Glycol Heat-Transfer Fluids
Ethylene Glycol versus
Propylene Glycol

Water is probably the most efficent heat-transfer fluid known. If it did not freeze, water would be the ideal heat-transfer fluid for cooling applications. When freeze conditions exist (<35 F), ethylene glycol and propylene glycol can be added to water to provide freeze protection and burst protection. Both glycols have lower heat-transfer efficiencies than water and are more dense, resulting in higher volumetric flowrates or heat-exchange areas required to maintain the same temperature levels (see Tables 1 and 2). Higher flowrates lead to higher pressure drops, energy consumption, and equipment wear. As a result, it is important to accurately determine the minimal concentration of glycol needed to do the job in order to maintain system efficiency.

Between the two, ethylene glycol ($C_2H_6O_2$) is a better heat transfer fluid than propylene glycol ($C_3H_8O_2$). Propylene glycol is less toxic and is considered when toxicity is a concern.

Table 1 - Ethylene Glycol Versus Propylene Glycol Thermal Conductivities

Temperature (F)	Ethylene Glycol Thermal Conductivity [Btu/(hrft^2)(F/ft)] at 30% Volume	Propylene Glycol Thermal Conductivity [Btu/(hr ft^2)(F/ft)] at 30% Volume
10	0.238	0.235
20	0.243	0.239
30	0.247	0.243
40	0.251	0.247
50	0.255	0.251
60	0.259	0.254
70	0.263	0.258
80	0.266	0.261

Table 2 - Flow Increases Necessary to Achieve Same Heat Transfer as Pure Water

Percent Solution at 50F	Ethylene Glycol Volume Flow Increase vs. Water	Propylene Glycol Volume Flow Increase vs. Water
0	1.00	1.00
10	1.020	1.008
20	1.050	1.014
30	1.090	1.043
40	1.140	1.075
50	1.210	1.132

Water Quality: High quality water will help maintain system efficiency and prolong glycol fluid life. Recommended water characteristics include:

- Less than 50 ppm calcium (as $CaCO_3$),
- Less than 50 ppm magnesium (as $CaCO_3$),
- Less than 100 ppm total hardness (as $CaCO_3$),
- Less than 25 ppm chloride (as $CaCO_3$), and
- Less than 25 ppm sulfate (as $CaCO_3$).

Freeze Protection Versus Burst Protection: Water volume expands by 9% when frozen. Glycols depress water's freezing point providing protection to temperatures as low as -70 F to -100 F.

Freeze protection prevents ice crystal formation at the lowest temperature expected in the coolant circuit. This type of protection is necessary for year-round pumping. Continuous pumping will also prevent freezing but is costly and risky because of possible power failures.

Burst protection requires less glycol and allows some freezing to turn the coolant into a slush that is not easily pumped, but will not cause the pipe to burst. This method is used in closed circuits that are not operated in cold weather.

Corrosion: All glycols produce acids in the presence of air (oxidants). The acids can reduce pH and cause corrosion. When the system pH drops below 7, rust will form on any ferrous metal, and nonferrous metals start to corrode. For HVAC applications, glycols are formulated with passivating and buffering corrosion inhibitors to counteract acids formed by the oxidation of glycols.

System Monitoring: Glycols can typically be expected to last 12 years or longer, providing corrosion inhibitor strength is maintained. Inhibitor analysis is usually offered as a free service by glycol manufacturers.

Glycol fluid pH can be a good barometer for the condition of the glycol. Although the pH is primarily a function of the corrosion inhibitor and, therefore, will vary from product to product, a few rules of thumb are helpful in determining what constitutes proper pH.

Most concentrated inhibited glycols have a pH in the range of 9.0 to 9.5. A pH reading below 8.0 indicates that a significant portion of the inhibitor has been depleted and that more inhibitor needs to be added.

When the pH falls below 7.0, most manufacturers recommend replacing the fluid. A pH value of less than 7.0 indicates that oxidation of the glycol has occurred. The system should then be drained and flushed before severe damage occurs.

Should the system require cleansing after removing old or damaged antifreeze, flush the system with a heated 1% to 2% solution of trisodium phosphate for two to four hours then drain and rinse thoroughly.

Analysis: Inhibitor analysis is usually offered as a free service by glycol manufacturers with the assumption that you will buy any new glycol from them. They typically perform a GC analysis. To determine the type of glycol in your system, Bowser-Morner, Inc. will do an IR scan for $50. Houghton Chemical Corporation sells glycol freeze protection testers and will do the analysis too (617-254-1010).

Mixing Glycols: Do not mix ethylene and propylene glycols in the same system.

Other Considerations: Automatic makeup water systems should be avoided to prevent undetected dilution or loss of glycol.

Do not use automotive-type glycols. These glycols are formulated with silicates which tend to gel, reducing heat-transfer efficiency.

LEICA Duo-Chek Engine Coolant & Battery Tester

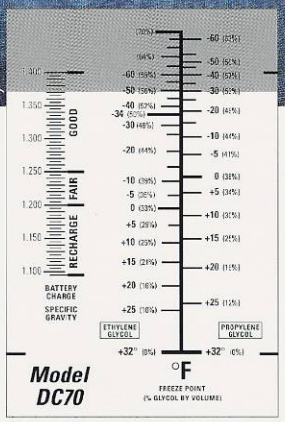
Accurately Measures All Engine Coolants Including Automotive, Heavy-Duty and Environmentally Safe Coolants.

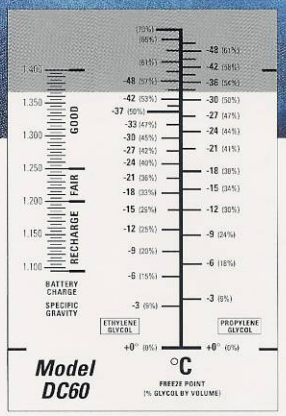
Quickly and Accurately Determine Freeze Protection of Engine Coolants and Battery Charge Level

Leica Duo-Chek Engine Coolant/Battery Tester (refractometer) offers an accurate, fast and easy-to-use method for testing engine coolant freeze point, glycol concentration and battery charge condition. It provides automatic temperature compensation for immediate, accurate direct readings of ethylene glycol or environmentally safe propylene glycol coolants with only a few drops of sample.

Standard Features

- Automatic temperature compensation—correct readings at any temperature. Responds much faster than older models.
- Portable—no batteries or power cord
- Waterproof design—eliminates the possibility of condensation on the optics
- Brighter, direct read scale—readings provided in concentration or freeze point protection
- Quality optics - The large depth of field eyepiece is easy to read even when wearing eyeglasses
- Rugged design - Drop tests indicate the Leica Duo-Chek maintains calibration when repeatedly dropped from 36" height
- Manufactured in the United States





Trust Your Engine to the Accuracy of a Leica Duo-Chek

Accuracy is important to be sure the coolant provides adequate freeze-up and boil-over protection. Accurate coolant concentration also means the coolant viscosity and heat transfer properties are correct. The proper coolant/water mix means worry-free, trouble-free cooling system operation and prevents engine damage from cavitation corrosion, a problem which can occur when the coolant/water ratio is too high. Compare the Leica Duo-Chek with a field test hydrometer which meets ASTM standards:

	LEICA Duo-Chek	Hydrometer
Precision	±1°F (ASTM D 3321)	±8°F (ASTM D 1124)
Measures "Environmentally Safe" Propylene Glycol Coolants	Yes	No
Automatically Correct readings for temperature effects	Yes	No
Measure Coolant and Battery Charge level with one instrument	Yes	No

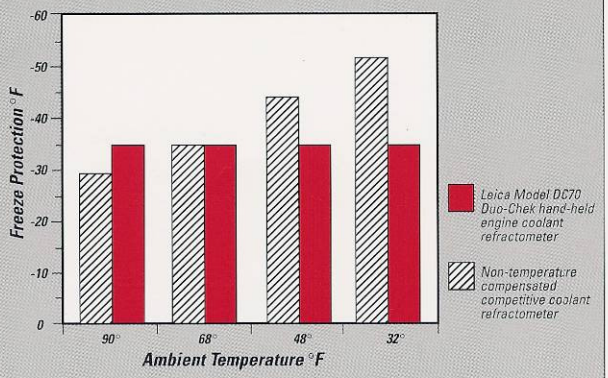
Houghton Chemical Corporation
P.O. Box 307 • 52 CAMBRIDGE STREET
ALLSTON (BOSTON), MA 02134
(617) 254-1010

Leica

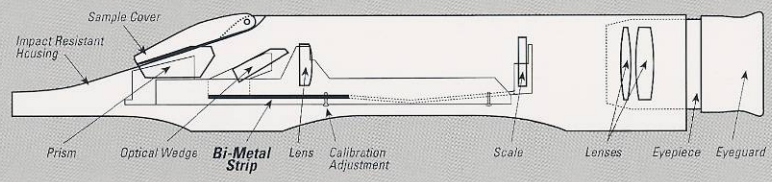
Temperature Compensation Makes the Difference

Automatic temperature compensation makes it unnecessary to measure temperature and apply a correction factor when taking readings. Without temperature compensation or correction readings can be very inaccurate. The chart shows the difference between a temperature compensated instrument and a non-temperature compensated instrument.

Freeze Protection Readings at Various Temperatures
50% Ethylene Glycol based engine coolant

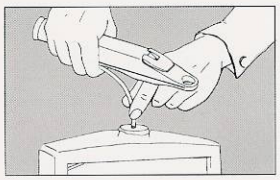


Cutaway view showing DC70/60 optics and temperature compensation mechanism. As temperature changes the bi-metal strip moves, changing the position of the optical wedge. This automatically applies the temperature compensation.

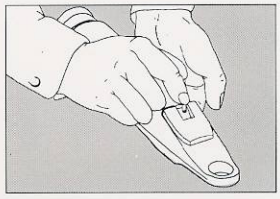


Easy Rapid Technique

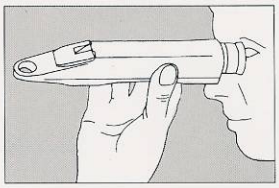
Use LEICA Duo-Chek to take engine coolant or battery charge readings in 3 easy steps.



1. Take sample.



2. Place a few drops of sample on the measuring prism and close the cover.



3. Hold up to a light and read the scale.

Technical Specifications

Leica Duo-Chek is available in two models to measure freeze point protection: Model DC70 measures degrees Fahrenheit and Model DC60 measures degrees Centigrade.

	Model DC70	***Model DC60***
Catalog No.	7584L	7564L
Specific Gravity	1.100 - 1.400	1.100 - 1.400
Scale Division	0.01	0.01
AntiFreeze Protection		
Ethylene Glycol	+32° to -60°F	0°C to -48°C
Propylene Glycol	+32° to -60°F	0°C to -48°C
Scale Division	5°F	3°C
Coolant Concentration Scale		
Ethylene Glycol	0 - 70%	0 - 70%
Propylene Glycol	0 - 63%	0 - 61%
Refractive Index Range	1.3330 - 1.4048	1.3330 - 1.4048
Temperature Compensation Range	0° to 95°F	-18° to 35°C
Calibration Liquid	Distilled Water	Distilled Water
Accuracy	±1.0°F	±0.55°C
Application	Check engine coolant and battery condition	Check engine coolant and battery condition

Based on ease-of-use, accuracy, and the ability to measure environmentally safe coolants the LEICA Duo-Chek is the instrument of choice.

[1] *1992 Annual Book of ASTM Standards. Volume 15.05 Engine Coolants; Halogenated Organic Solvents; Industrial Chemicals. Published as Practice D 3321, "Standard Practice for Use of the Refractometer for Field Test Determination of the Freezing Point of Aqueous Engine Coolants." (Philadelphia, PA: American Society for Testing and Materials, 1992), Section 9.1, 21, 107-109.*

Due to a policy of continuous development, we reserve the right to change specifications without notice.

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