Dynalene HC Series

engineering guide

DYNALENE
Tomorrow's Solutions **Flow** Through Us

Contents

Product Overview

The Dynalene HC Series consists of Dynalene HC and Dynalene HC-FG, that are water-based, environmentally friendly heat transfer fluids engineered to operate efficiently within the range of -58°F (-50°C) and 425°F (218°C). These fluids are also non-toxic, non-flammable, and non-hazardous. Dynalene HC fluids are odor free, biodegradable, PFAS-free, and do not promote microbial growth.

Dynalene HC-FG is specially formulated to meet NSF HT-1 standards for incidental food contact and is often used in food, beverage, and pharmaceutical heat transfer applications.

The Dynalene HC Series has superior thermophysical properties as compared to other heat transfer fluids within its temperature range. The low viscosity at low temperatures combined with high thermal conductivity and specific heat provide for an exceptionally efficient coolant. Unlike glycols, Dynalene HC fluids demonstrate excellent thermal stability at high temperatures.

With five standard formulations, the Dynalene HC Series offers a cost-effective solution for a variety of applications. Temperature range, freezing points, and boiling points of the standard HC Series formulations are given in Table 1.

Table 1. Temperature ranges, freezing points, and boiling points of the Dynalene HC fluids. Boiling points are given for closed systems.

	Operating Temperature Range			Freezing Point		Boiling Point	
HC/HC-FG 10	14°F (-10°C)	to	425°F (218°C)	< -4°F	(< -20°C)	226°F	(108°C)
HC/HC-FG 20	-4°F (-20°C)	to	425°F (218°C)	< -22°F	(< -30°C)	230°F	(110°C)
HC/HC-FG 30	-22°F (-30°C)	to	425°F (218°C)	< -40°F	(< -40°C)	234°F	(112°C)
HC/HC-FG 40	-40°F (-40°C)	to	425°F (218°C)	< -58°F	(< -50°C)	239°F	(115°C)
HC/HC-FG 50	-58°F (-50°C)	to	425°F (218°C)	< -67°F	(< -55°C)	244°F	(118°C)

Packing & Shipping

Dynalene HC fluids are available in 5-gallon pails, 55-gallon drums, 265-gallon totes, and bulk tankers.

Dynalene HC has a shipping hazard classification number of 0. Please refer to the SDS for additional shipping information.

Vapor Pressure

Vapor pressure is a critical property to be considered when calculating Net Positive Suction Head (NPSH). The vapor pressures for Dynalene HC are given in Table 2. It is recommended to be used in airtight systems when operating at elevated temperatures to maintain liquid phase.

Table 2. Vapor pressures of the Dynalene HC and HC-FG fluids.

Temp		Vapor Pressure, psia				
°C	°F	HC-10	HC-20	HC-30	HC-40	HC-50
20	68	0.33	0.30	0.26	0.22	0.23
40	104	0.69	0.66	0.58	0.55	0.45
50	122	1.24	1.16	1.04	0.97	0.81
60	140	2.16	1.99	1.81	1.67	1.43
70	158	3.57	3.26	2.99	2.72	2.39
80	176	5.62	5.11	4.69	4.24	3.78
90	194	8.47	7.68	7.06	6.35	5.71
100	212	12.3	11.2	10.3	9.21	8.31
110	230	17.4	15.8	14.5	13.0	11.7
120	248	24.0	21.8	20.0	17.9	16.2
130	266	32.4	29.6	27.0	24.2	21.9
140	284	43.1	39.4	35.9	32.3	29.1
150	302	56.6	51.8	47.1	42.4	38.2
160	320	73.3	67.1	61.0	55.0	49.5
180	356	119.0	109.2	99.2	89.4	80.3
200	392	186.5	171.2	155.4	140.1	125.8
218	424	271.9	249.5	226.6	204.2	183.6

An inert gas such as nitrogen should be used in the headspace at a pressure 3-5 psi greater than the vapor pressure of the fluid to maintain the liquid phase when it is taken above the boiling point of the fluid.

Shelf Life

Dynalene HC will remain stable for a period of at least five years if:

1. It is stored in the original unopened container
2. The storage area temperature does not exceed 100°F (37°C)
3. It is kept out of direct sunlight

Metals Compatibility

Dynalene HC 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 copper, brass, and bronze are used as a wetted material of construction with the Dynalene HC-FG formulation.***

** *Contact Dynalene when utilizing aluminum or cast iron as a wetted material of construction with any Dynalene HC formulation. Call 1-877-244-5525 or email at info@dynalene.com*

Caution: Do not use magnesium, zinc, zinc-plated, or galvanized metals in the heat transfer loop containing Dynalene HC. These metals are acceptable to use as support framing, electrical conduit, and structural components. If HC spills or splashes on any metals rinse immediately with water to prevent surface discoloration.

Gasket & Polymer Compatibility

For compatibility of Dynalene HC with gasket and polymer materials, refer to the table below.

Table 3. Polymer and gasket compatibility with Dynalene HC and HC-FG.

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

General Installation Guidelines

The following recommendations are provided to assist the Dynalene HC 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 HC, review and understand all of the information contained in this engineering guide (if replacing a fluid in an existing system with Dynalene HC, be sure to review section "Retrofitting for Dynalene HC").

3 Presence of Air

It is always recommended to eliminate the presence of air in your system. In closed systems, Dynalene advises use of a nitrogen blanket 3-5 psi above the vapor pressure of the fluid. This will prevent outside oxygen from entering the system.

4 Maximum Surface Temperature

Surface temperature of heat source components in systems using Dynalene HC should not exceed 500°F (260°C). 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 HC systems should not exceed a maximum watt density of 60 W/in^2 with a minimum fluid velocity of 6 to 8 ft/sec. Watt density not exceeding 45 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 electrical connection, there may be condensation resulting in short circuiting.

6 Pump Equipment

Pumps with mechanical seals should be evaluated by the pump manufacturer. Dynalene recommends using **tungsten carbide** or **silicon carbide** mechanical seals. Seal materials such as polymer, carbon, or soft ceramics may abrade over time, causing leakage. Sealless, magnetically driven, and canned pumps are also acceptable.

Elastomer compatibility, working temperatures and pressure limitations of a mechanical seal assembly should be reviewed by the pump manufacturer prior to operating in a system with Dynalene HC.

7 Volumetric Expansion

Volumetric expansion and/or contraction of Dynalene HC 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 4.

8 Reservoir Tank

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

9 Pressure Relief Valve Considerations

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

Valve Sizing: Relief valve sizing depends on whether the valve is located to relieve liquid or vapor from Dynalene HC. Regarding liquid, the relief valves should be sized using the Dynalene HC 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 vapor is primarily water (steam). The latent heat of water should be used to calculate flashing.

Table 4. Volumetric expansion of Dynalene HC and HC-FG.

Temp		Volumetric Expansion, %				
°F	°C	HC-10	HC-20	HC-30	HC-40	HC-50
-50	-45.6					-2.44
-40	-40.0				-2.31	-2.23
-30	-34.4			-1.96	-2.08	-2.01
-20	-28.9			-1.74	-1.86	-1.79
-10	-23.3		-1.60	-1.53	-1.63	-1.57
0	-17.8		-1.38	-1.31	-1.40	-1.35
10	-12.2	-1.04	-1.15	-1.10	-1.17	-1.13
20	-6.7	-0.84	-0.92	-0.88	-0.94	-0.90
40	4.4	-0.42	-0.46	-0.44	-0.47	-0.45
60	15.6	0.00	0.00	0.00	0.00	0.00
90	32.2	0.64	0.70	0.67	0.71	0.69
130	54.4	1.50	1.66	1.58	1.68	1.62
170	76.7	2.37	2.63	2.50	2.67	2.57
210	98.9	3.26	3.62	3.44	3.68	3.54
250	121.1	4.17	4.62	4.40	4.70	4.52
290	143.3	5.09	5.65	5.37	5.75	5.53
330	165.5	6.03	6.70	6.36	6.82	6.55
370	187.8	6.98	7.77	7.37	7.91	7.60
425	218.3	8.33	9.28	8.80	9.45	9.07

10 Dynalene HC Quality Check

Dynalene recommends a sample to be sent to Dynalene for a quality inspection immediately after system startup, in a clean collection container made of material compatible with Dynalene HC. 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 return the fluid to Dynalene for testing. Often residual flushing water left in the system can dilute the Dynalene HC fluid, in which case Dynalene will recommend how to readjust the concentration. Representative samples of Dynalene HC should be obtained from an active liquid stream, ideally at room temperature.

Retrofitting for Dynalene HC

Dynalene HC can be substituted for the following fluids:

- Calcium Chloride Brine
- CFC / HFC Based
- Chlorinated Solvents
- Glycols
- Hydrocarbon Based
- Alcohol
- Petroleum Derivatives
- Perfluorocarbon
- Silicone Based Liquid
- Terpene Derived Liquid

Review and understand all of the information contained in this manual prior to purchasing Dynalene HC for use as a replacement heat transfer fluid.

Care must be taken when preparing an existing system for installation of Dynalene HC. Once the original heat transfer fluid is removed, it is not unusual for systems to retain small amounts of the residual fluid in low lying areas such as piping traps, inverted coils, pump housings, valve housings, drain pipes, etc. The residual fluids must be removed if Dynalene HC is to function properly as specified.

The system preparation procedure is particularly important when the existing heat transfer fluid is a non-aqueous fluid. Although Dynalene HC is miscible with glycols and alcohols, proper cleaning procedures should be followed.

The following recommendations are provided by Dynalene to assist the installer or end user in achieving a successful retrofit.

- Determine the actual volume of the heat transfer fluid used during the original system charge. Compare against the volume of liquid removed during the draining process to determine the amount of residual fluid remaining in the system. Storage tank level readings must also be taken into consideration.
- To remove residual fluids, purge the existing system with compressed air or an inert gas such as nitrogen (for combustible liquids). For best results, purge intermittently with disruptions to zero pressure once every two minutes. For example, purge with pressure for one minute, and then disrupt purge to zero pressure in system for the next minute. Continue this process for several minutes until there is no more fluid leaving the system.
- Collect the residual fluid from the purging process in a vented container for disposal.

Residual liquid that remains in an existing system after thorough gas purging can usually be removed by one of the following methods discussed below:

1. System evacuation
2. Air and inert gas evaporation
3. Dilution

If the heat transfer fluid is water soluble, thoroughly flush the entire system with distilled or deionized water. Do not use chlorinated tap water. Small amounts of clean, non-ionic flush water that remains in the system is acceptable if free from 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 in accordance with local, state and federal regulations.

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 is generally opposite to the inlet air or inert gas connection.

3 Dilution

Dilution of residual fluid can be performed in conjunction with the system evacuation or evaporation methods. Dilution of the residual fluid can be performed by selecting a dilution solvent that is miscible with the residual fluid and has a high vapor pressure.

After diluting the residual fluid with the solvent, drain and follow either step 1 or 2.

Contaminants in Dynalene HC

Residual fluid particulates can be removed from Dynalene HC by flowing the fluid through an inline or slipstream filter. Dynalene's DYS series filters are frequently used with HC and are available through Dynalene for purchase.

New Systems Using Dynalene HC

The following recommendations are provided by Dynalene to assist the end user in achieving a proper installation.

- **Flush the System**
  New systems intending to use Dynalene HC should be properly flushed after installing components such as pipes, valves, pumps, etc. Materials from welding operations, excess pipe joint compound, oils, and other unwanted contaminants must be removed completely. Thoroughly flush the system with distilled or deionized water and drain to remove as much water as possible. Small amounts of flush water that remain in the system are acceptable if free from contaminants. Residual water may dilute the Dynalene HC upon initial installation, in which case the HC concentration can be adjusted using Dynalene HC-Max.

- **Install Line Filtration**
  Dynalene HC should remain free of debris throughout the operational life of the liquid. Entrained sediment and other solid contaminants accelerate erosion and corrosion, lowering the threshold velocities at which erosion begins to occur. In the case of very low velocities, sediment is 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 conditioning Dynalene HC. Strainer/filtration equipment that bypasses the main system can be installed for systems that cannot be interrupted to change filter cartridges.

Dynalene HC Property Comparisons

A heat transfer performance comparison of Dynalene HC vs other antifreeze coolants is given in Figure 1. Heat transfer coefficients are calculated for solutions with melting temperatures of -40°C while flowing at 3 ft/s velocity through 1” piping. Dynalene HC shows superior heat transfer throughout its temperature range when compared against propylene glycol, ethylene glycol, and calcium chloride with similar melting temperatures.

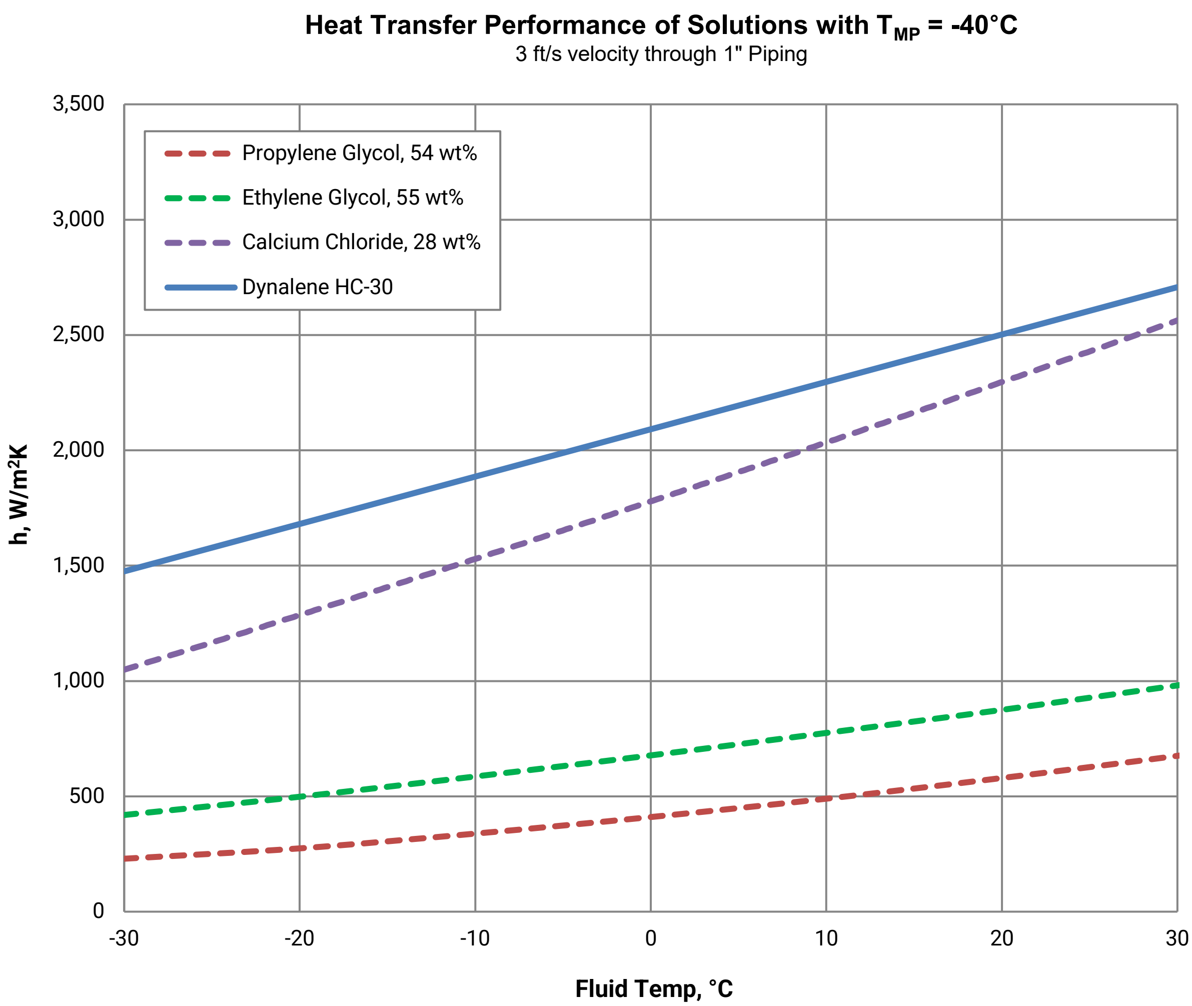

Figure 1. Heat transfer performance comparison of Dynalene HC-30 vs propylene glycol, ethylene glycol, and calcium chloride solutions with T_{MP} = -40°C.

Dynalene HC-50 Properties

Thermophysical properties for Dynalene HC-50 are given in Tables 5a and 5b.

Table 5a. Dynalene HC-50 properties, SI units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°C	mPa·s	W/m·K	kJ/kg·K	kg/m³
-50	38.40	0.435	2.563	1378
-40	20.40	0.445	2.583	1373
-30	12.50	0.455	2.602	1367
-20	8.40	0.465	2.622	1362
-10	5.99	0.475	2.642	1356
0	4.70	0.485	2.661	1351
10	3.80	0.495	2.681	1345
20	3.20	0.505	2.701	1340
30	2.70	0.515	2.720	1334
40	2.40	0.525	2.740	1328
50	2.10	0.535	2.760	1323
60	1.80	0.545	2.780	1317
70	1.60	0.555	2.799	1312
80	1.50	0.565	2.819	1306
90	1.30	0.575	2.839	1301
100	1.20	0.585	2.858	1295
110	1.10	0.595	2.878	1290
120	1.00	0.605	2.898	1284
130	0.94	0.615	2.917	1279
140	0.87	0.625	2.937	1273
150	0.81	0.635	2.957	1267
160	0.76	0.645	2.977	1262
170	0.71	0.655	2.996	1256
180	0.66	0.665	3.016	1251
190	0.62	0.675	3.036	1245
200	0.58	0.685	3.055	1240
210	0.55	0.6945	3.075	1234

Table 5b. Dynalene HC-50 properties, English units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°F	cP	BTU/hr·ft·°F	BTU/lb·°F	lb/ft³
-58	38.40	0.256	0.612	85.9
-50	28.30	0.258	0.615	85.7
-40	20.40	0.262	0.617	85.6
-20	11.90	0.268	0.622	85.2
0	7.70	0.275	0.628	84.8
20	5.40	0.281	0.633	84.4
40	4.20	0.288	0.638	84.0
60	3.40	0.294	0.643	83.6
80	2.90	0.301	0.649	83.3
100	2.40	0.307	0.654	82.9
120	2.10	0.314	0.659	82.5
140	1.80	0.320	0.664	82.1
160	1.60	0.327	0.669	81.7
180	1.40	0.333	0.675	81.3
200	1.30	0.340	0.680	80.9
220	1.20	0.346	0.685	80.6
240	1.10	0.353	0.690	80.2
260	0.97	0.356	0.696	79.8
280	0.89	0.366	0.701	79.4
300	0.82	0.373	0.706	79.0
320	0.76	0.379	0.711	78.6
340	0.70	0.386	0.717	78.3
360	0.65	0.392	0.722	77.9
380	0.61	0.399	0.727	77.5
400	0.57	0.405	0.732	77.1
420	0.53	0.412	0.737	76.7
425	0.53	0.413	0.739	76.6

Dynalene HC -40 Properties

Thermophysical properties for Dynalene HC-40 are given in Tables 6a and 6b.

Table 6a. Dynalene HC-40 properties, SI units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°C	mPa·s	W/m·K	kJ/kg·K	kg/m³
-40	14.90	0.449	2.80	1348
-30	9.20	0.459	2.82	1343
-20	6.50	0.469	2.84	1337
-10	4.90	0.479	2.87	1332
0	3.90	0.489	2.89	1326
10	3.20	0.499	2.91	1321
20	2.70	0.509	2.93	1315
30	2.30	0.519	2.96	1309
40	1.96	0.529	2.98	1304
50	1.70	0.539	3.00	1298
60	1.50	0.549	3.03	1293
70	1.40	0.559	3.05	1287
80	1.20	0.569	3.07	1281
90	1.10	0.579	3.09	1276
100	0.99	0.589	3.12	1270
110	0.91	0.599	3.14	1265
120	0.83	0.609	3.16	1259
130	0.77	0.619	3.19	1253
140	0.71	0.629	3.21	1248
150	0.66	0.639	3.23	1242
160	0.61	0.649	3.25	1237
165	0.59	0.654	3.27	1234
170	0.57	0.659	3.28	1231
180	0.53	0.669	3.30	1225
190	0.50	0.679	3.32	1220
200	0.47	0.689	3.35	1214

Table 6b. Dynalene HC-40 properties, English units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°F	cP	BTU/hr·ft·°F	BTU/lb·°F	lb/ft³
-40	14.90	0.264	0.669	84.0
-20	8.80	0.271	0.675	83.6
0	6.10	0.277	0.681	83.2
20	4.50	0.284	0.687	82.8
40	3.50	0.290	0.693	82.5
60	2.90	0.297	0.699	82.1
80	2.40	0.303	0.705	81.7
90	2.20	0.307	0.708	81.5
100	2.00	0.310	0.711	81.3
120	1.70	0.316	0.717	80.9
140	1.50	0.323	0.723	80.5
160	1.30	0.330	0.729	80.1
180	1.20	0.336	0.735	79.8
200	1.10	0.343	0.741	79.4
220	0.95	0.349	0.747	79.0
240	0.86	0.356	0.753	78.6
260	0.79	0.362	0.759	78.2
280	0.72	0.369	0.765	77.8
300	0.66	0.375	0.771	77.4
320	0.61	0.382	0.777	77.0
340	0.56	0.388	0.784	76.7
360	0.52	0.395	0.79	76.3
380	0.49	0.401	0.796	75.9
400	0.45	0.408	0.802	75.5
420	0.42	0.414	0.808	75.1
425	0.42	0.416	0.809	75.0

Dynalene HC -30 Properties

Thermophysical properties for Dynalene HC-30 are given in Tables 7a and 7b.

Table 7a. Dynalene HC-30 properties, SI units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°C	mPa·s	W/m·K	kJ/kg·K	kg/m³
-30	7.00	0.469	2.961	1300
-20	5.50	0.479	2.984	1295
-10	4.50	0.489	3.007	1290
0	3.70	0.499	3.031	1285
10	3.00	0.509	3.054	1280
20	2.50	0.519	3.077	1275
30	2.20	0.529	3.100	1270
40	1.90	0.539	3.123	1265
50	1.60	0.549	3.146	1260
60	1.40	0.559	3.169	1255
70	1.30	0.569	3.192	1250
80	1.10	0.579	3.215	1244
90	0.99	0.589	3.238	1239
100	0.89	0.599	3.262	1234
110	0.80	0.609	3.285	1229
120	0.73	0.619	3.308	1224
130	0.67	0.629	3.331	1219
140	0.61	0.639	3.354	1214
150	0.57	0.649	3.377	1209
160	0.52	0.659	3.400	1204
170	0.48	0.669	3.423	1199
180	0.45	0.679	3.446	1193
190	0.42	0.689	3.469	1188
200	0.39	0.699	3.493	1183
210	0.37	0.709	3.516	1178

Table 7b. Dynalene HC-30 properties, English units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°F	cP	BTU/hr·ft·°F	BTU/lb·°F	lb/ft³
-22	6.99	0.276	0.708	81.0
-20	6.80	0.276	0.708	81.0
0	5.30	0.283	0.714	80.6
20	4.20	0.289	0.721	80.3
40	3.40	0.296	0.727	79.9
60	2.70	0.302	0.733	79.6
80	2.30	0.309	0.739	79.2
100	1.90	0.316	0.745	78.9
120	1.60	0.322	0.751	78.5
140	1.40	0.329	0.757	78.2
160	1.20	0.335	0.763	77.8
180	1.10	0.342	0.770	77.5
200	0.95	0.348	0.776	77.1
220	0.85	0.355	0.782	76.8
240	0.76	0.361	0.788	76.4
260	0.69	0.368	0.794	76.0
280	0.62	0.374	0.800	75.7
300	0.57	0.381	0.806	75.3
320	0.52	0.387	0.812	75.0
340	0.48	0.394	0.819	74.6
360	0.44	0.400	0.825	74.3
380	0.41	0.407	0.831	73.9
400	0.38	0.414	0.837	73.6
420	0.36	0.420	0.843	73.2
425	0.35	0.422	0.845	73.1

Dynalene HC -20 Properties

Thermophysical properties for Dynalene HC-20 are given in Tables 8a and 8b.

Table 8a. Dynalene HC-20 properties, SI units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°C	mPa·s	W/m·K	kJ/kg·K	kg/m³
-20	4.50	0.483	3.117	1258
-10	3.60	0.493	3.141	1253
0	3.00	0.503	3.164	1248
10	2.50	0.513	3.188	1242
20	2.10	0.523	3.212	1237
30	1.80	0.533	3.235	1232
40	1.60	0.543	3.259	1227
50	1.40	0.553	3.282	1222
60	1.20	0.563	3.306	1216
70	1.10	0.573	3.330	1211
80	0.95	0.583	3.353	1206
90	0.85	0.593	3.377	1201
100	0.77	0.603	3.400	1196
110	0.70	0.613	3.424	1191
120	0.63	0.623	3.448	1185
130	0.58	0.633	3.471	1180
140	0.54	0.643	3.495	1175
150	0.49	0.653	3.518	1170
160	0.46	0.663	3.542	1165
170	0.43	0.673	3.566	1159
180	0.40	0.683	3.589	1154
190	0.37	0.693	3.613	1149
200	0.35	0.703	3.636	1144
210	0.33	0.713	3.660	1139

Table 8b. Dynalene HC-20 properties, English units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°F	cP	BTU/hr·ft·°F	BTU/lb·°F	lb/ft³
-4	4.50	0.284	0.745	78.4
0	4.30	0.285	0.746	78.3
20	3.40	0.292	0.752	77.9
40	2.80	0.298	0.759	77.6
60	2.30	0.305	0.765	77.2
80	1.90	0.311	0.771	76.9
100	1.60	0.318	0.777	76.5
120	1.40	0.324	0.784	76.1
140	1.20	0.331	0.790	75.8
160	1.00	0.337	0.796	75.4
180	0.93	0.344	0.803	75.1
200	0.82	0.351	0.809	74.7
220	0.73	0.357	0.815	74.3
240	0.66	0.364	0.821	74.0
260	0.60	0.370	0.828	73.6
280	0.54	0.377	0.834	73.3
300	0.50	0.383	0.840	72.9
320	0.46	0.390	0.846	72.6
340	0.42	0.396	0.853	72.2
360	0.39	0.403	0.859	71.8
380	0.36	0.409	0.865	71.5
400	0.34	0.416	0.871	71.1
420	0.32	0.422	0.878	70.8
425	0.31	0.424	0.879	70.7

Dynalene HC -10 Properties

Thermophysical properties for Dynalene HC-10 are given in Tables 9a and 9b.

Table 9a. Dynalene HC-10 properties, SI units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°C	mPa·s	W/m·K	kJ/kg·K	kg/m³
-10	3.00	0.494	3.246	1204
0	2.50	0.504	3.271	1199
10	2.10	0.514	3.296	1195
20	1.80	0.524	3.320	1190
30	1.50	0.534	3.345	1186
40	1.30	0.544	3.370	1181
50	1.20	0.554	3.395	1177
60	1.00	0.564	3.420	1172
70	0.91	0.574	3.444	1167
80	0.81	0.584	3.469	1163
90	0.73	0.594	3.494	1158
100	0.66	0.604	3.519	1154
110	0.60	0.614	3.544	1149
120	0.55	0.624	3.568	1145
130	0.51	0.634	3.593	1140
140	0.47	0.644	3.618	1136
150	0.43	0.654	3.643	1131
160	0.40	0.664	3.668	1127
170	0.37	0.674	3.692	1122
180	0.35	0.684	3.717	1118
190	0.33	0.694	3.742	1113
200	0.31	0.704	3.767	1109
210	0.29	0.714	3.792	1104
218	0.28	0.722	3.811	1101

Table 9b. Dynalene HC-10 properties, English units.

	Viscosity	Therm. Cond.	Specific Heat	Density
°F	cP	BTU/hr·ft·°F	BTU/lb·°F	lb/ft³
14	3.00	0.291	0.776	75.0
20	2.80	0.293	0.778	74.9
40	2.30	0.299	0.784	74.6
60	1.90	0.306	0.791	74.3
80	1.60	0.312	0.797	74.0
90	1.50	0.316	0.801	73.8
100	1.40	0.319	0.804	73.6
120	1.20	0.326	0.811	73.3
140	1.00	0.332	0.817	73.0
160	0.90	0.339	0.824	72.7
180	0.79	0.345	0.830	72.4
200	0.71	0.352	0.837	72.1
220	0.63	0.358	0.843	71.8
240	0.57	0.365	0.850	71.5
260	0.52	0.371	0.857	71.1
280	0.47	0.378	0.863	70.8
300	0.44	0.384	0.870	70.5
320	0.40	0.391	0.876	70.2
340	0.37	0.397	0.883	69.9
360	0.34	0.404	0.890	69.6
380	0.32	0.410	0.896	69.3
400	0.30	0.417	0.903	68.9
420	0.28	0.424	0.909	68.6
425	0.28	0.425	0.911	68.6

Toxicological Report

The following toxicological information on Dynalene HC heat transfer fluid are excerpts obtained from the "Detailed Report" conducted by a 3rd party expert, Target Health Inc. (Dr. Jules T. Mitchell). Select proprietary information has been omitted in this abbreviated report for the sole purpose of maintaining confidentiality on the product recipe. More detailed information is available to qualified recipients. Please contact the Dynalene Engineering Department at (610) 262-9686, fax (610) 262-7437 or through the Internet at www.dynalene.com, if you require additional information.

1 Introduction

Dynalene HC is a heat transfer fluid used in food processing. Under normal conditions of use, the cooling solution would not contact food, and thus human exposure is unlikely. It is nevertheless possible that an unforeseen circumstance in the processing area might result in unintended contact with food, or that there might be accidental exposure in the workplace. Therefore, an assessment of the toxicity of Dynalene HC was undertaken. This safety assessment involved the following three steps:

- Three non-clinical toxicology studies were conduct with Dynalene HC in order to characterize the acute toxicity profile.
- A literature review of the toxicity data of each of the components of Dynalene HC was conducted.
- An overall assessment was made of the safety of the product.

2 Toxicity Data on Dynalene HC

Three acute toxicity studies, performed under contract by Sitek Research Laboratories, were conducted using Dynalene HC. The studies evaluated:

- Acute oral toxicity
- Acute dermal toxicity
- Dermal irritation potential

All studies were performed under Good Laboratory Practice (GLP) standard:
United States Environmental Protection Agency Title 40 Code of Federal Regulations parts 160 and 792 Revised July 1, 1992.

Based on the data collected in animals, Dynalene HC did not product acute oral or dermal toxicity and was not a skin irritant. "The limit doses" used in the toxicity studies were based on recommendations of Hazardous Substances Labeling Act (HSLA), the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA). Products that do not induce toxicity at the 'limit doses" may be considered non-toxic.

In the acute oral study, rats (n ¸ 5/sex) received a single oral dose of 5,000 mg/kg (the limit dose) and were observed for 14 days (Cockerham 1999a). None of the rats died during the study and no advance clinical signs were reported. The only finding noted at necropsy was the presence of small amorphous, fatty-like deposits in the bladders of the five males. Similar findings were not noted in the females. A relationship to treatment was neither proved nor disproved. Based on this data, the acute oral LD50 (lethal dose killing 50% of the animals) is greater than 5,000 mg/kg. It is concluded that Dynalene HC can be considered non-toxic by the oral route and that no acute effects would be anticipated following accidental oral exposure.

In the acute dermal toxicity study, rabbits (in = 5/sex) received a single dermal dose of 2,000 mg/kg (the limit dose) and were observed for 14 days (Cockerham 1999b). No treatment-related mortalities, clinical signs or gross pathological changes were observed. The acute dermal LD50 was greater than 2,000 mg/kg. It is concluded that Dynalene HC can be considered non-toxic by the dermal route and that no skin reactions would be anticipated following accidental dermal exposure.

The dermal irritation potential of Dynalene HC (0.5 ml) was examined in rabbits (n = 6 females) up to 72 hours post-dosing (Cockerham 1999C). No irritation occurred at any time. It is concluded that Dynalene HC can be considered non-irritating to the skin.

3 Overall Safety Assessment

Based on the data collected in animals, Dynalene HC did not produce acute oral or dermal toxicity and was not a skin irritant. The “limit doses” used in the toxicity studies were based on recommendations of the Hazardous Substances labeling Act (HSLA), the Environmental protection Agency (EPA) and the Food and Drug Administration (FDA). Products that do not induce toxicity at the "limit doses” may be considered non-toxic. It is also concluded that Dynalene HC is unlikely to produce adverse effects after possible accidental acute exposures. These conclusions are based on the:

- Lack of toxic effects in a series of acute toxicity studies conducted Dynalene HC.
- Minimal evidence of acute toxicity reported in the published literature on the components of Dynalene HC.

While reports of long-term effects were noted [in the literature] for some of the components, the multiple or lifetime doses [suspected of producing these long-term effects] are not an anticipated risk of Dynalene HC. [One component (present in Dynalene HC at less than 0.5%) upon high, long-term dosing produced equivocal evidence of carcinogenicity in rodents and weakly positive mutagenicity in an Ames test. (Carcinogenicity: NTP: no, IARC: no, OSHA: no).] It is concluded that in the event of an accidental human exposure to Dynalene HC, the material will not produce adverse effects.
All studies were performed under Good Laboratory Practice (GLP) standard: United States Environmental Protection Agency Title 40 Code of Federal Regulations parts 160 and 792 Revised July 1, 1992 25.

Product Disclaimer

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Locations and Contact Information

Corporate Headquarters
Dynalene, Inc.
5250 West Coplay Road
Whitehall, PA 18052
USA
Phone: 610-262-9686 / 1-855-216-7639
Fax: 610-262-7437
Email: info@dynalene.com
Website: www.dynalene.com

Midwest Location
248 Beinoris Drive
Wood Dale, IL 60191
USA
Phone: 1-855-216-7639
Fax: 847-228-2842

West Location
1701 S 5350 W
Salt Lake City, UT 84104
USA
Phone: 1-877-244-5525
Fax: 610-262-7437