Ethylene Glycol

Product Guide

MEGlobal

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INTRODUCTION

Precautions

Carefully review our current Material Safety Data Sheets. Ethylene glycol can be toxic if ingested. To prevent accidental poisonings in humans and animals, please ensure proper storage and disposal of materials containing ethylene glycol.

About MEGlobal

MEGlobal™ is a world leader in the manufacture and marketing of merchant monoethylene glycol (MEG) and diethylene glycol (DEG), collectively known as EG. Established in July 2004, the company is a joint venture between The Dow Chemical Company and Petrochemical Industries Company of Kuwait and is headquartered in Dubai, United Arab Emirates. MEGlobal produces about 1.0 million metric tons per year of EG, and markets in excess of 2.7 million metric tons of EG per year. With approximately 200 employees worldwide, MEGlobal serves customers around the world.

MEGlobal is committed to being the preferred and low-cost supplier of MEG and DEG for customers worldwide.

Doing Business With Us

In addition to our corporate offices in Dubai, United Arab Emirates, and our production facilities, we operate commercial service locations in Hong Kong, Switzerland and the United States. Our knowledgeable, local professionals are native to the regions they work in, so they speak your language, know your culture, and understand your needs.

World-class technical service and support are available through our highly trained sales representatives.

Service

For solutions to problems or answers to questions, take advantage of MEGlobal technical service and support, available through trained sales representatives. Your order of ethylene glycol will be processed expertly and quickly when you place a call to one of our many helpful customer service representatives (See page 33).

Products and Applications

MEGlobal's advanced manufacturing process is based on more than 70 years of experience, and is characterized by seamless integration, catalyst efficiency, and local access to feedstock. With our total approach to continuous improvement in quality and quality systems, we fully meet the stringent ISO 9001 series of standards, allowing us to deliver the high-quality products you require.

Optimum performance demands a quality product, and that is what we deliver. Our vast distribution system of plants, terminals, tankers, barges, tankcars and trucks helps to ensure delivery of ethylene glycol and diethylene glycol when and where you need it.

Our MEG can be used for applications that require chemical intermediates for resins, solvent couplers, freezing point depression, solvents, humectants and chemical intermediates. These applications are vital to the manufacture of a wide range of products, including resins; deicing fluids; heat transfer fluids; automotive antifreeze and coolants; water-based adhesives, latex paints and asphalt emulsions; electrolytic capacitors; textile fibers; paper and leather.

The characteristics of our DEG products supplement our MEG portfolio, augmenting our capabilities to include applications that require hygroscopicity, lubricants and low volatility. Products that capitalize on these and other DEG properties include plasticizers; glass- and cement-grinding aids; printing ink; drywall joint compound; thermoplastic polyurethanes and emulsifiers.

For more information on our DEG products, please refer to our MEGlobal Diethylene Glycol Product Guide.

Ethylene Glycol – The Versatile Performer

Ethylene Glycol:

$HOCH_2CH_2OH$

CAS Registry Number:

107-21-1

Synonyms:

1, 2-Ethanediol

Glycol

EG

Monoethylene glycol

Ethylene glycol is a colorless, practically odorless, low-volatility, low-viscosity, hygroscopic liquid. It is completely miscible with water and many organic liquids.

The hydroxyl groups on glycols undergo the usual alcohol chemistry, giving a wide variety of possible derivatives. Hydroxyls can be converted to aldehydes, alkyl halides, amines, azides, carboxylic acids, ethers, mercaptans, nitrate esters, nitriles, nitrite esters, organic esters, peroxides, phosphate esters and sulfate esters. This chemistry permits ethylene glycol to act as an intermediate in a wide range of reactions. Especially significant is resin formation, including the condensation with dimethyl terephthalate or terephthalic acid resulting in a polyester resin.

The reactivity and solubility of ethylene glycol provide the basis for many applications. The widespread use of ethylene glycol as an antifreeze is based on its ability to lower the freezing point when mixed with water. The physical properties of ethylene glycol-water mixtures are therefore extremely important. The end uses for ethylene glycol are numerous (See Table 1).

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Table 1: Applications

Properties/Characteristics	Applications/Uses
Chemical Intermediate for Resins	• Polyester resins (fibers, containers and films) • Resin esters as plasticizers (adhesives, lacquers and enamels) • Alkyd-type resins (synthetic rubbers, adhesives, surface coatings)
Solvent Coupler	• Stabilizer against gel formation
Freezing Point Depression	• Deicing fluids (aircraft, runway) • Heat transfer fluids (gas compressors, heating, ventilating, air conditioning, process chillers, ice rinks) • All-weather automotive antifreeze and coolants • Water-based formulations (adhesives, latex paints, asphalt emulsions)
Solvent	• Medium for suspending conductive salt in electrolytic capacitors
Humectant	• Textile fibers • Paper • Leather • Adhesives • Glue
Chemical Intermediate	• Solvents

Responsible Care

MEGlobal embraces and advocates Responsible Care®, a voluntary industry-wide commitment to safely handle our chemicals from inception in the laboratory to ultimate disposal. We take this commitment very seriously since it focuses on continuous improvement in not only employee health and safety, but also a cleaner environment for our employees, customers and the public.

Additionally, our environmental, health and safety policies require, as a minimum, full compliance with all applicable laws and regulations.

Our employees are held to a rigid set of health and safety requirements. They are expected to commit to our Employee Health and Safety policy (EH&S) as MEGlobal's number-one priority; to work to achieve zero personal-safety incidents and leak-free facilities; and to proactively identify and resolve EH&S issues. This kind of serious accountability helps us ensure the highest possible level of EH&S throughout the company.

MEGlobal products are easy to store and handle. Of course, we provide current Material Safety Data Sheets that contain complete safety information for all of our products, but we also supply vital health, safety and environmental information through presentations, literature and access to a wide variety of other reference materials and information resources to give our customers the comprehensive knowledge they need to concentrate on process safety, emergency response and other areas vital to their health and safety and to the environment.

Our Product Stewardship philosophy gives us a means to assess information on the potential health and environmental impacts of our products, helping us to take whatever steps are necessary to protect our employees, customers, the public and the environment.

Non-Supported Applications of MEGlobal Ethylene Glycol Products (MEG, DEG)

The following list identifies end-use applications that are NOT supported by MEGlobal for ethylene glycol products, monoethylene glycol (MEG) and diethylene glycol (DEG) marketed by MEGlobal ("MEGlobal Ethylene Glycol Products"). These limitations include applications in which the use of MEGlobal Ethylene Glycol Products is restricted by law, applications in which the use of MEGlobal Ethylene Glycol Products may raise unacceptable risks, and other applications which MEGlobal has decided not to pursue for business reasons, including minimizing unnecessary risk and liabilities to the company. MEGlobal does not knowingly market MEGlobal Ethylene Glycol Products into these non-supported applications, requests its distributors to refuse sales of MEGlobal Ethylene Glycol Products into these non-supported applications, and alerts its customers about the special risks associated with some of these non-supported applications. The following list of applications not supported by MEGlobal does not imply any MEGlobal warranty or MEGlobal support of uses in applications not covered by this list. This list is not all-inclusive, and MEGlobal reserves the right to modify the same at any time.

- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) in the production of tobacco and in the manufacture of tobacco products (including but not limited to additives, humectants, filters, inks, and paper) is not supported by MEGlobal.
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) for the generation of artificial smoke/theatrical fogs/mist is not supported by MEGlobal. This includes applications such as artificial / e-cigarettes.
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) as ingredient in fuel for warming foods (Sterno™-like application) or in fuel for heating an enclosed space where human exposure is possible is not supported by MEGlobal.
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) in fire extinguishing sprinkler systems is not supported by MEGlobal.
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) in the manufacture of munitions is not supported by MEGlobal.
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) in the production of deicers for use on roadways, sidewalks and in aircraft lavatories is not supported by MEGlobal.
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) as a component of heat transfer fluids in systems where the heat transfer fluids could infiltrate (i.e., via an exchanger leak, backflow prevention failure, or other means) a potable water system is not supported by MEGlobal.
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) as a non-reacted component in a formulation for direct internal or external human /animal contact, including but not limited to ingestion, inhalation, and skin contact and in medical / veterinary devices and medical / veterinary applications is not supported by MEGlobal. (Examples of some such applications are uses as a direct component in foods, beverages, pharmaceuticals, cosmetics, or personal care products).
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) for deodorizing or air "purifying" purposes by spraying as an aerosol is not supported by MEGlobal.
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) as a non-reacted component in adhesives, plasticizers, and softening agents for food packaging that has direct contact with food is not supported by MEGlobal.
- The use of MEGlobal Ethylene Glycol Products (MEG, DEG) as a non-reacted component in the formulation of glues, pastes or other items where the potential for significant human contact and/or ingestion exists (including but not limited to children's school glue/paste or arts/craft glue/paste) is not supported by MEGlobal.

To enter into new applications beyond the traditional standard industrial use applications supported by MEGlobal, contact your MEGlobal representative to review the specific application. MEGlobal has a risk assessment process whereby the application will be reviewed and a determination will be made as to whether the application meets MEGlobal's requirements and can therefore be supported by MEGlobal. Because use conditions and applicable laws may differ from one location to another and may change with time, when an application is supported by MEGlobal, MEGlobal does not warrant and is not responsible for the use in such applications.

NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ALL OTHER EXPRESS OR IMPLIED REPRESENTATIONS AND WARRANTIES PROVIDED BY STATUTE OR COMMON LAW ARE EXPRESSLY EXCLUDED.

Further, any violation of or failure to comply with the information contained in MEGlobal's Material Safety Data Sheet, Product Label, Product Information Guide, product literature or other product safety information is a misuse of MEGlobal Ethylene Glycol Products. These documents can be obtained by contacting your MEGlobal representative or MEGlobal's Customer Information Group.

MEGlobal can not specify all circumstances in which MEGlobal Ethylene Glycol Products may be used in applications not supported by MEGlobal. Accordingly, you are strongly encouraged to immediately contact the MEGlobal Customer Information Group if you become aware that MEGlobal Ethylene Glycol Products may be or have been used in any such non-supported application.

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Table 2: Physical Properties of Ethylene Glycol

	Scientific	Common
Autoignition Temperature	427°C	801°F
Critical Pressure	8,200 kPa	61,505 mm Hg
Critical Specific Volume	0.191 L/gmol	3.06 ft^3/lbmol
Critical Temperature	446.85°C	836.33°F
Dielectric Constant at 25°C	37.7	37.7
Electrical Conductivity at 20°C	1.07 x 10^{-6} mhos/cm	1.07 micromhos/cm
Evaporation Rate (Butyl Acetate = 1)	0.01	0.01
Flash Point, Closed Cup (Pensky-Martens Closed Cup ASTM D93)	126.7°C	260°F
Flash Point, Open Cup (Cleveland Open Cup ASTM D92)	137.8°C	280°F
Heat of Combustion at 25°C	-1,053 kJ/gmol	-7,297 Btu/lb
Heat of Formation at 25°C	-460 kJ/gmol	-3,188 Btu/lb
Heat of Fusion	9.96 kJ/gmol	69 Btu/lb
Heat of Vaporization at 1 atm	53.2 kJ/gmol	369 Btu/lb
Molecular Weight	62.07 g/mol	62.07 g/mol
Normal Boiling Point	197.1°C	386.8°F
BP/ P (750 to 770 mm Hg)	0.337°C/kPa	0.045°C/mm Hg
Normal Freezing Point	-13°C	8.6°F
Onset of Initial Decomposition	240°C	464°F
Refractive Index, n_D, at 25°C	1.4306	1.4306
Solubility in Water at 20°C	100 wt%	100 wt%
Solubility of Water in Ethylene Glycol at 20°C	100 wt%	100 wt%
Specific Gravity (20/20°C)	1.1153	1.1153
Specific Gravity/ T(10 to 40°C)	0.00070 per °C	0.00039 per °F
Surface Tension at 25°C	48.0 mN/m	48.0 dynes/cm
Vapor Density (air = 1)	2.1	2.1
Vapor Pressure at 20°C	0.0075 kPa	0.06 mm Hg

Table 3: Solubilities of Various Materials in Ethylene Glycol

Solubility, g/100 mL of Ethylene Glycol at 25°C

Acetone	Completely Soluble	Lard Oil	Insoluble
Animal Glue (Dry)	Slightly Soluble	Linseed Oil	Insoluble
Benzene	6.0	Methanol	Completely Soluble
Carbon Tetrachloride	6.6	Methyl Orange	1.8
Castor Oil	Insoluble	Monoethanolamine	Completely Soluble
Cellulose Acetate	Insoluble	Nitrocellulose	Insoluble
Chlorobenzene	6.0	Olive Oil	Insoluble
Coconut Oil	Insoluble	o-Dichlorobenzene	4.7
Cottonseed Oil	Insoluble	Paraffin Oil	Insoluble
Dextrin (10% water)	Soluble	Phenol	Completely Soluble
Dextrin	Slightly Soluble	Pine Oil	Completely Soluble
Dibutyl Phthalate	0.5	Rosin	Slightly Soluble
Dichloroethyl Ether	11.8	Shellac	Slightly Soluble
Diethanolamine	Completely Soluble	Soya Bean Oil	Slightly Soluble
Ethyl Ether	8.9	Sperm Oil	Slightly Soluble
Ethylene Glycol Distearate	Slightly Soluble	Tall Oil	1.1
Gum Damar	Slightly Soluble	Toluene	3.1
Heptane	Slightly Soluble	Tung Oil	Insoluble
Hydrous Wool Fat	Slightly Soluble	Turkey Red Oil	3.3
Kauri Gum	Slightly Soluble	Urea	44.0

Table 4: Ethylene Glycol Compatibility with Elastomeric Materials

	Temperature		
Material	**25°C (77°F)**	**80°C (176°F)**	**160°C (320°F)**
Adiprene™ L-100	Good	Poor	Poor
Black Rubber 3773	Good	Poor	Poor
Buna N (or Buna 25)	Good	Good	
Buna S	Good	Poor	Poor
Butyl Rubber	Good	Good	
Compressed Asbestos	Good	Good	Fair
EPDM	Good	Good	Good
EPR Rubber	Good	Good	Good
Hycar™ D-24	Good	Poor	
Hypalon™	Good	Poor	Poor
Kalrez™	Good	Good	Good
Natural Rubber Gum	Good	Poor	Poor
Neoprene 7797	Good	Poor	
Red Rubber Number 107	Good	Poor	Poor
Saraloy™ 300	Good	Poor	Poor
Silicone No. 65	Good	Good	
Thiokol™ 3060	Fair	Poor	Poor
Viton™ A	Good	Good	Poor

Table 5: Constant Boiling Mixtures

Components	Specific Gravity at 20/20°C	Boiling Point at 760 mm Hg, °C	Azeotrope: Boiling Point at 760 mm Hg, °C	Composition, % by Wt at 20°C: In Azeotrope	In Upper Layer	In Lower Layer	Relative Volume of Layers at 20°C, %	Specific Gravity at 20/20°C of Azeotrope or Layers
Ethylene Glycol Butyl CARBITOL™ Solvent	1.1153 0.9556	197.1 231.0	196.2	72.5 27.5				1.074
Ethyl Glycol Butyl Ether	1.1153 0.7697	197.1 141.0	139.5	6.4 93.6	2.0 98.0	99.0 1.0	U 95.0 L 5.0	U 0.777 L 1.114
Ethylene Glycol (50 mm Hg) 2-Chloroethyl Ether	1.1153 1.2215	123.6[a] 96.05[a]	92.7[a]				U 9.9 L 90.1	
Ethylene Glycol Diethyl CARBITOL™ Solvent	1.1153 0.9098	197.1 189.0	178.0	26.1 73.9				0.959
Ethylene Glycol (100 mm Hg) Diisopropylethanolamine	1.1153 0.8760	139.5[a] 127.5[a]	121.0[a]	18.0 82.0				0.918
Ethylene Glycol (50 mm Hg) Diisopropylethanolamine	1.1153 0.8760	123.6[a] 110.6[a]	104.0[a]	15.0 85.0				0.908
Ethylene Glycol (10 mm Hg) Diisopropylethanolamine	1.1153 0.8760	91.3[a] 77.8[a]	74.0[a]	10.0 90.0				0.894
Ethylene Glycol CARBITOL™ Solvent	1.1153 0.9970	197.1 201.6	192.0	45.5 54.5				1.050
Ethylene Glycol (100 mm Hg) CARBITOL™ Solvent	1.1153 0.99007	139.5[a] 137.3[a]	134.0[a]	33.0 67.0				1.0305
Ethylene Glycol (50 mm Hg) Hexyl Ether	1.1153 0.7937	123.6[a] 140.0[a]	112.8[a]	35.6 64.4	0.1 99.9	99.9 0.1	U 71.8 L 28.2	U 0.795 L 1.115
Ethylene Glycol Methyl CARBITOL™ Solvent	1.1153 1.0247	197.1 193.6	192.0	30.0 70.0				1.051
Ethylene Glycol (200 mm Hg) Methyl CARBITOL™ Solvent	1.1153 1.0247	157.1[a] 150.3[a]	149.0[a]	12.0 88.0				1.033
Ethylene Glycol (50 mm Hg) Methyl CARBITOL™ Solvent	1.1153 1.0247	123.6[a] 114.4[a]	114.0[a]	4.0 96.0				1.025
Ethylene Glycol Phenyl Ether	1.1153 1.0658[b]	197.1 258.3	192.3	64.5 35.5	0.22 99.78	98.28 1.72	U 35.3[c] L 64.7[c]	U 1.068[b] L 1.108[b]
Ethylene Glycol (50 mm Hg) Phenyl Ether	1.1153 1.0658[b]	123.6[a] 158.0[a]	120.4[a]	62.3 37.7	0.2 99.8	98.5 1.5	U 37.6 L 62.4	U 1.076 L 1.114
Ethylene Glycol Toluene	1.1153 0.8700	197.1 110.6	110.1	2.3 97.7	0.1 99.9	97.0 3.0	U 98.2 L 1.8	U 0.866 L 1.110
Ethylene Glycol o-Xylene	1.1153 0.8814	197.1 144.4	135.7	6.9 93.1	0.08 99.92	98.3 1.7	U 94.5 L 5.5	U 0.865 L 1.113

(a) At the pressure investigated;

(b) At 30/20°C;

(c) At 30°C.

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Table 6: Volume Percent vs. Weight Percent of Aqueous Ethylene Glycol Solutions at 68°F (20°C)

Glycol, % by									
Wt	**Vol**	**Wt**	**Vol**	**Wt**	**Vol**	**Wt**	**Vol**	**Wt**	**Vol**
1	0.90	21	19.25	41	38.39	61	58.37	81	79.26
2	1.80	22	20.18	42	39.37	62	59.40	82	80.33
3	2.70	23	21.12	43	40.35	63	60.42	83	81.40
4	3.60	24	22.07	44	41.33	64	61.45	84	82.48
5	4.51	25	23.01	45	42.32	65	62.48	85	83.55
6	5.41	26	23.96	46	43.30	66	63.51	86	84.63
7	6.32	27	24.90	47	44.29	67	64.54	87	85.71
8	7.23	28	25.85	48	45.28	68	65.58	88	86.80
9	8.15	29	26.80	49	46.28	69	66.62	89	87.88
10	9.06	30	27.76	50	47.27	70	67.66	90	88.97
11	9.98	31	28.71	51	48.27	71	68.70	91	90.07
12	10.89	32	29.67	52	49.27	72	69.75	92	91.16
13	11.81	33	30.63	53	50.27	73	70.80	93	92.26
14	12.74	34	31.59	54	51.28	74	71.85	94	93.35
15	13.66	35	32.56	55	52.29	75	72.90	95	94.46
16	14.59	36	33.53	56	53.30	76	73.95	96	95.56
17	15.51	37	34.49	57	54.31	77	75.01	97	96.67
18	16.44	38	35.46	58	55.32	78	76.07	98	97.77
19	17.38	39	36.44	59	56.34	79	77.13	99	98.89
20	18.31	40	37.41	60	57.35	80	78.20	100	100.00

Please note that the above calculations were performed assuming that water + ethylene glycol form an ideal mixture:
$V^M = V_1 + X_2V_2$, where V = molar volume.

Figure 1: Conversion Chart of Aqueous Solutions of Ethylene Glycol at 68°F (20°C)

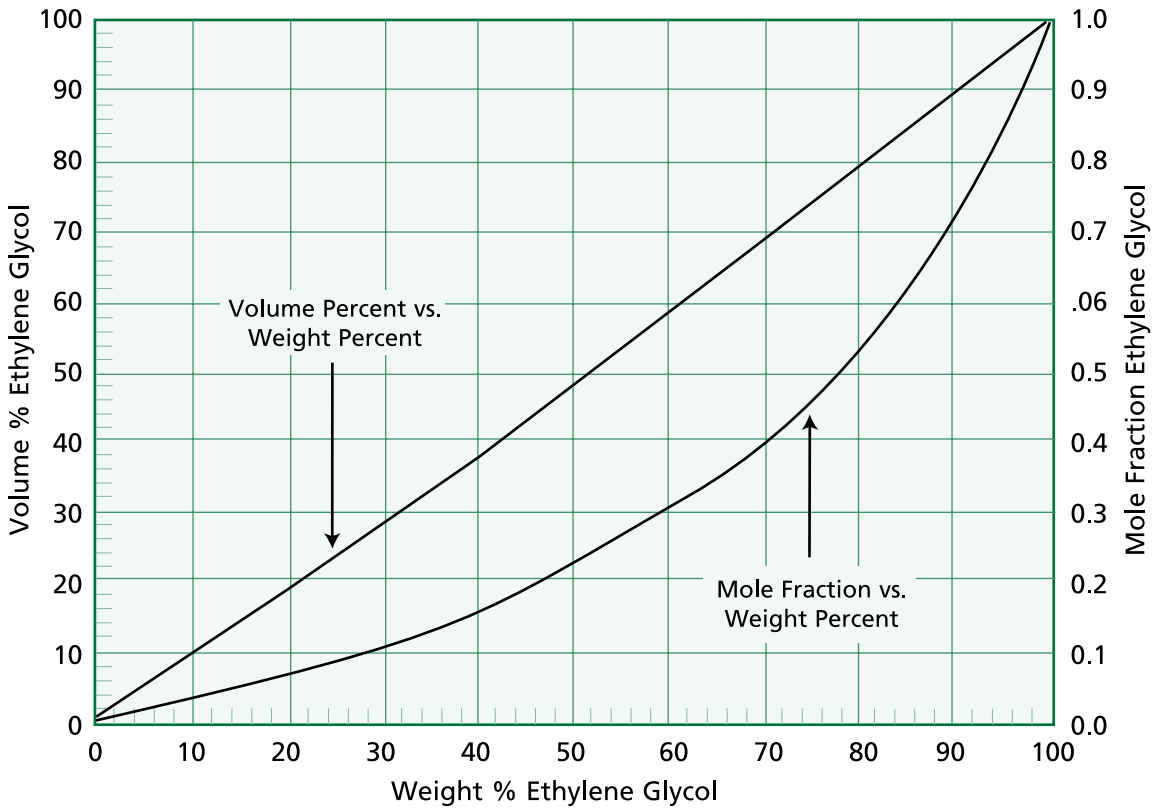
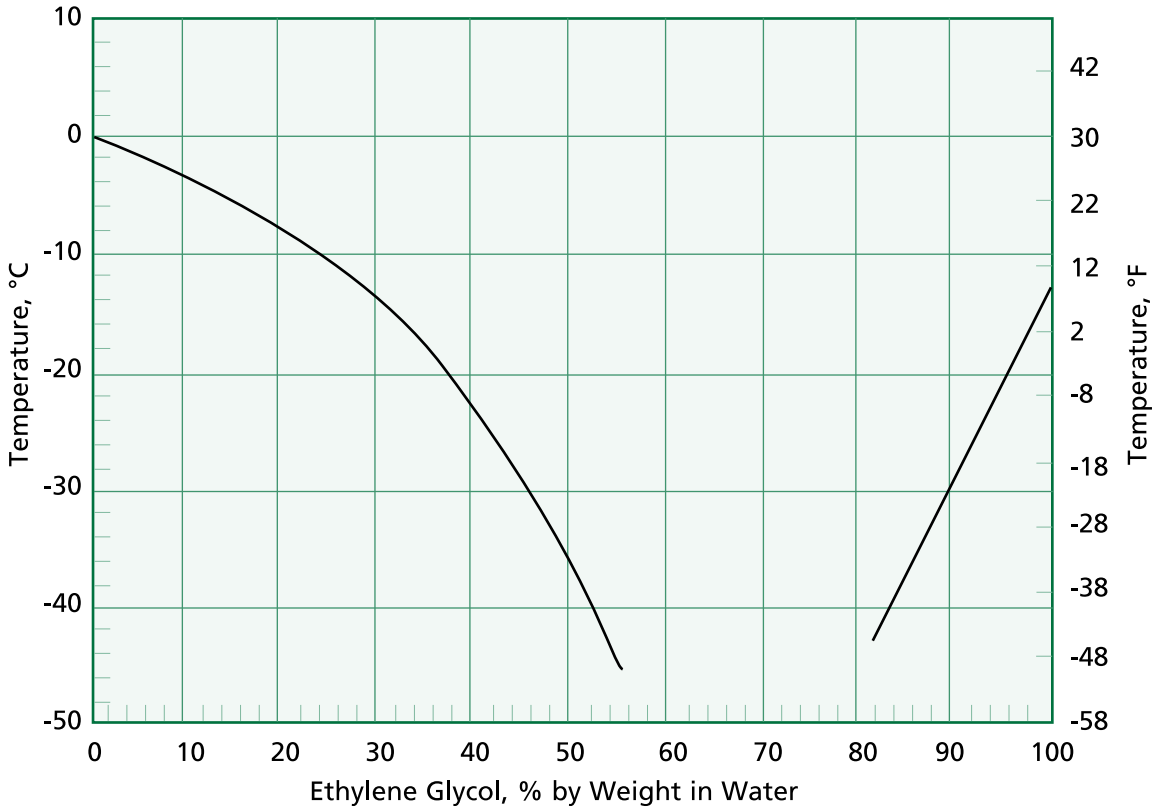
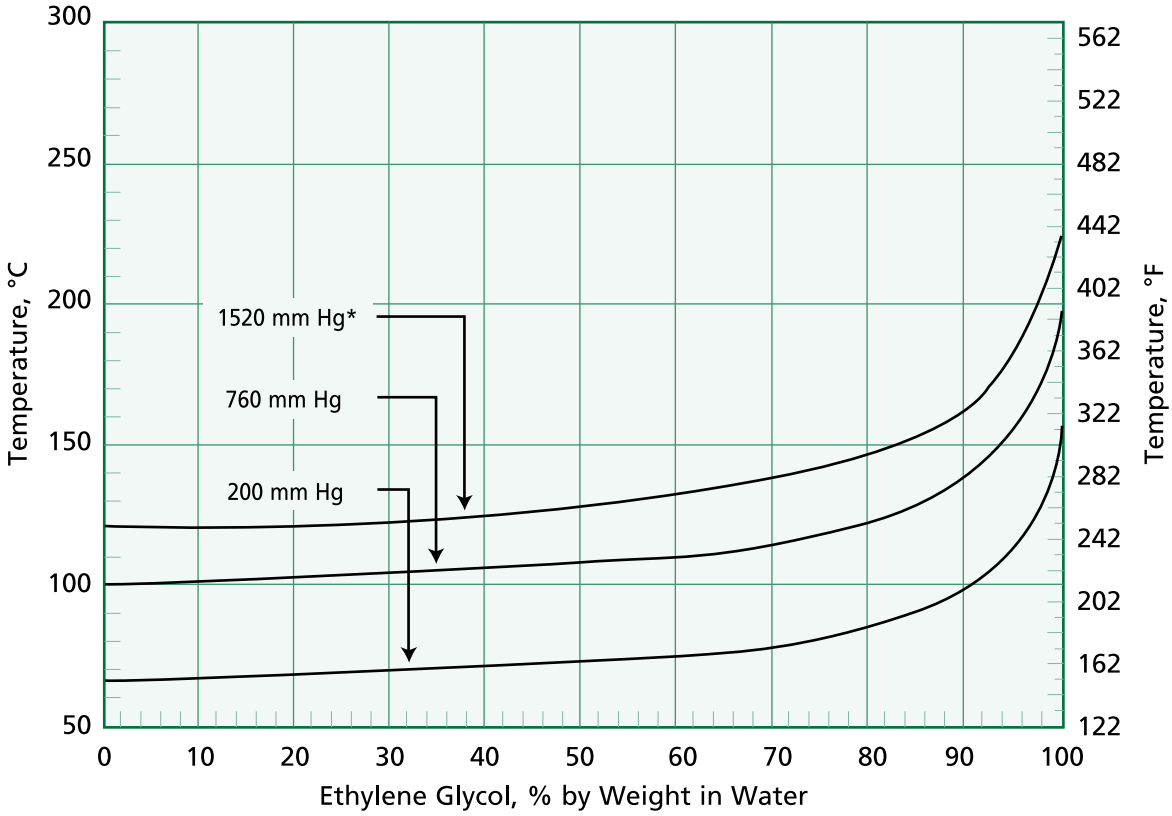


Figure 2: Freezing Points of Aqueous Ethylene Glycol Solutions



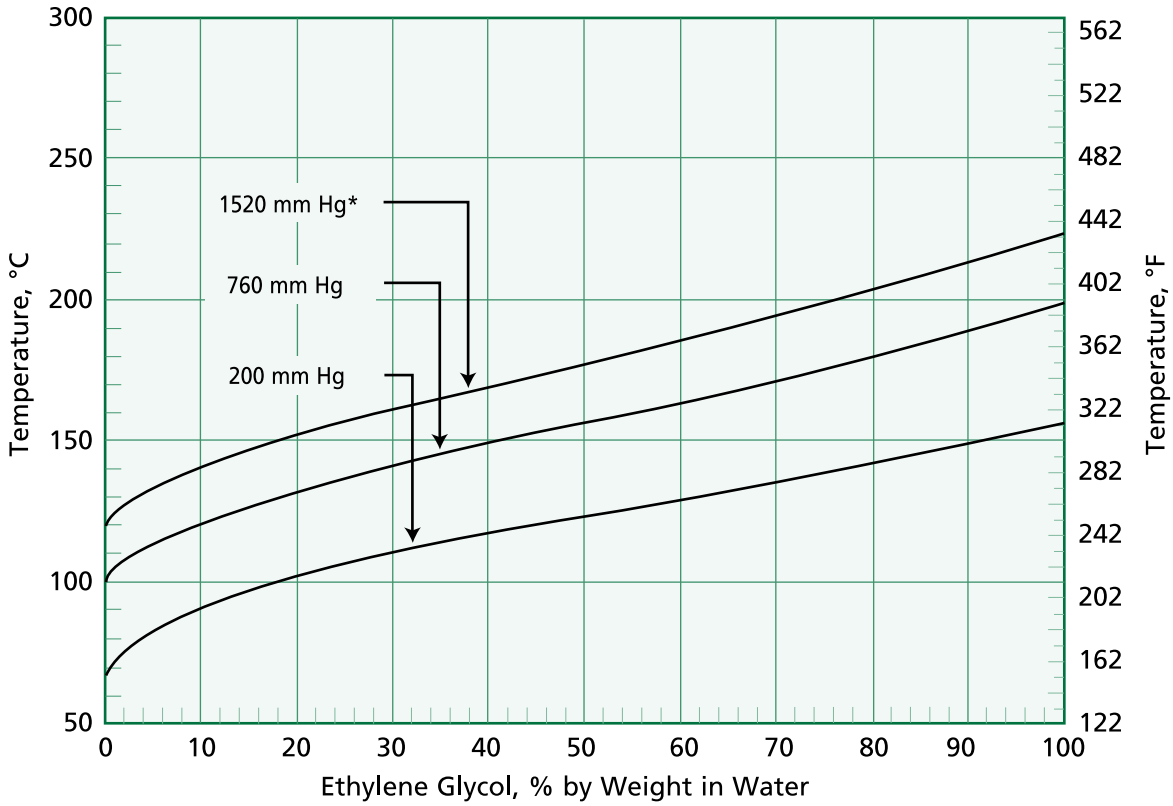
Further information on the freezing points of ethylene glycol-water mixtures can be found in an article by D.R. Cordray, L.R. Kaplan, P.M. Woyciesjes and T.F. Kozak entitled, "Solid-Liquid Phase Diagram for Ethylene Glycol + Water," published in *Fluid Phase Equilibria* 117, pp. 146-152 (1996).

Figure 3: Boiling Points vs. Composition of Aqueous Ethylene Glycol Solutions at Various Pressures



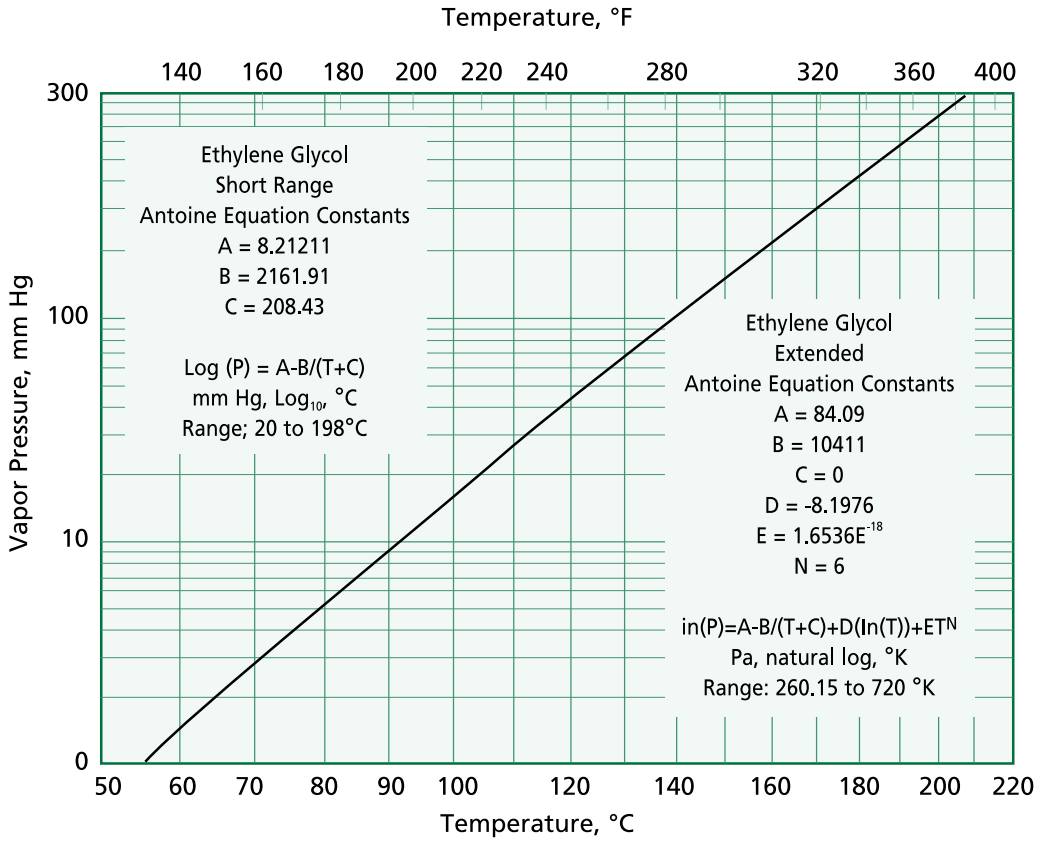
* 2 atmospheres absolute; 1 atmosphere gauge

Figure 4: Condensation Temperatures vs. Composition of Aqueous Ethylene Glycol Solutions at Various Pressures



* 2 atmospheres absolute; 1 atmosphere gauge

Figure 5: Vapor Pressure of Ethylene Glycol at Various Temperatures



* 2 atmospheres absolute; 1 atmosphere gauge

Ethylene Glycol Antoine Constants for Calculating Vapor Pressure

3–Constant Equation

A = 8.21211
B = 2161.91
C = 208.43
Log_{10} (P) = A – B/(T + C)

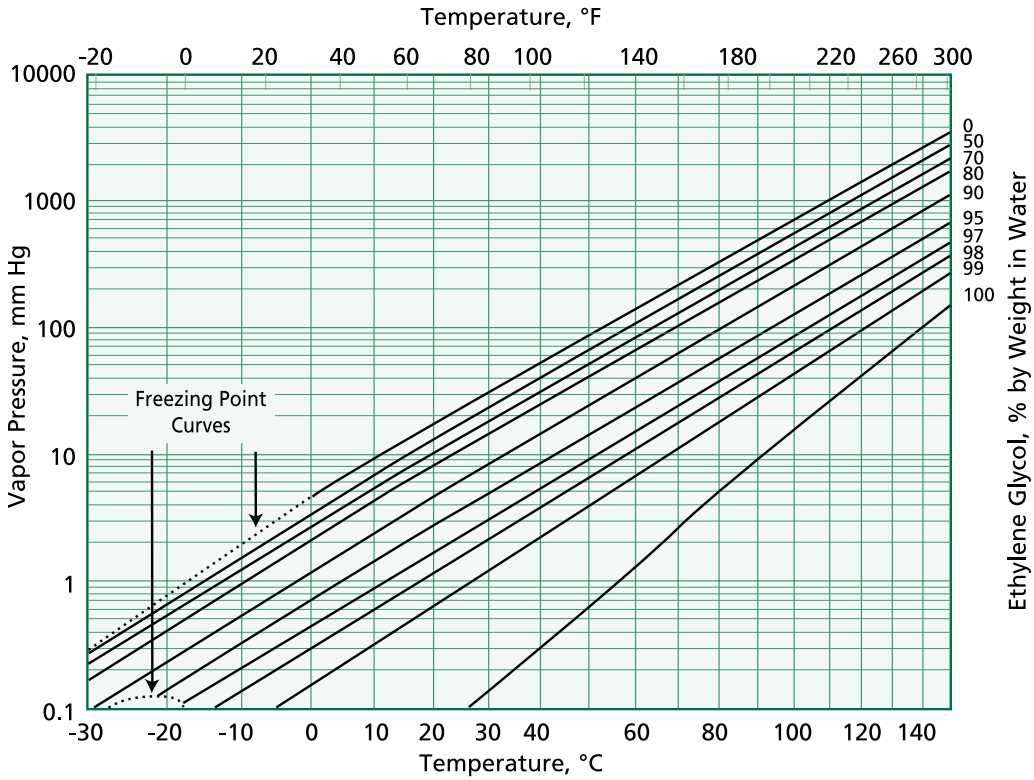
Range = 20 to 198°C
P = mm Hg
T = °C

5–Constant Equation

A = 84.09
B = 10411
C = 0.0
D = -8.1976
E = 1.6536 x 10^{-18}
N = 6
In (P) = A – B/(T + C) + D (In (T)) + ET^N

Range = 260.15 to 720°K
P = Pa
T = Kelvin

Figure 6: Vapor Pressures of Aqueous Ethylene Glycol Solutions at Various Temperatures



Ethylene Glycol Antoine Constants for Calculating Vapor Pressure

3-Constant Equation

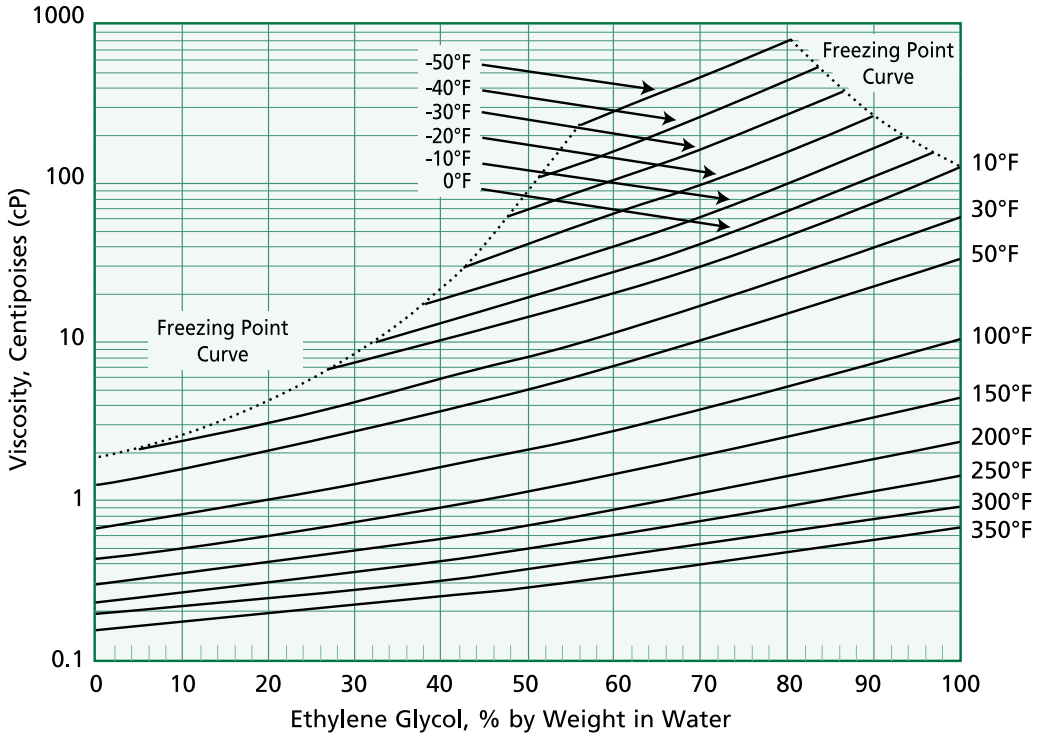
Log_{10} (P) = A – B/(T + C)

P = mm Hg

T = °C

EG, Wt%	A	B	C
0	7.966820	1668.210	228.000
50	7.901886	1691.452	229.778
70	7.833380	1712.369	231.166
80	7.775839	1736.188	232.689
90	7.685032	1792.464	235.836
95	7.856193	2019.846	251.898
97	8.123192	2273.083	267.910
98	8.384100	2493.364	279.584
99	9.189807	3103.597	309.713
100	8.212109	2161.907	208.429

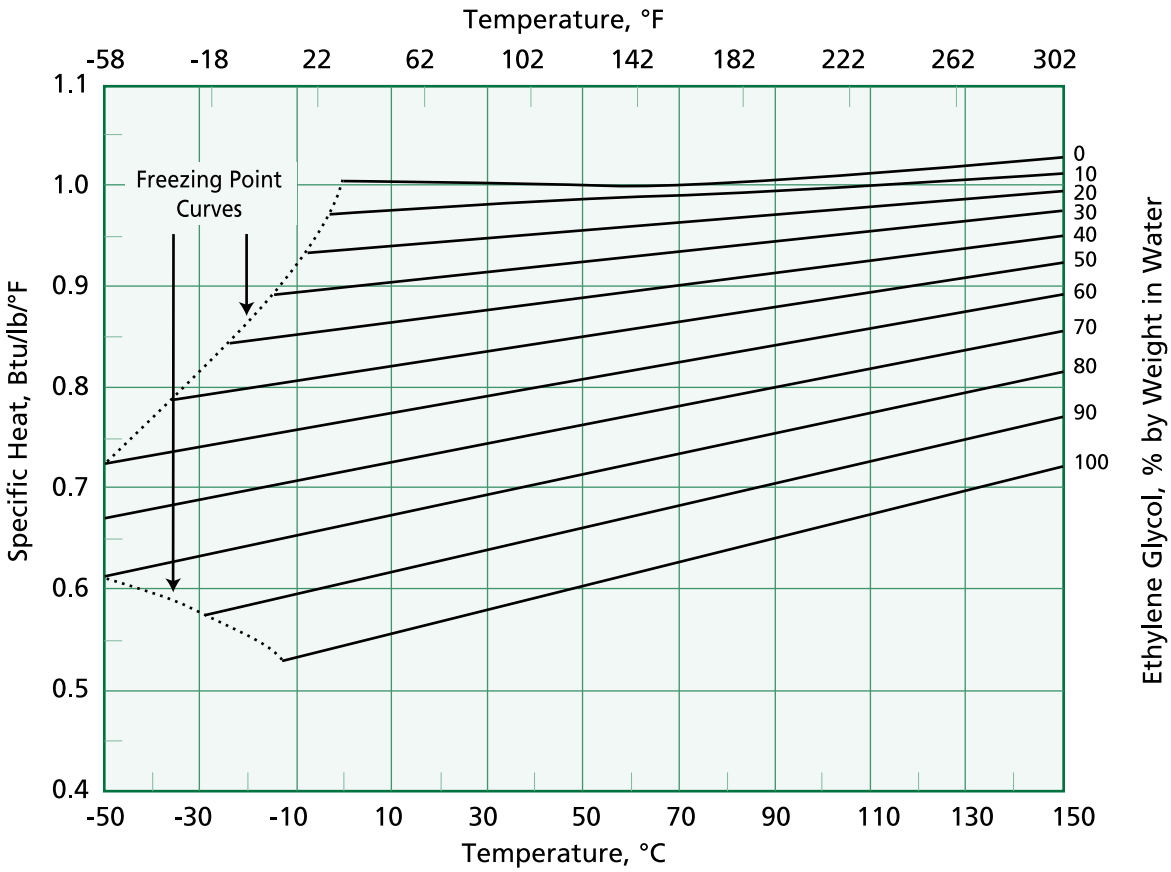
Figure 7: Viscosities of Aqueous Ethylene Glycol Solutions



Log_{10} (Viscosity, cP) = A – B/(x + C)
x = Weight % Ethylene Glycol

T, °F	A	B	C
-50	-0.782928	516.030	-219.294
-40	-1.089569	556.509	-228.728
-30	-1.327771	586.133	-236.676
-20	-1.673072	666.763	-252.223
-10	-2.598652	992.919	-295.499
0	-2.255218	817.542	-279.933
10	-2.789821	1029.329	-310.416
30	-3.770236	1495.186	-368.930
50	-4.489869	1941.309	-422.768
100	-3.968390	1596.092	-420.283
150	-3.619555	1368.620	-420.761
200	-3.552380	1341.596	-442.146
250	-3.695975	1491.089	-487.664
300	-3.789550	1626.778	-532.123
350	-4.411432	2357.689	-655.745

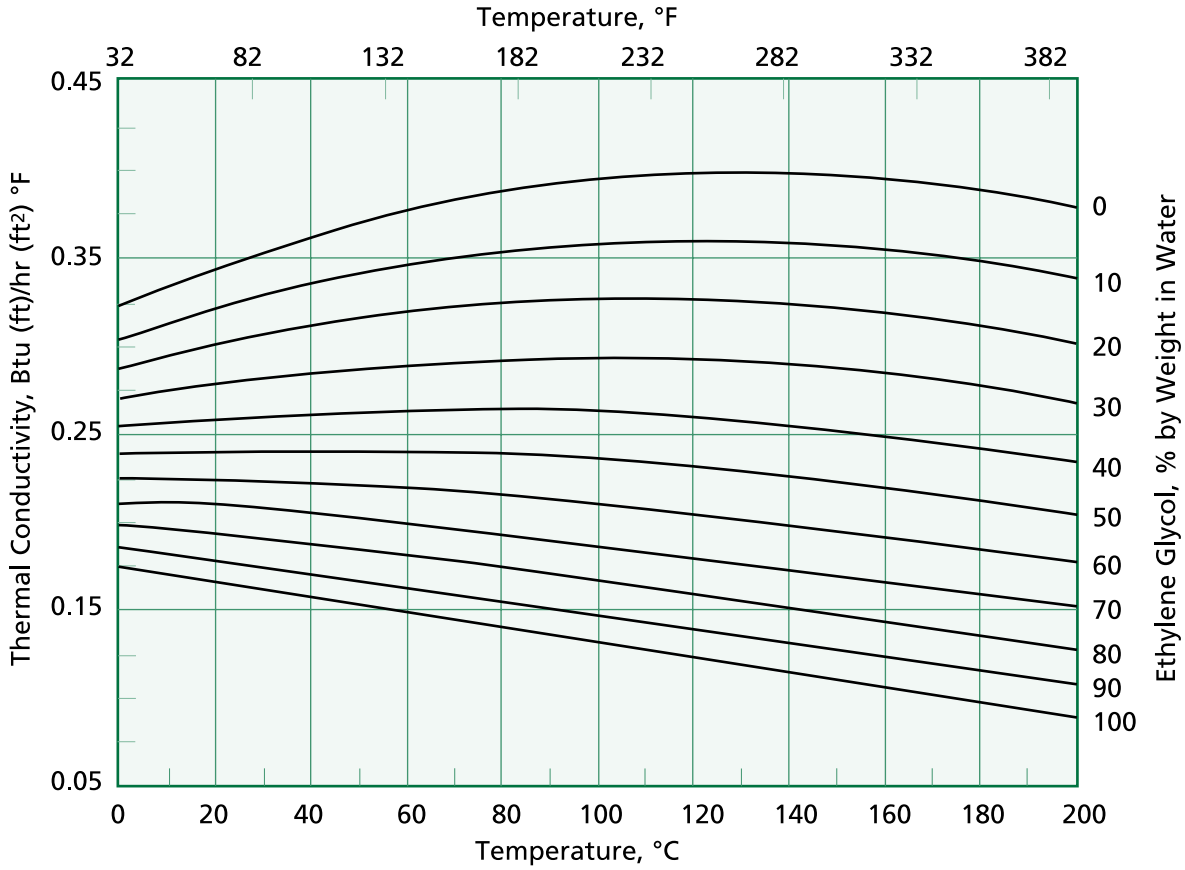
Figure 8: Specific Heats of Aqueous Ethylene Glycol Solutions



Specific Heats = $A + BT + CT^2$
T = Temperature, °C

EG, Wt%	A	B	C
0	1.00380	$-2.2459E^{-4}$	$2.6257E^{-6}$
10	0.97236	$1.8001E^{-4}$	$5.7049E^{-7}$
20	0.93576	$3.9963E^{-4}$	0.0
30	0.89889	$5.1554E^{-4}$	0.0
40	0.85858	$6.2639E^{-4}$	0.0
50	0.81485	$7.3219E^{-4}$	0.0
60	0.76768	$8.3293E^{-4}$	0.0
70	0.71707	$9.2863E^{-4}$	0.0
80	0.66304	$1.0193E^{-3}$	0.0
90	0.60557	$1.1049E^{-3}$	0.0
100	0.54467	$1.1854E^{-3}$	0.0

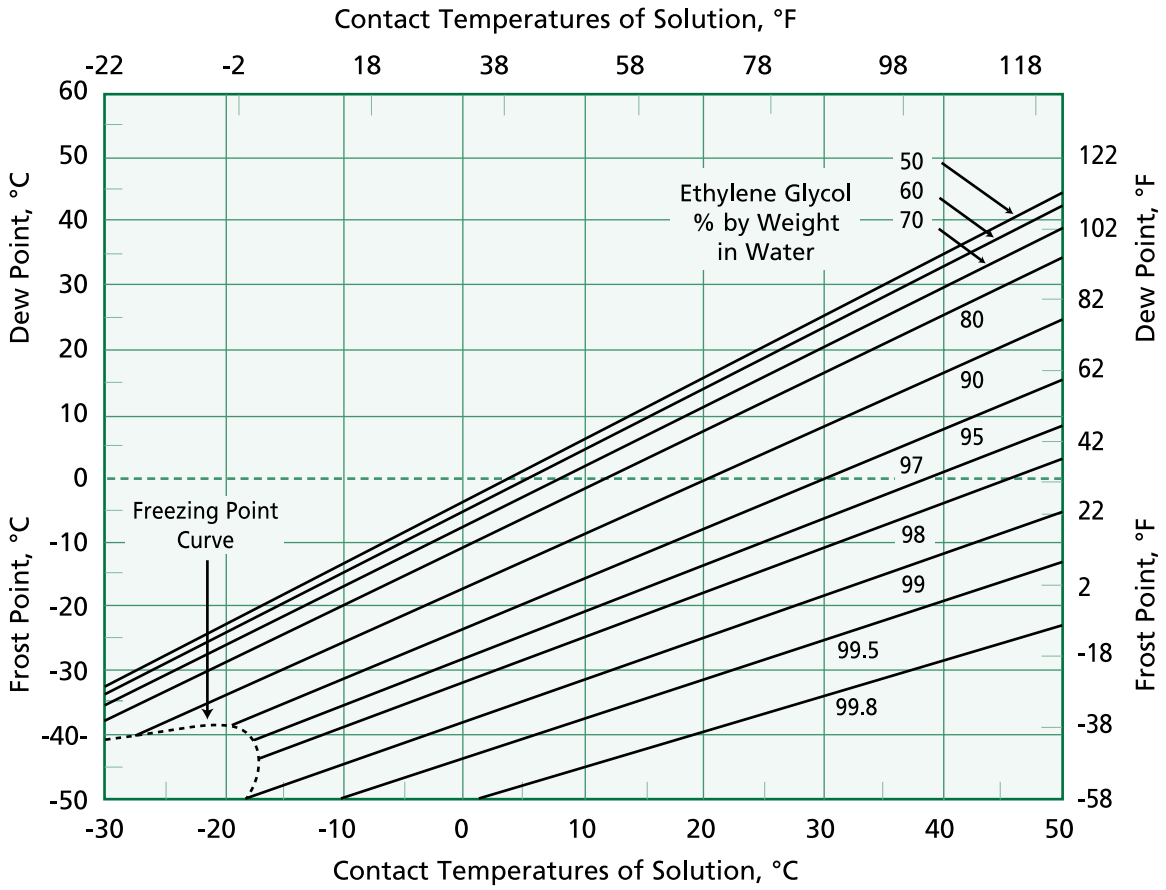
Figure 9: Thermal Conductivities of Aqueous Ethylene Glycol Solutions



Thermal Conductivity = $A + BT + CT^2$
T = Temperature, °C

EG, Wt%	A	B	C
0	0.32247	$1.1524E^{-3}$	$-4.3629E^{-6}$
10	0.30433	$8.9729E^{-4}$	$-3.6114E^{-6}$
20	0.28697	$6.6350E^{-4}$	$-2.9292E^{-6}$
30	0.27038	$4.5096E^{-4}$	$-2.3160E^{-6}$
40	0.25455	$2.5973E^{-4}$	$-1.7722E^{-6}$
50	0.23951	$8.9758E^{-5}$	$-1.3975E^{-6}$
60	0.22523	$-5.8962E^{-5}$	$-8.9196E^{-7}$
70	0.21172	$-1.8633E^{-4}$	$-5.5597E^{-7}$
80	0.19898	$-2.9247E^{-4}$	$-2.8895E^{-7}$
90	0.18701	$-3.7733E^{-4}$	$-9.1152E^{-8}$
100	0.17581	$-4.4092E^{-4}$	$3.7445E^{-8}$

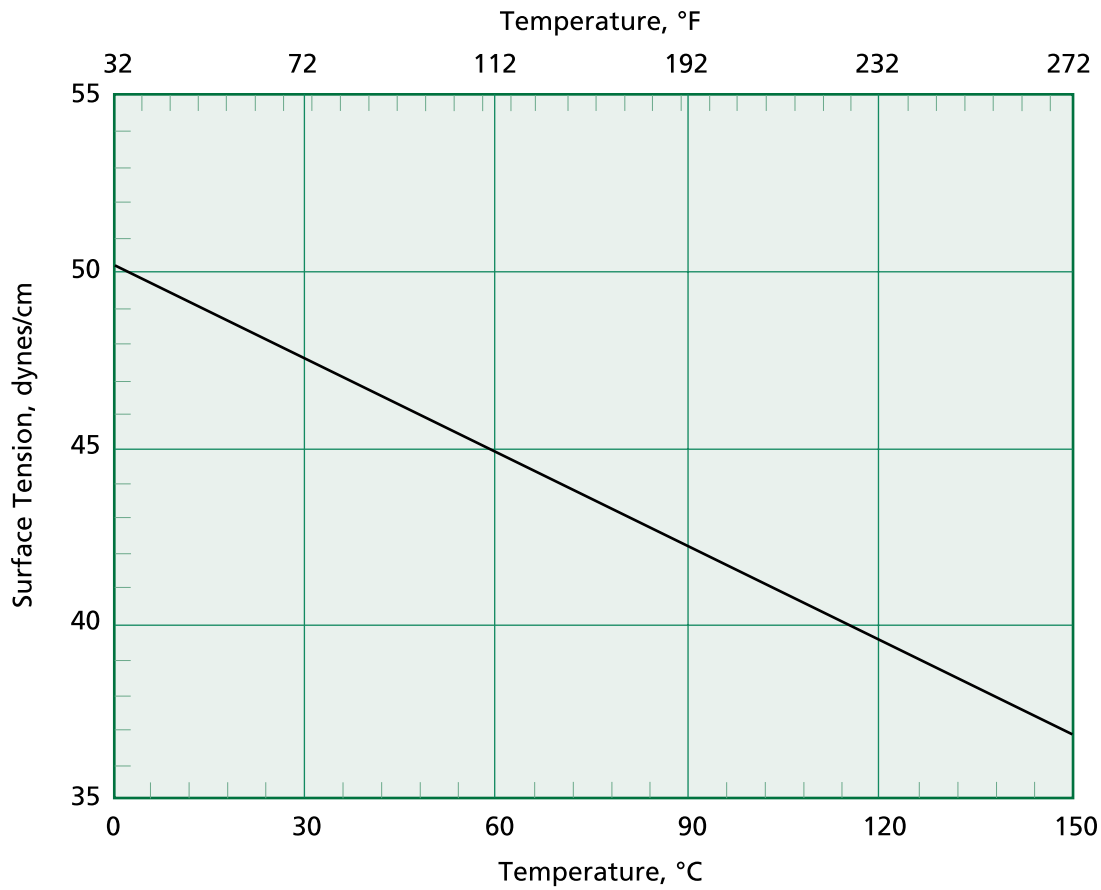
Figure 10: Dew Points of Aqueous Ethylene Glycol Solutions at Various Contact Temperatures



Dew or Frost Point = A + BT
T = Temperature, °C

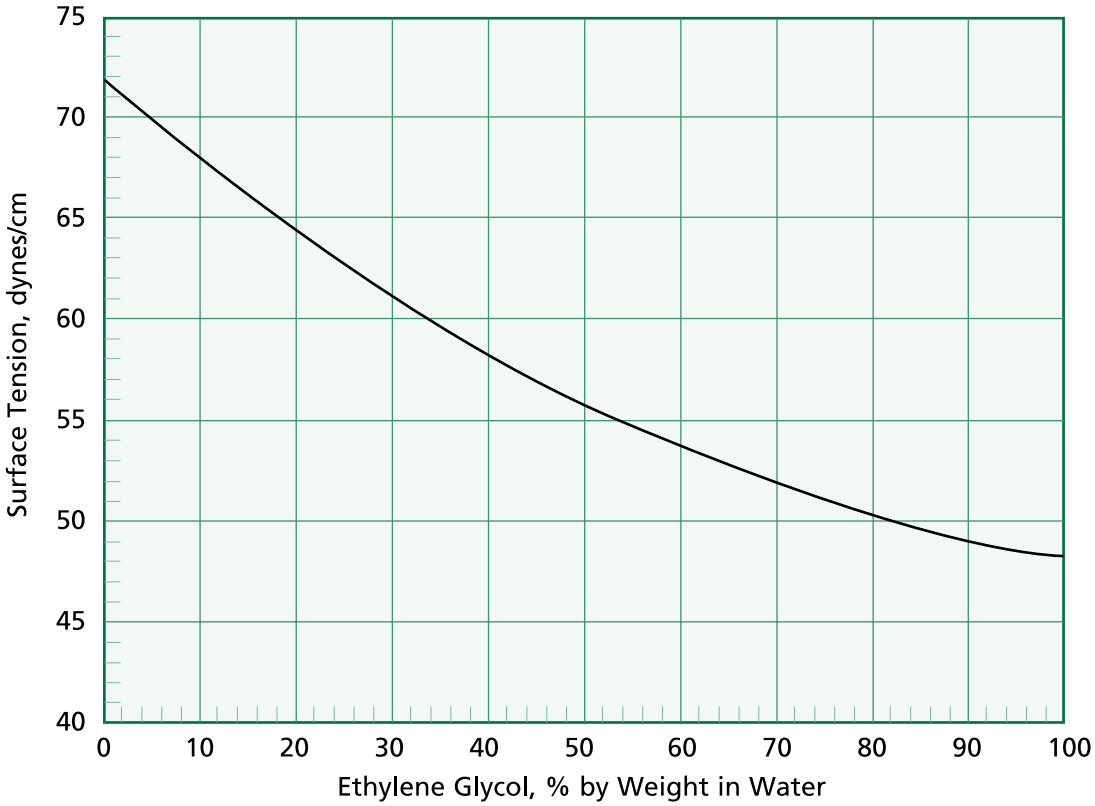
EG, Wt%	A	B
50.0	-3.532	0.96530
60.0	-5.043	0.95130
70.0	-7.231	0.93130
80.0	-10.663	0.90020
90.0	-17.081	0.84200
95.0	-23.575	0.77810
97.0	-28.124	0.72850
98.0	-31.807	0.69790
99.0	-37.996	0.65700
99.5	-43.626	0.61100
99.8	-50.671	0.55450

Figure 11: Surface Tensions of Pure Ethylene Glycol at Various Temperatures



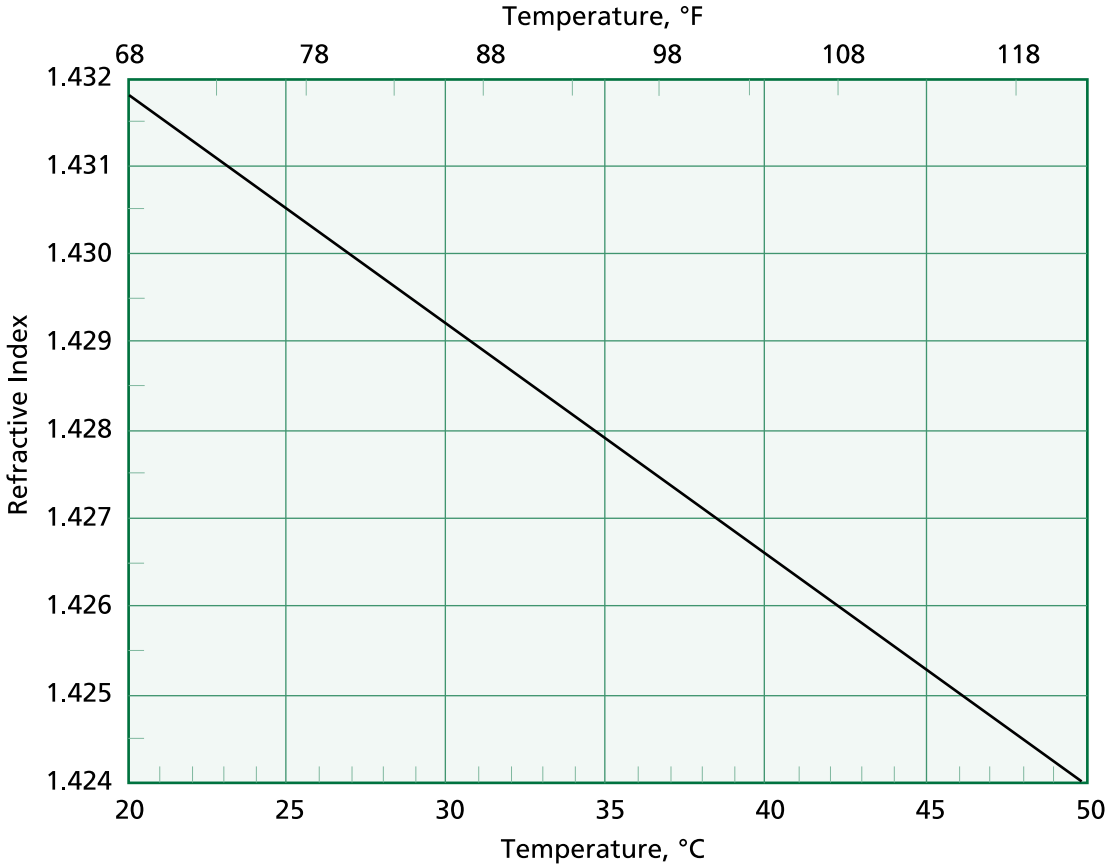
Surface Tension, dynes/cm = 50.206 – 0.089T
T = Temperature, °C

Figure 12: Surface Tensions of Aqueous Ethylene Glycol Solutions at 77°F (25°C)



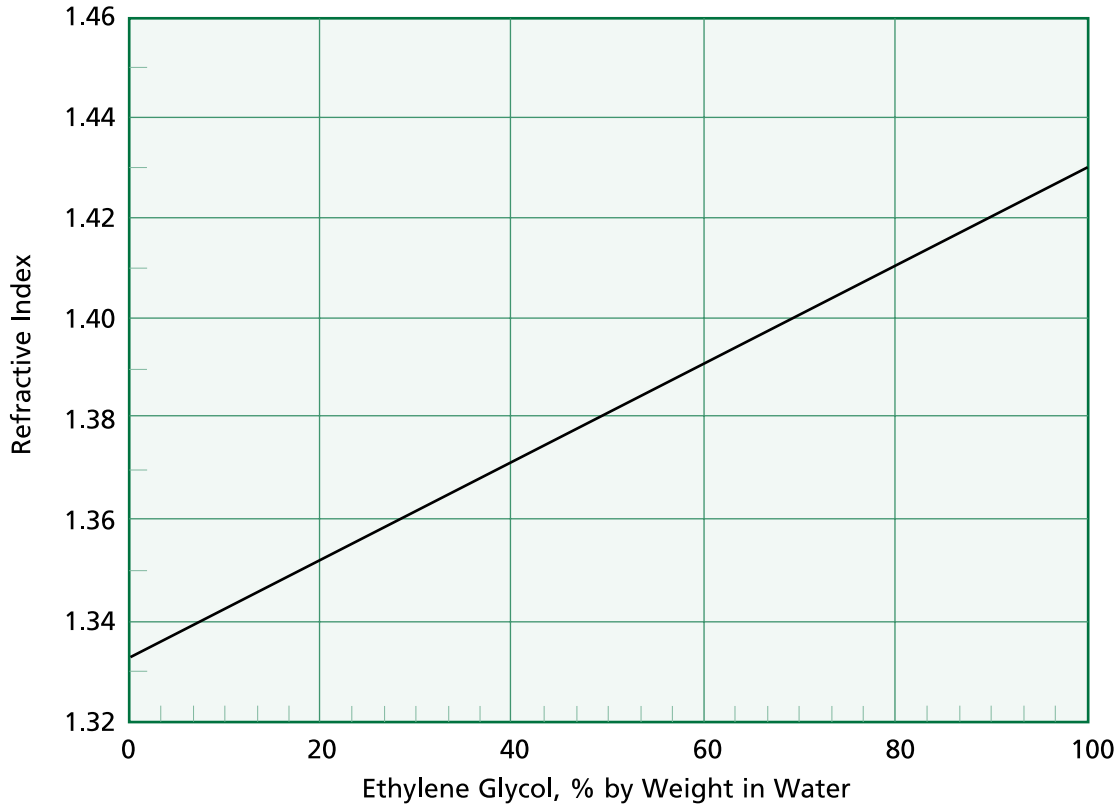
Surface Tension, dynes/cm at 77°F (25°C) = 71.536 – 0.39671x + 0.001625x^2
X = Weight % Ethylene Glycol

Figure 13: Refractive Indices of Pure Ethylene Glycol at Various Temperatures



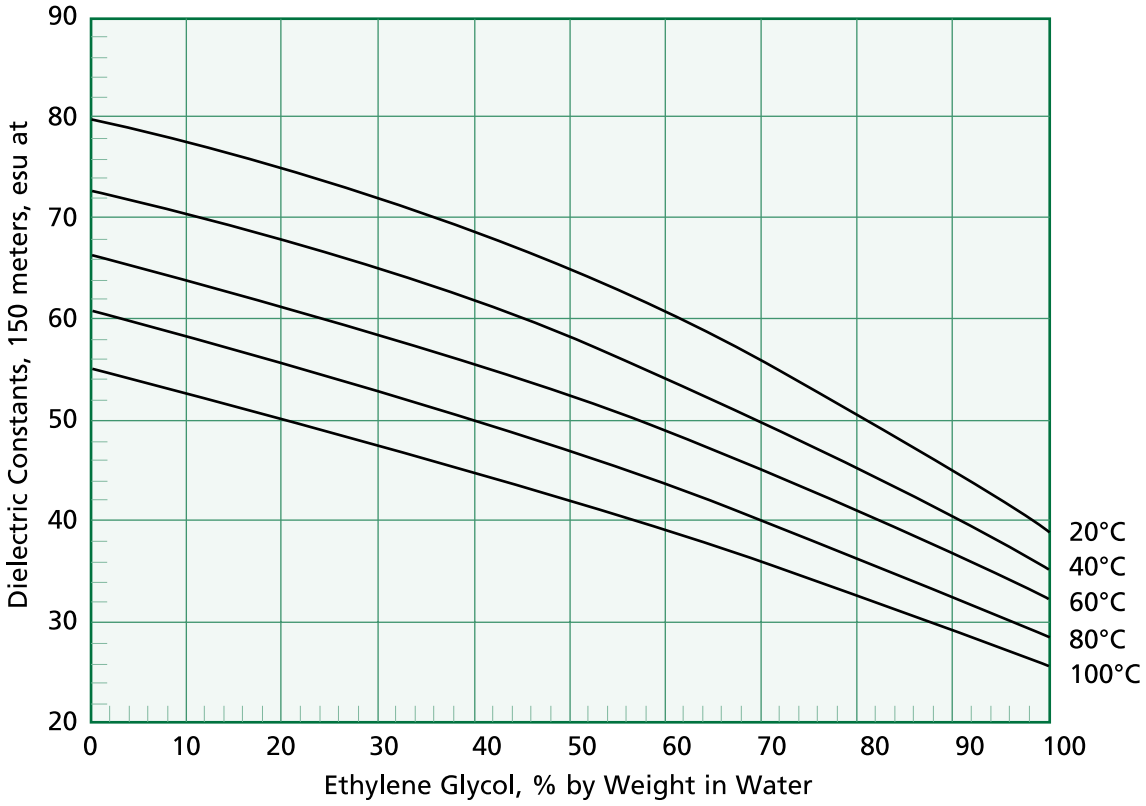
Refractive Index = 1.4370 – 0.00026T
T = Temperature, °C

Figure 14: Refractive Indices of Aqueous Ethylene Glycol Solutions at 77°F (25°C)



Refractive Index = 1.3325 + 0.000982x
x = Weight % Ethylene Glycol

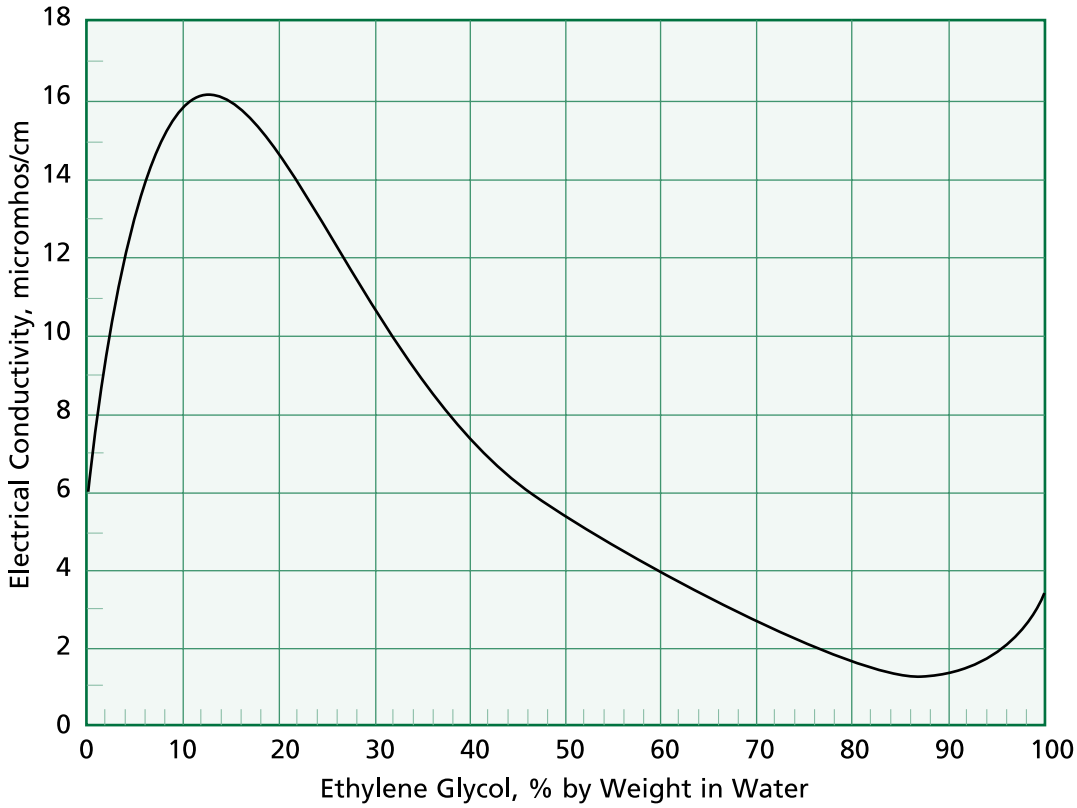
Figure 15: Dielectric Constant of Aqueous Ethylene Glycol Solutions



Dieclectric Constant = $A + Bx + Cx^2$
x = Weight % Ethylene Glycol

T, °C	A	B	C
20	79.752	-0.18962	-0.0021824
40	72.670	-0.20795	-0.0016683
60	66.330	-0.21942	-0.0012642
80	60.408	-0.22728	-0.0009121
100	55.067	-0.22807	-0.0006596

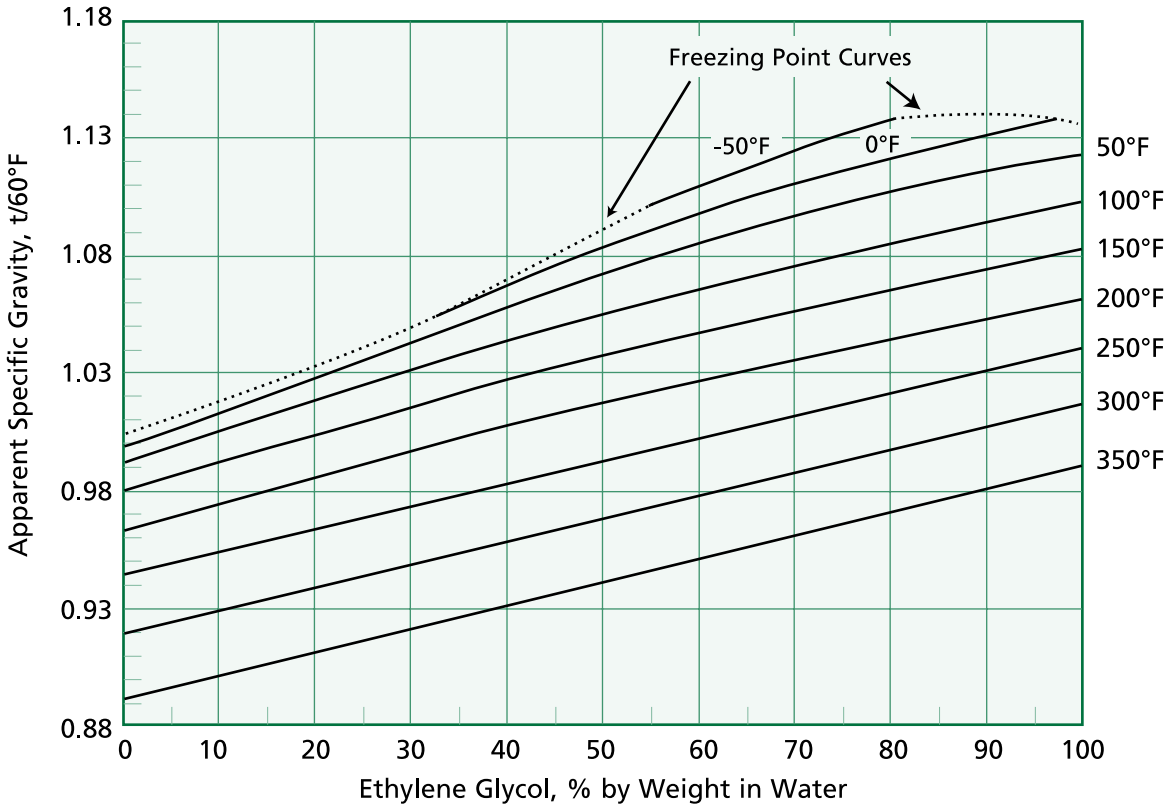
Figure 16: Electric Conductivities of Aqueous Ethylene Glycol Solutions



Ethylene Glycol, Wt %	Electrical Conductivity, mhos/cm
0	$5.89E^{-6}$
5	$1.33E^{-5}$
10	$1.58E^{-5}$
20	$1.41E^{-5}$
30	$1.16E^{-5}$
40	$6.28E^{-6}$
50	$5.09E^{-6}$
60	$3.50E^{-6}$
70	$2.76E^{-6}$
80	$1.79E^{-6}$
90	$1.17E^{-6}$
100	$3.30E^{-6}$

Note: The quality of water used for dilution can significantly affect electrical conductivity

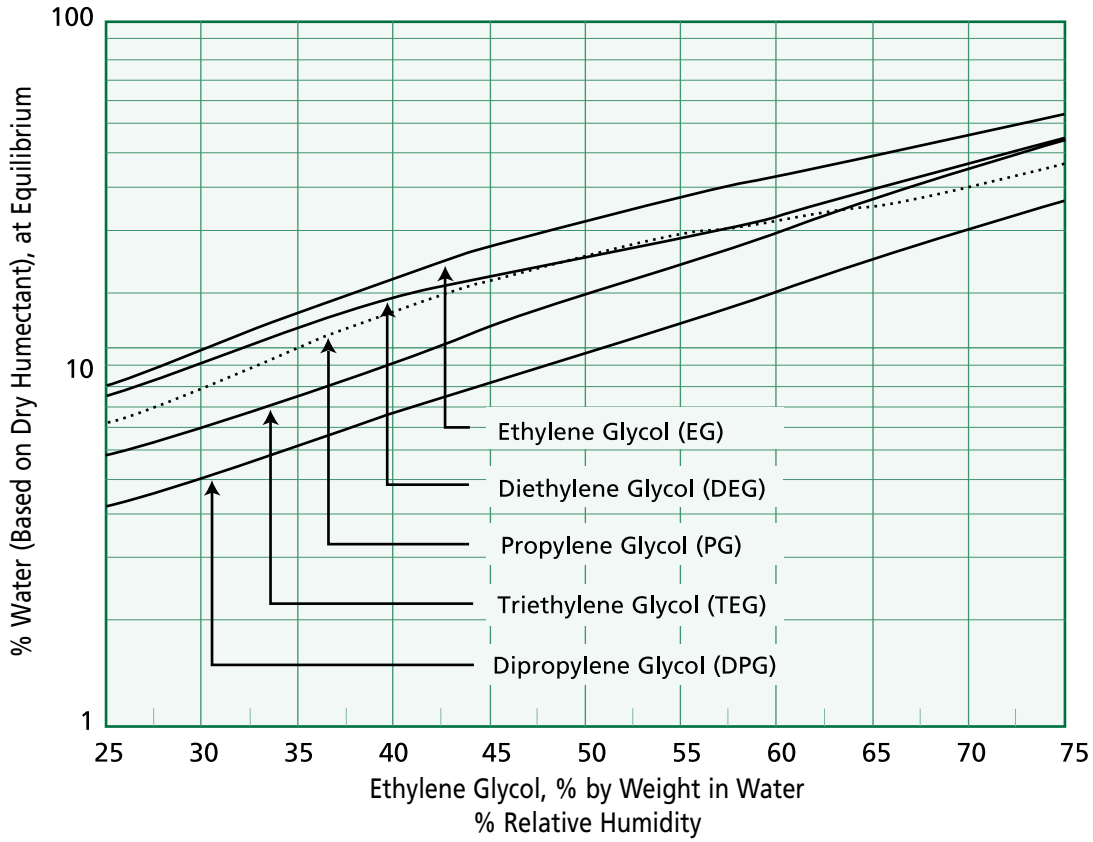
Figure 17: Specific Gravities of Aqueous Ethylene Glycol Solutions



Specific Gravity (T/60°F) = A + Bx + Cx^2
X = Weight % Ethylene Glycol

T (°F)	A	B	C
-50	0.95801	$3.4535E^{-3}$	$-1.5015E^{-5}$
0	0.98147	$2.4980E^{-3}$	$-9.1168E^{-6}$
50	0.99873	$1.6424E^{-3}$	$-4.0019E^{-6}$
100	0.99284	$1.4017E^{-3}$	$-2.9868E^{-6}$
150	0.98017	$1.2599E^{-3}$	$-2.3334E^{-6}$
200	0.96344	$1.1610E^{-3}$	$-1.8084E^{-6}$
250	0.94445	$9.6829E^{-4}$	0.0
300	0.91974	$9.7284E^{-4}$	0.0
350	0.89171	$9.9650E^{-4}$	0.0

Figure 18: Comparative Hygroscopicities of Various Glycols at 70°F (21°C)



Health Effects

Ethylene glycol can be harmful or fatal if misused. See our current Material Safety Data Sheet for health, first aid, exposure limits and toxicology information.

Environmental Information

Ethylene glycol should be treated effectively in conventional wastewater treatment plants and should not persist in the environment. See our current Material Safety Data Sheet for toxicity information.

Biodegradation

For information concerning the biodegradability of ethylene glycol, please refer to the latest Material Safety Data Sheet.

Storage and Handling

Ethylene glycol is commonly stored and handled in steel equipment. This product is compatible with any other commonly used materials of construction. Tanks that have been lined with baked phenolic or epoxy-phenolic coatings have been used, as have fiberglass-reinforced plastic tanks and stainless steel tanks. Aluminum has been used at low temperatures (about 104°F or 40°C, maximum), but is not recommended where the aluminum container is heated. Zinc or galvanized iron is not recommended, and copper or copper alloys may cause product discoloration. Galvanized iron and tin or tinned steel should not be used.

For long-term storage, or if trace iron contamination and the development of color are objectionable in the glycol, a storage vessel lined with a baked-phenolic resin, an air-drying epoxyphenolic resin, or a vinyl resin or a stainless steel or aluminum tank is suggested. Zinc or galvanized iron is not recommended, and copper or copper alloys may cause product discoloration. Galvanized iron and tin or tinned steel should not be used.

An inert gas in the vapor space of storage tanks is not generally required since ethylene glycol has a high boiling point, and the vapors in the tanks are relatively non-flammable. However, if extremely low water content is required, consistent with long-term storage (e.g., with polyester and low conductivity grades), a nitrogen blanket can be used to exclude atmospheric moisture and to protect against UV quality degradation. Since ethylene glycol is hygroscopic, a dry gas pad should be maintained in the vapor space of the tank if moisture pickup is to be minimized. The inert gas prevents air oxidation (to glycolic acid) to maintain product within acidity specifications. Increased acidity enhances iron pickup from steel vessels.

Pure ethylene glycol freezes at about 9°F (-13°C). In cold climates, the storage tanks and lines will require heating and insulation unless they are located inside a heated building or underground.

To maintain product quality, polyester and low conductivity grades should be stored under a slight positive pressure of inert gas, typically nitrogen.

Shipping Data for Ethylene Glycol

Weight per Gallon at 20°C	9.29 lb
Coefficient of Expansion at 55°C	0.00065 1/°C
Flash Point, Tag Closed Cup	260°F

Net Contents and Type of Container

1–Gallon Tin Can	9.0 lb
5–Gallon DOT 17E, Pail	47 lb
55–Gallon DOT 17E, Drum	519 lb

All bulk shipments of ethylene glycol (5,000 lbs or more) are regulated by the U.S. Department of Transportation; therefore, the DOT shipping name is "Other Regulated Substances, Liquid, NOS." The technical name is "Contains Ethylene Glycol" and the hazard classification is "9." The DOT warning label or identification number is "NA 3082."

Product Safety

When considering the use of ethylene glycol in any particular application, review and understand our current Material Safety Data Sheet for the necessary safety and environmental health information. For Material Safety Data Sheets and other product safety information on MEGlobal products, contact the MEGlobal sales office nearest you. Before handling any products mentioned in this booklet, you should obtain the available product safety information from the suppliers of those products and take the necessary steps to comply with all precautions regarding the use of ethylene glycol.

No chemical should be used as or in a food, drug, medical device, or cosmetic, or in a product process in which it may come in contact with a food, drug, medical device, or cosmetic until the user has determined the suitability of the use. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other governmental enactments.

MEGlobal requests that the Customer read, understand and comply with the information contained in this publication and the current Material Data Safety Sheet(s). Customer should furnish the information in this publication to its employees, contractors and customers, or any other users of the product(s), and request that they do the same.

MEGlobal

Emergency Service

MEGlobal, through The Dow Chemical Company, maintains an around-the-clock emergency service for its products. The Chemical Manufacturers Association (CHEMTREC), Transportation Canada (CANUTEC), and the Chemical Emergency Agency service maintain an around-the-clock emergency service for all chemical products.

Location	MEGlobal Products	All Chemical Products
Mainland United States and Puerto Rico	Phone Dow HELP: +1 800-822-4357 (toll-free)	Phone CHEMTREC: +1 800-424-9300 (toll-free)
Alaska and Hawaii	Phone Mainland United States: +1 304-744-3487 (collect)	Phone CHEMTREC: +1 800-424-9300 (toll-free)
Canada	Phone Dow: + 1 989-636-4400 (collect)	Phone CANUTEC: +1 613-996-6666 (collect)
Continental Europe, Middle East, North and Central Africa, United Kingdom and Ireland	Phone Dow in Terneuzen, The Netherlands: + 1 31-115-694982	Phone CHEMTREC (United States): +1 703-527-3887 (collect)
Latin America, Asia/Pacific, South Africa and any other location, worldwide	Phone United States: +1 304-744-3487 (collect)	Phone CHEMTREC (United States): +1 703-527-3887 (collect)
If you are at sea	Radio U.S. Coast Guard, who can directly contact Dow HELP +1 800-822-4357 (toll-free) or CHEMTREC +1 800-424-9300 (toll-free)	

DO NOT WAIT. Phone if in doubt. You will be referred to a specialist for advice.

Sales Office

For additional information, contact our Customer Service Center:

Customer Service

Geographical Area	Phone
Argentina Bolivia Chile Paraguay Peru Uruguay	+54 11-4319-0328
Asia	+852-2879-7273
Brazil	+55 11-5188-98
Venezuela Colombia	+52 55-5201-4874
Mexico	+52 55-5201-4720
Europe South America South Africa	+41 44-728-2496 or +41 44-728-2596
North America	(toll-free) +1 888-610-9048
Middle East India Pakistan	+971 4-292-3999
Turkey	+90 216-571-1600

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