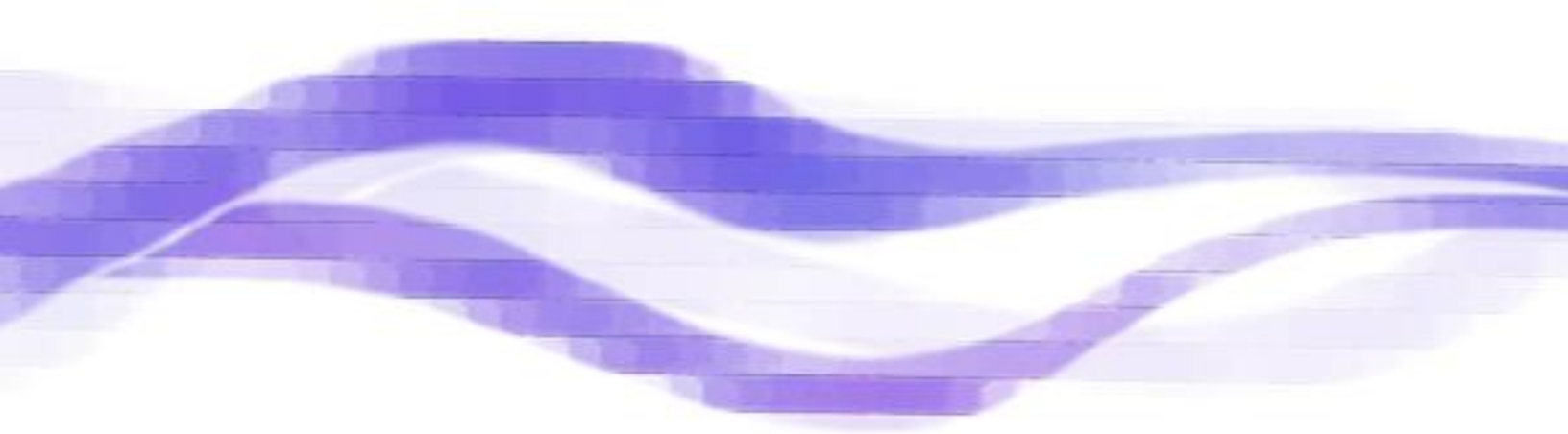
Dynalene Propylene Glycol Series

engineering guide



DYNALENE

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Product Series Overview

This engineering guide provides operating guidelines, product information, and engineering data for the Dynalene propylene glycol-based heat transfer fluids. Dynalene propylene glycols are intended for use in secondary heating and cooling applications, burst and freeze protection of pipes, and various deicing and snow melting systems.

The series of Dynalene propylene glycol coolants are blended with specially formulated Dynalene additive packages depending on your system's specifications. These packages provide superior corrosion protection for steel, brass, copper, and other metals, as well as extend the long-term life of the coolant due to the additive's excellent buffering capacity. This buffer allows the coolant to maintain stable pH levels after years of use by minimizing acidic breakdown and neutralizing contaminants that are present in your system.

Dynalene offers five different propylene glycol blends, each with its own specific advantages depending on the process it is used in and which materials the fluid will be contacting. These products are Dynalene PG, Dynalene PG-FG, Dynalene PG-XT, Dynalene PG-V1, Dynalene PG-A1, and Dynalene Raw PG. All Dynalene propylene glycol products can be blended to any concentration, sold as a concentrate, or customized based on the requirement of the customer (dye, pH, inhibitor, packaging, etc.). Dynalene offers both technical and USP food grade propylene glycols.

Dynalene Propylene Glycol Series

Dynalene offers the following propylene glycol-based coolants:

Dynalene PG -50°F to 250°F (-45.6°C to 121.1°C)

Inhibited propylene glycol

Dynalene PG is an inhibited technical-grade propylene glycol-based coolant used in industrial applications. It is blended with Dynalene's PE-1 inhibitor package for pH stability, inhibiting corrosion in steel, brass, copper, and other metals, and reducing thermal breakdown at high temperatures. It is nearly odorless, non-toxic, and is non-flammable in solutions of up to 80% propylene glycol. Dynalene PG offers excellent freeze and burst protection down to -50°F while maintaining high heat transfer performance.

Dynalene PG-FG -50°F to 250°F (-45.6°C to 121.1°C)

USP food grade inhibited propylene glycol

Dynalene PG-FG is made with USP food grade propylene glycol and blended with Dynalene's PE-1 additive package.

Dynalene PG-XT -50°F to 350°F (-45.6°C to 176.7°C)

High temperature inhibited propylene glycol

Dynalene PG-XT is designed for systems with operating temperatures that exceed those of Dynalene PG. It uses a specially formulated additive package that minimizes thermal breakdown by neutralizing organic acids that are produced when glycols are exposed to high temperatures. Dynalene PG-XT can be used in solar applications, inline heaters, boiler systems, molding/casting, and other processes up to 350°F.

Dynalene PG-V1 -50°F to 194°F (-45.6°C to 90°C)

Inhibited propylene glycol for aluminum systems

Dynalene PG-V1 is designed for systems containing significant amounts of aluminum, posing unique corrosion concerns that may not be addressed by traditional inhibitor packages. Above 60°C, aluminum can experience a runaway corrosion reaction, causing deposits to form in the system as well as weakening the metal components. Radiators, heat exchangers, and fins that are constructed out of aluminum can be further

protected from corrosion by using Dynalene's V1 inhibitor package. PG-V1 also offers excellent protection for steel, brass, copper, and other materials of construction. Dynalene PG-V1 is provided pre-mixed up to 60%.

Dynalene PG-A1 -50°F to 194°F (-45.6°C to 90°C)

Inhibited propylene glycol for aluminum and ferrous metal systems

Dynalene PG-A1 has an organic acid-based (OAT) inhibitor formulation designed for systems with significant aluminum components, while also providing added protection for cast iron and carbon steel that may not be provided by other aluminum inhibitor packages. PG-A1 is free from amine, phosphate, and silicate. The inhibitors stabilize the pH of the fluid between 8 and 8.5, offering superior corrosion protection for most metals, including aluminum, carbon steel, brass, copper, stainless steel, and cast iron. Dynalene PG-A1 is provided pre-mixed up to 60%.

Dynalene Raw PG / Raw PG USP

> 99.5% propylene glycol with no additives

Dynalene offers pure propylene glycol that is available in technical grade as well as food grade.

Table 1. Typical properties of Dynalene propylene glycol solutions.

Composition	Propylene glycol, inhibitors
Natural Color	Clear, light yellow (dyes available)
Odor	Little or none
Flash Point (less than 80 wt%)	None

	Dynalene PG / PG-FG	Dynalene PG-XT	Dynalene PG-V1	Dynalene PG-A1	Raw PG / Raw PG USP
pH	8.0 – 9.0	8.5 – 10.0	10.5 – 11.5	8-8.5	6.0 – 8.0
Reserve Alkalinity (100 wt%)	>10 mL	>15.0 mL	N/A	N/A	0 mL
Reserve Alkalinity (50 wt%)	>5 mL	>7.5 mL	>8 mL	>3 mL	0 mL
Operating Range	-50 to 250°F (-46 to 121°C)	-50 to 350°F (-46 to 177°C)	-50 to 194°F (-46 to 90°C)	-50 to 194°F (-46 to 90°C)	Contact Dynalene

Propylene vs Ethylene Glycol

Dynalene offers both propylene glycol and ethylene glycol-based coolants. When choosing which glycol to use, there are a few important factors to consider. Ethylene glycol-based coolants are less viscous than propylene glycol-based coolants, therefore ethylene glycol will provide better heat transfer than propylene glycol across the entire temperature range, as depicted in Figure 1 below. However, when toxicity is a concern, such as with food applications or where contact with drinking water is possible, propylene glycol is used because it has a lower acute oral toxicity compared to ethylene glycol. It is important to identify any toxicity concerns that could be associated with your system prior to installing ethylene glycol.

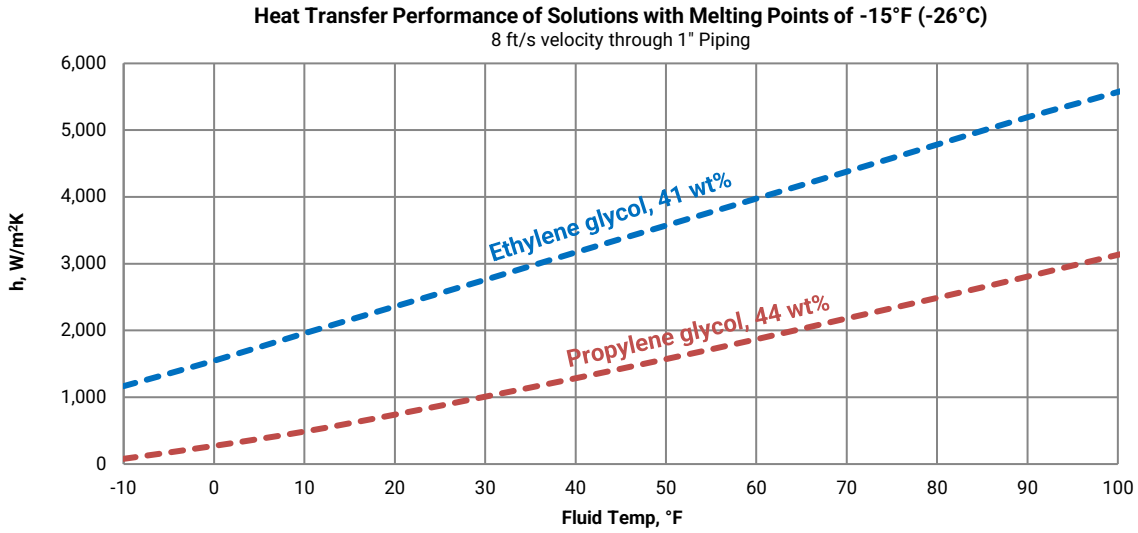

Figure 1. Heat transfer performance comparison of propylene glycol and ethylene glycol solutions.

Freeze and Burst Protection

When glycol is added to water, it lowers the freezing point of the total solution. As the temperature of the glycol solution drops below its melting point, ice crystals begin to form in the fluid. When water freezes, it expands, causing the total volume of the heat transfer fluid to increase. The resultant slush is harder to pump, and can lead to system clogging and even damage to the pump or other system components. Systems that shut down during the winter but need to start up again when the weather is still cold may require freeze protection. For optimal freeze protection, Dynalene recommends a glycol solution that can maintain a melting point of at least 10°F below the lowest anticipated operating or environmental temperature to prevent any ice crystal formation. See Table 2 for Dynalene propylene glycol melting points for various concentrations.

If a heat transfer fluid freezes completely, the resulting volume expansion could cause pipes or other system components to break. The temperature where this can happen is commonly referred to as the burst point. To avoid this possibility, there must be an adequate amount of glycol in the fluid to prevent complete freezing. This is important for systems that remain dormant during winter shutdown where there is potential for the temperature to drop below the glycol solution's melting point. The glycol concentration required for simple freeze protection may not be enough to provide burst protection. Table 2 gives Dynalene's recommendations for sufficient burst protection using Dynalene propylene glycols.

Selecting the Right Concentration

Glycols are generally mixed with water to form solutions to increase the heat transfer performance of the fluid. Water has a lower viscosity, higher thermal conductivity, and higher heat capacity than pure glycol, so solutions with lower glycol concentrations will have superior heat transfer performance than solutions with higher glycol concentrations. However, in situations where low temperature freeze protection is necessary, higher glycol concentrations must be used. To determine what percentage of glycol your application requires for freeze protection, identify the lowest possible temperature the fluid will be exposed to and select a solution with a freezing point 10°F below your lowest anticipated temperature. Table 2 provides Dynalene propylene glycol freezing points, burst points, boiling points, and specific gravities for various concentrations.

Table 2. Melting points, burst points, boiling points, and specific gravities of Dynalene propylene glycol solutions.

Vol% Propylene Glycol	Wt% Propylene Glycol	Melting Point °F	Melting Point °C	Burst Point °F	Burst Point °C	Boiling Point °F	Specific Gravity (22°C)
0	0	32	0.0	32	0.0	212	1.000
5	5.2	29	-1.7	27	-2.7	212	1.005
10	10.5	26	-3.3	22	-5.6	212	1.010
15	15.6	23	-5.0	18	-7.5	212	1.015
20	20.8	19	-7.2	11	-11.8	213	1.020
21	21.8	17	-8.3	9	-12.9	213	1.021
22	22.9	17	-8.3	7	-14.2	213	1.022
23	23.9	16	-8.9	4	-15.5	213	1.023
24	24.9	15	-9.4	2	-16.9	213	1.024
25	25.9	14	-10.1	-1	-18.4	214	1.025
26	27.0	13	-10.6	-4	-20.1	214	1.026
27	28.0	12	-11.1	-7	-21.8	214	1.027
28	29.0	10	-12.2	-10	-23.6	215	1.028
29	30.1	9	-12.8	-14	-25.5	216	1.029
30	31.1	8	-13.3	-18	-27.5	216	1.030
31	32.1	7	-13.9	-21	-29.6	216	1.031
32	33.1	5	-15.0	-24	-31.1	216	1.032
33	34.1	4	-15.6	-30	-34.4	216	1.032
34	35.1	2	-16.7	-38	-38.9	217	1.033
35	36.1	1	-17.2	-46	-43.3	217	1.034
36	37.2	-1	-18.3	-53	-47.2	217	1.035
37	38.2	-3	-19.4	-60	-51.1	218	1.036
38	39.2	-4	-20.0	-60	-51.1	218	1.037
39	40.2	-6	-21.1	-60	-51.1	219	1.038
40	41.2	-8	-22.2	-60	-51.1	219	1.039
41	42.2	-10	-23.3	-60	-51.1	219	1.040
42	43.2	-12	-24.4	-60	-51.1	219	1.041
43	44.2	-14	-25.5	-60	-51.1	219	1.042
44	45.2	-16	-26.7	-60	-51.1	220	1.043
45	46.2	-18	-27.8	-60	-51.1	220	1.044
46	47.2	-21	-29.4	-60	-51.1	220	1.045
47	48.2	-23	-30.6	-60	-51.1	221	1.046
48	49.2	-26	-32.2	-60	-51.1	221	1.047
49	50.2	-28	-33.3	-60	-51.1	222	1.048
50	51.2	-31	-35.0	-60	-51.1	222	1.049
51	52.2	-34	-36.7	-60	-51.1	222	1.049
52	53.2	-37	-38.3	-60	-51.1	223	1.050
53	54.2	-40	-40.0	-60	-51.1	223	1.050
54	55.2	-43	-41.7	-60	-51.1	223	1.051
55	56.2	-46	-43.3	-60	-51.1	223	1.052

(Table continued on page 6)

(Table continued from page 5)

Vol% Dynalene PG	Wt% Dynalene PG	Freezing Point °F	Freezing Point °C	Burst Point °F	Burst Point °C	Boiling Point °F	Specific Gravity (22°C)
56	57.2	-49	-45.0	-60	-51.1	224	1.053
57	58.2	-53	-47.2	-60	-51.1	224	1.054
58	59.2	-56	-48.9	-60	-51.1	224	1.054
59	60.2	<-60	-51.1	-60	-51.1	225	1.055
60	61.2	<-60	-51.1	-60	-51.1	225	1.055
65	66.1	<-60	-51.1	-60	-51.1	227	1.057
70	71	<-60	-51.1	-60	-51.1	230	1.057
75	75.9	<-60	-51.1	-60	-51.1	238	1.058
80	80.8	<-60	-51.1			246	1.059
90	90.4	<-60	-51.1			270	1.056
95	95.2	<-60	-51.1			310	1.052

System Preparation

New Systems

Newly constructed systems typically contain residual amounts of metal debris, machine oil, lubricant, flux, solder, dirt, and other general pipe scale. It is important to remove films and particulates as thoroughly as possible prior to installing Dynalene propylene glycols. Unremoved contaminants can degrade the quality of the fluid and metal components over time. Systems should be thoroughly rinsed with either distilled water, deionized water, or soft tap water (see section 'Solution Preparation' regarding the effects of hard water) until the rinse fluid runs clear. It is strongly recommended to not use heavily chlorinated tap water. Dynalene also offers a flushing fluid, DynaFlush, that will remove debris, scale, and residual oils in the system that water alone cannot remove. DynaFlush will also remove remaining salts and minerals, such as chlorides and sulfates, from the system interior. Contact Dynalene for information on using DynaFlush for system preparation.

An effective procedure for cleaning new systems is as follows:

1. Rinse with fresh water for at least 1 hour, or until a sample of rinse water is free of debris. If significant amounts of particulates remain, drain water, charge with fresh water, and repeat until most contaminants are removed.
2. (Optional) Rinse thoroughly with DynaFlush. Contact Dynalene for instructions on proper use.
3. Rinse with distilled or deionized water for at least 1 hour, then drain.
4. (Optional) Purge the existing system with compressed air or an inert gas such as nitrogen, until there is no more fluid leaving the system. Build up a small amount of pressure with the purging gas, then disrupt to zero pressure several times until all residual fluid is removed. This is also an ideal time to check for system leaks using a soapy solution applied to joints and fittings.
5. Fill system with Dynalene propylene glycol fluid.

In most cases, the cleaning and rinsing procedure can result in a hold up of water in places like heat exchangers, reservoirs, pump housings, elbows, etc. Thus, after initially installing Dynalene propylene glycol the concentration may be slightly diluted. Concentration can be checked on-site using a handheld refractometer or hydrometer (see Table 2 for densities) and can be adjusted using the appropriate Dynalene propylene glycol concentrate or deionized/distilled water. After circulation it is recommended to send a fluid sample to Dynalene to check for concentration, inhibitor amount, and other chemical analysis if needed.

Dynalene propylene glycols should remain free of debris throughout the operational life of the liquid. Entrained sediment and other solid contaminants accelerate erosion and corrosion. Sediment can be deposited in high fouling areas (tubes, tank bottoms, etc.) and may increase localized corrosion. An appropriately sized in-line strainer assembly using a perforation size 1/32” or smaller is recommended to be installed directly in the flow of fluid to allow the most effective particulate removal from the fluid. Providing filtration down to approximately 5 microns nominal, combined with an in-line strainer as a pre-filter, is the best method of maintaining the condition of Dynalene propylene glycol. Strainer/filtration equipment that bypasses the main system can be installed for systems that cannot be interrupted to change filter cartridges.

Retrofitting Systems

Existing systems may contain rust, scale, and debris which must be cleaned and removed before installing Dynalene propylene glycol. If the previous heat transfer fluid was either glycol or another aqueous-based fluid, several rinses with water should remove almost all residual heat transfer fluid. A hydrocarbon, silicone, or mineral oil-based fluid may require a different type of rinse fluid. Dynalene recommends testing the previous heat transfer fluid used in the system in order to determine the best method of cleaning.

Small amounts of clean flush water that remain in the system are acceptable if free from dissolved ions and other contaminants. Performing analytical tests on the flush water to detect traces of residual heat transfer fluid is the recommended method of determining the effectiveness of the procedure. Flush water that may be contaminated should be disposed of in accordance with local, state and federal regulations.

The following methods are useful for removing residual heat transfer fluids before installing Dynalene propylene glycols:

1. **System Evacuation**
   System evacuation is usually performed for volatile heat transfer fluids. Residual fluid is removed by creating a vacuum, usually more than 28”Hg within the existing system. As the vacuum within the system increases, the boiling point of the residual liquid will decrease, resulting in evaporation. The intent is to evaporate the residual liquid completely by lowering its boiling point to below the internal temperature of the system.
2. **Air and Inert Gas Evaporation**
   For volatile heat transfer fluids, evaporation using air or inert gas may be another method of removing residual fluid from an existing piping system. This is performed by allowing warm compressed air or nitrogen to enter the existing system and flow through the wetted areas, including low points. The intent is to evaporate the residual fluid and allow the effluent to exit the system at a point that ideally is opposite to the inlet air or inert gas connection.
3. **Dilution**
   For low-volatility fluids, a solvent such as methanol or isopropanol can be added to dissolve the residual fluid. The chosen solvent should be miscible with the residual fluid and have a high vapor pressure. After diluting the residual fluid with the solvent, drain and follow either step 1 or 2.

If corrosion is severe, an acid wash followed by a neutralization with DynaFlush will remove scale and rust and help prep the system before installing Dynalene propylene glycol. Consult a Dynalene representative regarding this flushing procedure.

Solution Preparation

Good quality water must be used if diluting Dynalene propylene glycols. Dynalene recommends using distilled or deionized water to maximize the performance of the fluid and system, but in cases where distilled or deionized water cannot be used, tap water is also acceptable provided it meets minimum standards for purity. Hard minerals and salts in dilution water can increase metal corrosion, cause formation of scale and deposits, interfere with inhibitor protection, and clog system components. In areas where only very hard water is available and where total hardness is above 100 ppm, Dynalene offers prediluted solutions of Dynalene propylene glycols. Chloride and sulfate content in dilution water should each be below 25 ppm to minimize corrosion potential.

Dynalene propylene glycol solutions can be mixed either by weight or volume using the conversions in Table 2. Determine the total system volume, either from design calculations or by metering in water until the system is full. Drain the water and load in the correct amount of glycol solution (for pre-mixed solution) or glycol concentrate and water (if mixing on-site). After circulation, check the glycol concentration to determine if there needs to be any adjustment.

The propylene glycol concentration can be checked with a handheld refractometer or hydrometer, after sufficient circulation in the system for complete mixing. The concentration can be adjusted using an appropriate Dynalene propylene glycol concentrate or deionized/distilled water. Inexpensive refractometers and hydrometers are available from multiple sources.

General Installation Guidelines

The following recommendations are provided to assist the Dynalene propylene glycol fluid installer in achieving a simple and safe installation. Always refer to component manufacturer's installation guidelines when initially setting up your system.

1. **Consult with Dynalene**
   Every system is different. Dynalene recommends talking to one of the Dynalene experts for specific system needs.
2. **The Manual**
   Prior to purchasing any Dynalene propylene glycol, review and understand all of the information contained in this manual
3. **Presence of Air Bubbles in the Fluid**
   It is always recommended to eliminate the presence of air bubbles in your system to prevent foaming, corrosion, and pump cavitation. Bleeder valves and air separators can be used to remove air bubbles during circulation.
4. **Maximum Surface Temperature**
   Surface temperature of heat source components in systems using Dynalene PG, PG-FG, PG-V1, or PG-A1 should not exceed 300°F (400°F for Dynalene PG-XT). Fluid velocity should be maintained between 4 to 8 ft/sec to reduce overheating of the heater walls.
5. **Using Electric Resistance Heaters**
   In-line electric resistance heaters used in Dynalene propylene glycol systems should not exceed a maximum watt density of 45 W/in^2 with a minimum fluid velocity of 6 to 8 ft/sec. Watt density not exceeding 30 W/in^2 is recommended for direct tank immersion electric resistance heater applications.

   Ensure electrical connections are properly contained and kept away from splash or spill areas. If there is a thermal contact between the cold surface and an electrical connection, there may be condensation resulting in short circuiting.

6 Materials of Construction

Steel, brass, bronze, copper, cast iron, and most plastic piping materials are acceptable. See the compatibility charts on pages 11 and 12 for more information. If there is a significant amount of aluminum in the system, Dynalene PG-V1 or PG-A1 should be considered. Please contact Dynalene about using Dynalene propylene glycols with PVC or CPVC.

Galvanized steel is not recommended with inhibited Dynalene propylene glycols as the zinc coating will react with the inhibitors in the fluid, causing precipitation (and depletion) of the inhibitor and removal of the protective zinc surface. To prevent galvanic corrosion in the presence of dissimilar metals, it is important to monitor the Dynalene propylene glycol inhibitor concentration over the life of the fluid.

7 Pump Equipment

Centrifugal pumps are commonly used with Dynalene propylene glycols. Gear, reciprocating, and other positive displacement pumps are also acceptable. Steel, brass, bronze, copper, cast iron, and most plastic piping materials used in pump equipment are acceptable. The same mechanical seals and packing used for water may be used with Dynalene propylene glycols, however it is always recommended to consult the seal, packing, and pump manufacturers regarding high (above 150°F) or low (below 32°F) operating temperatures.

8 Volumetric Expansion

Volumetric expansion and/or contraction of propylene glycol must be taken into consideration when calculating the overall fluid volume within the entire system. For systems with large temperature ranges, consider using an expansion tank. Refer to the volumetric expansion in Table 3 below.

Table 3. Percent volumetric expansion of Dynalene propylene glycol solutions vs temperature.

Temp	% Volumetric Expansion								
	Dynalene propylene glycol concentration =								
°F	20%	25%	30%	35%	40%	45%	50%	55%	60%
-30									-2.41
-20							-2.03	-2.13	-2.23
-10							-1.86	-1.95	-2.05
0					-1.51	-1.59	-1.67	-1.76	-1.85
10			-1.18	-1.26	-1.34	-1.42	-1.49	-1.56	-1.63
20	-0.90	-0.96	-1.03	-1.09	-1.16	-1.22	-1.27	-1.33	-1.39
30	-0.75	-0.81	-0.86	-0.91	-0.96	-1.00	-1.04	-1.09	-1.15
40	-0.58	-0.63	-0.67	-0.71	-0.74	-0.78	-0.81	-0.85	-0.89
50	-0.41	-0.43	-0.45	-0.48	-0.51	-0.53	-0.55	-0.58	-0.61
60	-0.20	-0.22	-0.23	-0.25	-0.26	-0.28	-0.29	-0.31	-0.32
70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.22	0.23	0.25	0.26	0.28	0.28	0.29	0.31	0.32
90	0.46	0.48	0.51	0.54	0.57	0.59	0.61	0.64	0.66
100	0.72	0.76	0.79	0.84	0.88	0.91	0.94	0.97	1.01
120	1.27	1.34	1.42	1.47	1.53	1.59	1.66	1.71	1.76
140	1.89	1.99	2.09	2.17	2.26	2.33	2.41	2.49	2.57
160	2.56	2.69	2.82	2.93	3.04	3.14	3.24	3.34	3.44
180	3.30	3.46	3.61	3.75	3.88	4.00	4.13	4.25	4.37
200	4.10	4.28	4.47	4.63	4.79	4.94	5.08	5.21	5.35
220	4.96	5.18	5.39	5.57	5.76	5.93	6.09	6.25	6.40

9 Reservoir Tank

Purging and eliminating air from the headspace above the propylene glycol in the reservoir tank is recommended. Return fluid piping should enter a storage tank below the propylene glycol fluid surface to prevent foaming, air entrapment, and bubbles. Air bubbles can contribute to damaging effects such as erosion, corrosion, and loss of heat transfer.

10 Pressure Relief Valve Considerations

Pressure relief valves should be cleaned of residue to prevent clogging or sticking if Dynalene propylene glycol is released through the valve.

Valve Sizing: Relief valve sizing depends on whether the valve is located to relieve liquid or vapor from the propylene glycol. Regarding liquid, the relief valves should be sized using the propylene glycol liquid properties to permit sufficient liquid volumetric flow to match or exceed the maximum possible pressure building volume rate increase in the system. If the relief temperature is above the fluid saturated vapor temperature for the discharge pressure, flashing will occur and relief valve must be sized for two-phase flow. Dynalene propylene glycol vapor is primarily water (steam). The latent heat of water should be used to calculate flashing.

11 Dynalene Propylene Glycol Quality Check

Dynalene recommends a sample to be sent to Dynalene for a quality inspection immediately after system startup. Sample intervals will be based on the results of that inspection and the customer's needs. Sample kits are available from Dynalene which contain a sample bottle and label and sampling instructions, to collect a sample to return to Dynalene for testing. Often residual flushing water left in the system can dilute the Dynalene propylene glycol-based fluid, in which case Dynalene will recommend how to correct the concentration. Representative samples of Dynalene propylene glycol should be obtained from an active liquid stream.

If the samples cannot be obtained from an active liquid stream at room temperature, locate a collection container that is clean, and that its materials of construction are compatible with Dynalene propylene glycol. Obtain a sample from an area within the active system and allow the liquid to achieve room temperature before packaging.

12 Leak Detection

If fluid is found on the outside of a system, it can sometimes be difficult to distinguish a glycol leak from condensation or other potential sources. Dyes can be added to Dynalene glycols to aid in identifying when a leak has developed in the system. Available dyes include food-safe or fluorescent options as well as basic industrial dyes. Please contact Dynalene to discuss dye options.

Vapor Pressure

Vapor pressure is a critical property to be considered when calculating Net Positive Suction Head (NPSH). It is important to provide sufficient head pressure above the pump to prevent local boiling and cavitation in the pump when operating at higher temperatures. Refer to the pump specifications and determine the necessary head pressure your pump requires. Glycols have higher boiling points and lower vapor pressures than those of pure water, and higher glycol concentrations will result in lower vapor pressures. The vapor pressures for Dynalene propylene glycols are given in Table 4. It is recommended to be used in airtight systems when operating at elevated temperatures to maintain liquid phase.

Table 4. Vapor pressures of Dynalene propylene glycol solutions.

Temp	Vapor Pressure, psia								
	Dynalene propylene glycol concentration =								
°F	20%	25%	30%	35%	40%	45%	50%	55%	60%
100	0.9	0.9	0.9	0.9	0.9				
110	1.9	1.6	1.2	1.2	1.2	1.2	1.1	1.1	1.0
120	1.7	1.7	1.6	1.5	1.5	1.5	1.5	1.5	1.4
130	2.2	2.2	2.1	2.1	2.0	2.0	1.9	1.9	1.8
140	2.8	2.8	2.7	2.7	2.6	2.6	2.5	2.4	2.3
150	3.6	3.6	3.5	3.5	3.4	3.4	3.2	3.0	3.0
160	4.6	4.5	4.4	4.4	4.3	4.2	4.1	4.0	3.8
170	5.8	5.8	5.6	5.4	5.4	5.3	5.2	5.0	4.8
180	7.2	7.1	7.0	6.9	6.7	6.6	6.5	6.2	5.9
190	9.0	8.9	8.7	8.5	8.3	8.2	8.1	7.8	7.4
200	11.0	10.9	10.7	10.5	10.2	10.1	9.9	9.5	9.1
210	13.5	13.5	13.1	12.8	12.5	12.3	12.1	11.6	11.1
220	16.4	16.4	15.9	15.6	15.2	15.0	14.8	14.2	13.6
230	19.8	19.5	19.2	18.8	18.4	17.8	17.8	17.1	16.4
240	23.8	23.4	23.0	22.5	22.0	21.7	21.4	20.6	19.7
250	28.4	27.9	27.4	26.9	26.3	26.0	25.6	24.6	23.5

Metals Compatibility

Dynalene propylene glycol is compatible with the following metals when used in a closed, airtight system:

- Aluminum*
- Cast Steel
- Monel
- Brass
- Copper
- Nickel
- Bronze
- Hastelloy
- Stainless Steel
- Carbon Steel
- Inconel
- Tantalum
- Cast Iron
- Incoloy 825
- Titanium

**Contact Dynalene when utilizing aluminum as a wetted material of construction. Call 1-877-244-5525 or email info@dynalene.com*

Corrosion Testing Results Based on Corrosion Test ASTM D1384

Corrosion rate given in mils per year (mpy).

Metal	Water	Raw PG	Dynalene PG	Dynalene PG-V1	Dynalene PG-A1
Solder (30/70A)	3.10	3.63	0.06	1.18	0.27
Aluminum (AL 319)	13.2	8.97	0.70	-0.11	0.09
Copper (Cu CDA 110)	0.08	0.84	0.12	0.21	0.03
Brass (CDA 260)	0.22	0.75	0.06	0.14	0.08
Greycast Iron	21.1	18.66	1.75	-0.11	-0.08
Carbon Steel 1020	9.69	23.65	-0.07	0.00	0.01

**Negative value means weight gain.*

Caution: Do not use magnesium, zinc, zinc-plated, or galvanized metals in the heat transfer loop containing inhibited Dynalene propylene glycols. Zinc coatings can interfere with the inhibitor mechanism, leading to precipitation of the inhibitor, reduction of inhibitor concentration, and removal of the protective zinc plating. These metals are acceptable to use as support framing, electrical conduit, and structural components that do not contact the fluid.

Gasket & Polymer Compatibility

Table 5. Gasket and polymer compatibility with Dynalene propylene glycol.

Material	Compatibility
Nitrile / NBR	Excellent to 150°F, Good above 150°F
Hydrogenated Nitrile / HNBR	Excellent
Ethylene Propylene / EP, EPDM	Excellent
Chloroprene / CR (Neoprene)	Fair
Isobutylene / IIR (Latex)	Good
Synthetic Isoprene / IR (Latex)	Good / Excellent
Natural Isoprene / NR (Natural Rubber)	Good / Excellent
Fluorocarbon / FKM (Viton)	Good to 100°F, Fair / Poor over 100°F
Chemraz Kalrez / FFKM	Excellent
PTEF / FEP (Teflon)	Excellent
Gylon Style 3500, 3504, 3510	Excellent
Nylon / Polyamide	Fair
Polyvinyl Chloride / PVC	Fair
Polyethylene	Excellent
Polypropylene	Excellent
Epoxy	Good / Excellent
Graphite	Excellent

If you would like to use another material not listed in the above table, please contact Dynalene at 1-877-244-5525 or email info@dynalene.com.

Packing & Shipping

Dynalene propylene glycols are available in

- 0.5-gallon jugs
- 1-gallon jugs
- 2.5-gallon pails
- 5-gallon pails
- 30-gallon drums
- 55-gallon drums
- 265-gallon totes
- Bulk tankers

Dynalene propylene glycols are not considered hazardous for shipping by land, air, or sea. Please refer to the SDS for additional shipping information.

Shelf Life

Dynalene propylene glycols will remain stable as indicated in the table below if:

1. They are stored in the original unopened container away from direct sunlight
2. The storage area temperature does not exceed 100°F (37°C)

Product	Shelf Life
Dynalene PG	5 years
Dynalene PG-FG	5 years
Dynalene PG-XT	5 years
Dynalene PG-V1	3 years
Dynalene PG-A1	3 years
Raw PG	5 years

If you have questions about the suitability of an older or opened container, contact Dynalene at 1-877-244-5525 or email info@dynalene.com.

Dynalene Propylene Glycol Properties: Viscosity

Viscosities of Dynalene propylene glycol solutions vs. temperature are given in Table 6.

Table 6. Viscosities of Dynalene propylene glycol solutions.

Temp	Viscosity, cP								
	Dynalene propylene glycol concentration =								
°F	20%	25%	30%	35%	40%	45%	50%	55%	60%
-30									498
-20									299
-10							96.0	140	183
0					40.9	51.1	61.3	88.2	115
10			13.4	20.2	27.0	33.8	40.6	57.4	74.2
20	5.36	7.63	9.89	14.2	18.5	23.2	27.8	38.6	49.3
30	4.23	5.85	7.46	10.3	13.1	16.4	19.7	26.7	33.7
40	3.41	4.58	5.75	7.68	9.60	12.0	14.3	19.0	23.7
50	2.79	3.66	4.52	5.87	7.21	8.96	10.7	13.9	17.1
60	2.32	2.97	3.62	4.59	5.56	6.85	8.13	10.4	12.6
70	1.95	2.45	2.94	3.66	4.38	5.36	6.34	7.93	9.51
80	1.66	2.05	2.43	2.98	3.52	4.28	5.04	6.19	7.34
90	1.43	1.74	2.04	2.46	2.88	3.48	4.08	4.93	5.77
100	1.25	1.49	1.73	2.07	2.40	2.88	3.35	3.99	4.62
120	0.97	1.14	1.30	1.52	1.73	2.05	2.36	2.74	3.11
140	0.78	0.90	1.01	1.16	1.31	1.53	1.75	1.99	2.22
160	0.64	0.73	0.82	0.93	1.04	1.20	1.35	1.51	1.66
180	0.54	0.61	0.68	0.77	0.85	0.97	1.08	1.19	1.29
200	0.46	0.52	0.58	0.65	0.71	0.80	0.88	0.96	1.04
220	0.40	0.45	0.50	0.56	0.61	0.68	0.74	0.80	0.86
240	0.36	0.40	0.44	0.49	0.53	0.59	0.64	0.69	0.73

1 cP= 0.001 Pa·s

Dynalene Propylene Glycol Properties: Thermal Conductivity

Thermal conductivities of Dynalene propylene glycol solutions vs. temperature are given in Table 7.

Table 7. Thermal conductivities of Dynalene propylene glycol solutions.

Temp	Thermal Conductivity, BTU/hr·ft·°F								
	Dynalene propylene glycol concentration =								
°F	20%	25%	30%	35%	40%	45%	50%	55%	60%
-30									0.171
-20							0.188	0.181	0.174
-10							0.191	0.184	0.176
0					0.211	0.203	0.194	0.186	0.178
10			0.235	0.225	0.215	0.206	0.196	0.188	0.179
20	0.262	0.251	0.239	0.229	0.218	0.209	0.199	0.190	0.181
30	0.267	0.255	0.243	0.233	0.222	0.212	0.201	0.192	0.183
40	0.272	0.260	0.247	0.236	0.225	0.215	0.204	0.194	0.184
50	0.277	0.264	0.251	0.239	0.227	0.217	0.206	0.196	0.186
60	0.281	0.268	0.254	0.242	0.230	0.219	0.208	0.198	0.187
70	0.285	0.272	0.258	0.246	0.233	0.222	0.210	0.199	0.188
80	0.289	0.275	0.261	0.248	0.235	0.223	0.211	0.200	0.189
90	0.292	0.278	0.263	0.250	0.237	0.225	0.213	0.202	0.190
100	0.295	0.281	0.266	0.253	0.239	0.227	0.214	0.203	0.191
120	0.298	0.283	0.268	0.255	0.241	0.228	0.215	0.204	0.192
140	0.306	0.290	0.274	0.260	0.245	0.232	0.218	0.206	0.194
160	0.309	0.293	0.277	0.262	0.247	0.234	0.220	0.207	0.194
180	0.312	0.296	0.279	0.264	0.249	0.235	0.221	0.208	0.195
200	0.314	0.297	0.280	0.265	0.249	0.235	0.221	0.208	0.194
220	0.314	0.297	0.280	0.265	0.249	0.235	0.220	0.207	0.194
240	0.314	0.297	0.280	0.265	0.249	0.235	0.220	0.207	0.194

1 Btu/hr·ft·°F = 1.73 W/mK

Dynalene Propylene Glycol Properties: Specific Heat

Specific heats of Dynalene propylene glycol solutions vs. temperature are given in Table 8.

Table 8. Specific heats of Dynalene propylene glycol solutions.

Temp	Specific Heat, BTU/lb·°F								
	Dynalene propylene glycol concentration =								
°F	20%	25%	30%	35%	40%	45%	50%	55%	60%
-30									
-20									0.799
-10									0.804
0							0.855	0.832	0.809
10					0.898	0.879	0.859	0.837	0.814
20			0.936	0.919	0.902	0.883	0.864	0.842	0.82
30	0.966	0.952	0.938	0.922	0.906	0.887	0.868	0.847	0.825
40	0.968	0.955	0.941	0.925	0.909	0.891	0.872	0.851	0.830
50	0.970	0.957	0.944	0.929	0.913	0.895	0.877	0.856	0.835
60	0.972	0.960	0.947	0.932	0.917	0.899	0.881	0.861	0.840
70	0.974	0.962	0.950	0.935	0.920	0.903	0.886	0.866	0.845
80	0.976	0.965	0.953	0.939	0.924	0.907	0.890	0.870	0.850
90	0.979	0.968	0.956	0.942	0.928	0.911	0.894	0.875	0.855
100	0.981	0.970	0.959	0.945	0.931	0.915	0.899	0.880	0.861
120	0.985	0.975	0.965	0.952	0.939	0.924	0.908	0.890	0.871
140	0.989	0.980	0.970	0.958	0.946	0.931	0.916	0.899	0.881
160	0.993	0.985	0.976	0.965	0.953	0.939	0.925	0.908	0.891
180	0.996	0.989	0.982	0.972	0.961	0.948	0.934	0.918	0.902
200	1.000	0.994	0.988	0.978	0.968	0.956	0.943	0.928	0.912
220	1.003	0.999	0.994	0.985	0.975	0.963	0.951	0.937	0.922
240	1.007	1.003	0.999	0.991	0.982	0.971	0.960	0.946	0.932

1 Btu/lb·°F = 4,186 J/kg°C

Dynalene Propylene Glycol Properties: Density

Densities of Dynalene propylene glycol solutions vs. temperature are given in Table 9.

Table 9. Densities of Dynalene propylene glycol solutions.

Temp	Density, lb/ft^3								
	Dynalene propylene glycol concentration =								
°F	20%	25%	30%	35%	40%	45%	50%	55%	60%
-30									67.05
-20							66.46	66.70	66.93
-10							66.35	66.58	66.81
0					65.71	65.97	66.23	66.46	66.68
10			65.00	65.30	65.60	65.86	66.11	66.33	66.54
20	64.23	64.57	64.90	65.19	65.48	65.73	65.97	66.18	66.38
30	64.14	64.47	64.79	65.07	65.35	65.59	65.82	66.02	66.22
40	64.03	64.35	64.67	64.94	65.21	65.44	65.67	65.86	66.05
50	63.92	64.23	64.53	64.80	65.06	65.28	65.50	65.69	65.87
60	63.79	64.09	64.39	64.65	64.90	65.12	65.33	65.51	65.68
70	63.66	63.95	64.24	64.49	64.73	64.94	65.14	65.31	65.47
80	63.52	63.80	64.08	64.32	64.55	64.75	64.95	65.11	65.26
90	63.37	63.64	63.91	64.14	64.36	64.55	64.74	64.89	65.04
100	63.20	63.47	63.73	63.95	64.16	64.35	64.53	64.67	64.81
120	62.85	63.09	63.33	63.54	63.74	63.90	64.06	64.19	64.32
140	62.46	62.68	62.90	63.09	63.27	63.42	63.57	63.68	63.79
160	62.03	62.23	62.43	62.60	62.76	62.90	63.03	63.13	63.22
180	61.56	61.74	61.92	62.07	62.22	62.34	62.45	62.53	62.61
200	61.05	61.21	61.37	61.50	61.63	61.73	61.83	61.90	61.97
220	60.50	60.64	60.78	60.89	61.00	61.09	61.17	61.23	61.28
240	59.91	60.03	60.15	60.25	60.34	60.41	60.47	60.51	60.55

1 lb/ft^3= 16 kg/m^3

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