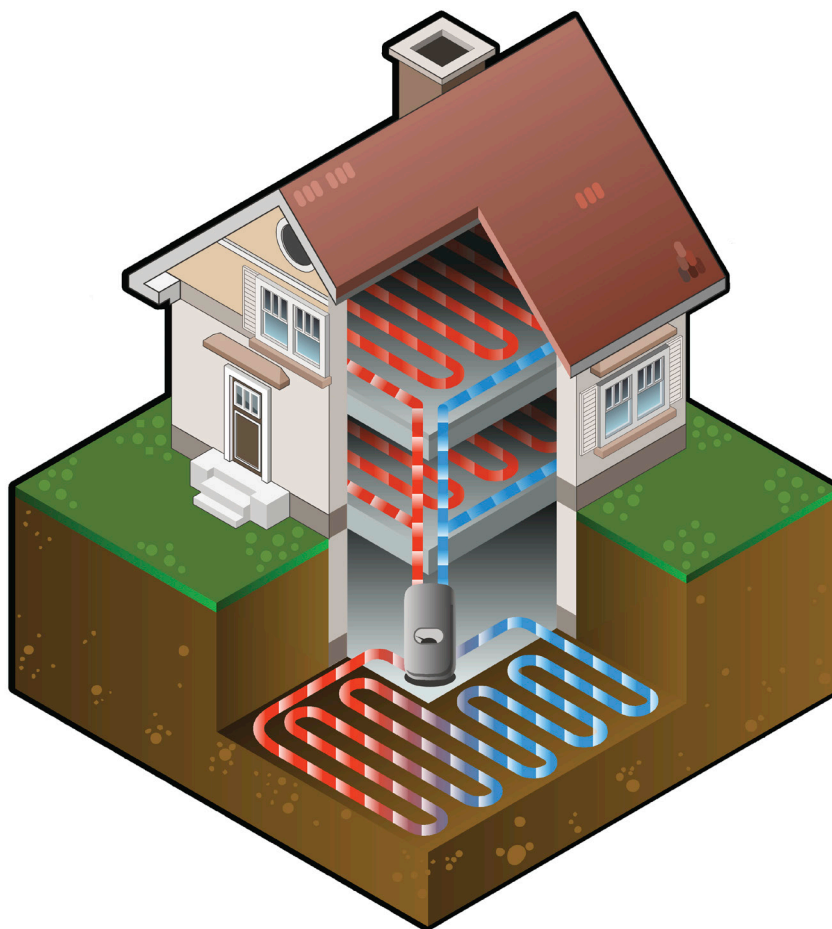
Experience confirms that DOWCAL™ geothermal fluids can be used in installations for many years. However, the concentration of DOWCAL™ fluids and the products' functional performance should be checked at intervals of one to two years. Dow offers a fluid analysis service to evaluate fluid condition at regular use intervals and after prolonged storage. Contact us to learn more about our services and to begin working with our experts on your successful geothermal project.

Learn more at [www.dowcal.com](http://www.dowcal.com).

### Operating in Extreme Temperatures

A ground source heat pump (GSHP) extracts the consistent subsurface temperature of the earth or surface water to provide efficient heating and cooling in private and industrial buildings while reducing energy use. A typical ground source heat pump will circulate geothermal fluids through the ground using the earth's constant temperature to exchange hot air for cooler in the summer and cold air for warmer in the winter.

To prevent freezing when the fluid contacts the evaporating refrigerant at sub-zero temperatures, DOWCAL™ eGEO or DOWCAL™ pGEO fluids can be circulated in the captors/probes of the GSHP. Diluted to a 20% concentration, DOWCAL™ geothermal fluids provides corrosion protection while maintaining pumping efficiency.



## Advantages of DOWCAL™ Geothermal Fluids in Ground Source Heat Pumps

### Nonflammable

When diluted in water, DOWCAL™ fluids are nonflammable as they have no measurable flash points. Therefore, they pose no fire hazard compared to alcohol-based fluid which have a low flash point.

### Reduced Toxicity

DOWCAL™ pGEO fluid is a propylene glycol-based fluid that is low in acute oral toxicity, and can be used where toxicity is a concern. By comparison, methanol is characterized as relatively high in both acute oral and inhalation toxicity.

DOWCAL™ geothermal fluids are circulated through underground or underwater piping, carrying thermal energy to and from the building.

### Efficient Heat Transfer

At the concentration supplied, DOWCAL™ geothermal fluids are not likely to be the limiting factor in heat transfer efficiency for the overall system. Changing from alcohol-based fluids to DOWCAL™ geothermal fluids will likely have no measurable impact on overall system heat transfer efficiency, even though the individual fluid coefficients differ.

### Reliable Corrosion Control

In order to ensure the long-term success of the system and its equipment, a geothermal fluid must pass ASTM D-1384 corrosion evaluation. DOWCAL™ geothermal fluids can provide corrosion protection for heat pumps well within the recommended guidelines for

typical metals. Using methanol, water or uninhibited glycols could lead to serious corrosion problems and equipment failure, whereas DOWCAL™ geothermal fluids offer peace of mind and confidence to both the GSHP installer and owner.

### Fluid Dilution Requirements

Whenever possible, DOWCAL™ geothermal fluids should be diluted with demineralized or distilled water. DOWCAL™ geothermal fluids can also be mixed with other water according to certain requirements, which local tap water typically meets. If water of adequate quality is not available, Dow or Dow's local distributor can supply ready-to-use solutions of DOWCAL™ geothermal fluids.

## Typical Properties† for DOWCAL™ Geothermal Fluids

### DOWCAL™ eGEO Fluid

**Recommended Use Temperature Range: -50°C to 175°C**

#### Typical Properties† of DOWCAL™ eGEO Fluid

Composition (% by volume)

Ethylene Glycol: 91%

Performance Additive + Water: 9%

Color: Colourless or dyed according to local requirements

Specific Gravity: 1.125 - 1.135 at 25°C

pH of Solution: 7.6 - 8.2

Reserve Alkalinity: 10 ml

### DOWCAL™ pGEO Fluid

**Recommended Use Temperature Range: -50°C to 175°C**

#### Typical Properties† of DOWCAL™ pGEO Fluid

Composition (% by volume)

Propylene Glycol: 98%

Performance Additive + Water: 2%

Color: Colourless or dyed according to local requirements

Specific Gravity: 1.050 - 1.055 at 25°C

pH of Solution: 7.2 - 7.6

Reserve Alkalinity: 10 ml

#### Saturation Properties at 20% Volume Concentration

Temp °C	Specific Heat kJ / (kg) (K)	Density kg/m³	Thermal Conductivity W/mK	Viscosity mPa.s
0	3.800	1039.6	0.496	3.400
25	3.850	1026.2	0.522	1.550
50	3.910	1013.8	0.541	0.901
100	4.020	991.5	0.560	0.446
130	4.090	979.5	0.559	0.335
160	4.150	968.5	0.550	0.268

Temp °C	Specific Heat kJ / (kg) (K)	Density kg/m³	Thermal Conductivity W/mK	Viscosity mPa.s
0	3.950	1031.8	0.463	4.960
25	4.000	1016.6	0.496	1.960
50	4.050	1001.4	0.521	1.010
100	4.160	971.1	0.548	0.428
130	4.220	952.8	0.551	0.308
160	4.280	934.6	0.547	0.241

#### Saturation Properties at 25% Volume Concentration

Temp °C	Specific Heat kJ / (kg) (K)	Density kg/m³	Thermal Conductivity W/mK	Viscosity mPa.s
0	3.720	1051.0	0.482	4.120
25	3.780	1037.2	0.503	1.830
50	3.840	1024.3	0.519	1.040
100	3.960	1001.3	0.533	0.502
130	4.040	989.0	0.531	0.374
160	4.110	977.6	0.520	0.297

Temp °C	Specific Heat kJ / (kg) (K)	Density kg/m³	Thermal Conductivity W/mK	Viscosity mPa.s
0	3.890	1036.5	0.440	6.210
25	3.950	1021.3	0.470	2.330
50	4.010	1006.1	0.494	1.160
100	4.120	975.8	0.518	0.468
130	4.200	957.5	0.520	0.331
160	4.270	939.3	0.516	0.255

#### Saturation Properties at 30% Volume Concentration

Temp °C	Specific Heat kJ / (kg) (K)	Density kg/m³	Thermal Conductivity W/mK	Viscosity mPa.s
0	3.640	1061.2	0.468	4.990
25	3.698	1046.9	0.486	2.150
50	3.770	1033.8	0.498	1.200
100	3.910	1010.1	0.507	0.566
130	3.990	997.4	0.503	0.417
160	4.070	985.7	0.491	0.328

Temp °C	Specific Heat kJ / (kg) (K)	Density kg/m³	Thermal Conductivity W/mK	Viscosity mPa.s
0	3.762	1041.3	0.417	7.812
25	3.890	1026.1	0.446	2.780
50	3.897	1010.9	0.467	1.327
100	4.032	980.5	0.489	0.512
130	4.114	962.3	0.491	0.355
160	4.195	944.0	0.487	0.371

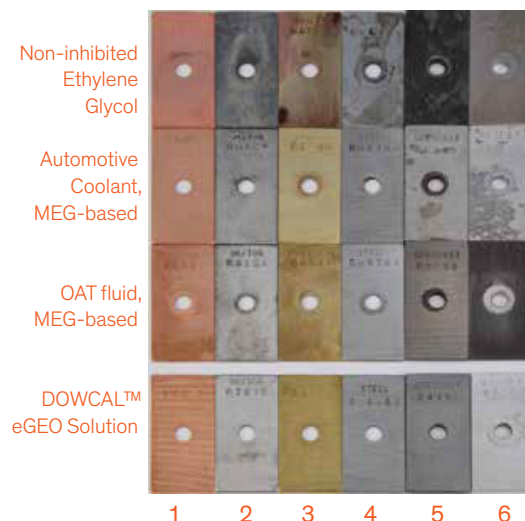
†Typical properties, not to be construed as specifications.



# Corrosion Protection Capabilities

## ASTM D1384 Corrosion Test Results at 20% Concentration by Volume Ethylene Glycol (Weight Difference [mg])

		Non-inhibited Ethylene Glycol	Automotive Coolant, MEG-based	OAT fluid, MEG-based	DOWCAL™ eGEO Solution
1	Copper	-19	-1.4	-0.8	-0.6
2	Solder	-46	-1.1	-0.8	-0.8
3	Brass	-29	-0.4	-0.4	-0.9
4	Mild Steel	-819	0.5	0.7	-0.2
5	Cast Iron	-642	1.8	1.6	2.7
6	Aluminum	-111	-10.2	-16	0.1



## ASTM D1384 Corrosion Test Results at 20% Concentration by Volume Propylene Glycol (Weight Difference [mg])

		Non-inhibited Propylene Glycol	Industrial Propylene Glycol Coolant	Alternative OAT Fluid	DOWCAL™ pGEO Solution
1	Copper	-12	-0.5	-1.3	-0.3
2	Solder	-55	-1	-1.8	-0.5
3	Brass	-31	-0.7	-1.4	0.3
4	Mild Steel	-969	0.7	0.3	0.6
5	Cast Iron	-700	1.5	0.3	1.3
6	Aluminum	-150	-11.3	-22	0.7



The above results were derived from tests performed according to the widely known ASTM D 1384 corrosion test method and represent the weight loss of metallic plates in milligrams per specimen due to corrosion (ASTM D 1384, 88°C for 2 weeks, glycol concentration 20% by volume, air bubbling, corrosive water contains 100 ppm Cl<sup>-</sup>, 100 ppm SO<sub>4</sub><sup>2-</sup>, 100 ppm HCO<sub>3</sub><sup>-</sup>). DOWCAL™ geothermal fluids fall well within the generally accepted corrosion limits considered adequate under this test. Rates in excess of 10 mg (30 mg for aluminum) are generally evidence of inadequate corrosion protection.

Many inhibited glycols show acceptable corrosion results at 33% concentration, however, concentrations as low as 20% by volume are required for certain applications. For comparison purposes, pure water and uninhibited propylene glycol and ethylene glycol are included. The data shows that the DOWCAL™ geothermal fluids demonstrate effective corrosion protection on all metals while the alternative products were more corrosive to aluminum. The tests also demonstrated that water and uninhibited glycols are highly corrosive, reinforcing the need for inhibited fluid protection.

### Product Stewardship

Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products - from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

### Customer Notice

Dow strongly encourages its customers to review both their manufacturing processes and their applications of Dow products from the standpoint of human health and environmental quality to ensure that Dow products are not used in ways for which they are not intended or tested. Dow personnel are available to answer your questions and to provide reasonable technical support. Dow product literature, including safety data sheets, should be consulted prior to use of Dow products. Current safety data sheets are available from Dow.

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