DYNALENE HC

HEAT TRANSFER FLUID

* Engineering Guide *

DYNALENE HC ENGINEERING GUIDE

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Dynalene HC Engineering Guide

Product Overview:

Dynalene HC (hydrocoolant) is an environmentally friendly low to medium temperature heat transfer fluid engineered to operate efficiently within the range of -58°F (-50°C) up to 425°F (218°C), in systems recognized as adequate by Dynalene's engineering department, and built in accordance with normal engineering practices.

DYNALENE HC is a non-combustible, aqueous based fluid that does not support bioactivity and has thermophysical qualities that far exceed most other alternatives. DYNALENE HC heat transfer fluid is also virtually odor free, biodegradable, CFC free, and is considered non-toxic based on recommendations of Hazardous Substances Labeling, Act, EPA and FDA (see Appendix 1).

Six standard formulations of DYANLENE HC have been preengineered to offer each low temperature application the most cost effective product selection. Each formulation exhibits specific qualities that include optimum viscosity; density and affordability, best suited for the modern day customer. Custom formulations and the full concentrate version, Dynalene HC-MAX are also available to satisfy special requirements.

Initial Crystallization Point (ICP):

ICP of DYANLENE HC heat transfer fluid is dependable on the specific formulation:

Dynalene HC Formulation	*ICP
Dynalene HC-10	-5°F (-21°C)
Dynalene HC-20	-25°F (-31°C)
Dyanlene HC-30	-45°F (-43°C)
Dynalene HC-40	-60°F (-51°C)
Dynalene HC-50	-67°F (-55°C)

**Minimum surface temperature should remain 10° higher than ICP.*

Packing & Shipping:

DYNALENE HC heat transfer fluids are available in 5-gallon pails, 55-gallon drum and bulk quantities.

DYNALENE HC has a shipping hazard classification number of 0 in the USA. By current definition in 49 CFR 172.101 by the US Department of Transportation, DYNALENE HC is not hazardous. DYNALENE HC is also recognized as non-combustible and is not a marine pollutant when transported by highway, rail, air or waterway.

All Dynalene HC heat transfer fluid 5-gallon pail(s) can be shipped using the typical ground or air delivery services including, but not limited to UPS, Federal Express, FedX Ground and Emery. Generally, this product is shipped the same day the order is placed. Multiple quantity 5-gallon pails or 55-gallon drum orders can be shipped via most common carriers trucking companies, select air or dedicated ground freight services. Contact your local authorized representative or Dynalene USA at +1-610-262-9686 or Fax +1-610-262-7437, if larger quantities are required. Special delivery requirements will be accommodated if possible.

All standard ground shipments are freight prepaid and billed with invoice, unless otherwise specified.

Non-Combustibility Rating:

DYNALENE HC heat transfer fluid formulations are aqueous based, therefore, this product demonstrates no flash point or fire point Operating temperatures in excess of 660°F (349°C) may decompose the components of DYNALENE HC into combustible by-products.

Vapor Pressure:

Vapor pressure is a critical property to be considered when calculating Net Positive Suction Head (NPSH), a major factor in the sizing of fluid handling equipment especially when DYNALENE HC heat transfer fluid is operating above of 120°F (49°C).

"Airtight" containment is recommended to limit the rapid escape of moisture from DYNALENE HC fluids when used in closed systems operating above 120°F (49°C). See the table below for the vapor pressure of DYNALENE HC at various temperatures. When operating in temperatures above 120°F (49°C), consult the Dynalene Engineering Department prior to using DYNALENE HC in open bath applications or where the heat transfer fluid is not in vapor tight containment.

Temperature Range	Dynalene HC-40 **PSIA**	Dynalene HC-30 **PSIA**
77°F (25°C)	<1.0	<1.0
212°F (100°C)	9.5	10.0
365°F (185°C)	105	120

∗Consult factory for vapor pressure values on other DYNALENE HC products or use of DYNALENE HC in systems operating above 365°F (185°C). Also, see vapor pressure graph on page 19 in this manual.

The basic fluid system sketch illustrated in Figure 1 (page 13), is an example of a typical Dynalene heat transfer fluid method of excluding oxygen especially when using DYNALENE HC, especially when operating temperatures above 200º F (93º C) is operated above its boiling point. The inert gas pressure regulator BPV set point should be approximately 5% higher than the maximum DYNALENE HC vapor pressure value anticipated with the system.

WARNING: AT NO TIME OVERALL OPERATING PRESSURE, WHICH INCLUDES THE INERTING GAS PRESSURE, SHALL BE EXCEED THE DESIGN PRESSURE RATING OF ANY INDIVIDUAL COMPONENT WITHIN A SYSTEM.

Storage Thermal Stability:

DYNALENE HC heat transfer fluids will remain thermophysically stable for a period of at least five years if:

1. It is stored in the original unopened pail or drum.
2. The storage area temperature does not exceed 100°F (37°C).

Metals Compatibility:

DYNALENE HC heat transfer fluid has a good compatibility rating when in pre-engineered, leak free systems constructed within the temperature, pressure, and structural limitations of the following metals:

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

*Consult factory when utilizing aluminum as a wetted material of construction.

Do not use DYNALENE HC in systems containing magnesium, zinc, zinc-plated, or galvanized metals. DYNALENE HC spilled or splashed on certain metallic surfaces may cause external corrosion as evaporation of water causes a change in pH and inhibitor effect. Galvanized or zinc plated metal is especially susceptible. Non-ferrous alloys may develop surface corrosion. Exterior metal surfaces exposed to DYNALENE HC should be thoroughly cleaned with water and dried as soon as practical to limit or eliminate the potential for corrosion. For a compatibility review on the materials listed above, or any other material not mentioned in this section consult the Dynalene Engineering Department in the USA at +1-610- 262-9686, Fax +1-610-262-7437, or e-mail at info@dynalene.com.

Gasket & Polymer Compatibility:

DYNALENE HC heat transfer fluid has an acceptable compatibility when used within the temperature and pressure limitations of the following polymer or gasketing material. The rating values of excellent, good or fair as listed below characterize the resistance to attack by DYNALENE HC and not the suitability for a particular sealing application.

Nitrile / NBR	Excellent to 150°F Good to 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
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	Good / Excellent
Polyvinyl Chloride /PVC	Good / Excellent
Polyethylene	Excellent
Polypropylene	Excellent
Epoxy	Good / Excellent
Graphite	Excellent

For a compatibility review on the materials listed in the previous column or other materials not mentioned in this section, consult Dynalene Engineering Department in the USA at +1-610-262-9686, or fax +1-610-262-7437 or at our website www.dynalene.com.

General Installation Guidelines:

The following recommendations are provided by the Dynalene Technical Field Support Group to assist the DYNALENE HC heat transfer fluid installer or user in achieving an incident free installation. It should be understood that installation procedures other than those described by Dynalene may also need to be followed by the engineer, installer or end user involved in the design, construction, or operation of the heat transfer fluid system to ensure ultimate safety and efficiency.

1. The Manual

Prior to purchasing any DYNALENE HC, review and understand all of the information contained in this manual-especially the section titled Retrofitting for Dynalene HC and New Systems Using Dynalene HC.

2. ***Oxygen***

Limiting the presence of oxygen within the wetted areas of a pipe system promotes the highest service favorable substitute to air in the vapor space. It should be understood that DYNALENE HC is recognized as a safe and efficient heat transfer fluid for open bath applications. However, a replenishable supply for air (oxygen) in contact with DYNALENE HC as with most other heat transfer fluids will promote corrosion for certain common ferrous and non-ferrous metals.

3. Maximum Surface Temperature

Surface temperature of heat source components in low velocity systems using DYNALENE HC heat transfer fluid should not exceed 500°F. Fluid velocity should be maintained between 4 to 8 feet per second.

4. ***Using Electric Resistance Heaters***

In-line electric resistance heaters used in DYNALENE HC heat transfer fluid systems should not exceed a maximum watt density of 60 watts per square inch with a minimum fluid velocity of 6 to 8 feet per second. Watt density not exceeding 45 watts per square inch is recommended for direct “tank” immersion electric resistance heater applications.

Enclosures containing electric resistance element and wire terminations that are in thermal contact with the cold surfaces of a system must be protective from the effects of moisture. Excessive moisture may accumulate inside the electrical enclosure. Given the appropriate conditions, this will eventually corrode the wiring connection points and may saturate the insulation with moisture, creating a possible “dead short” in the circuit of the element. Limiting moisture in the areas stated above can be accomplished by inerting the inner areas of the electric enclosure(s) with low pressure/ low flow (1 psig) 2 cfh gaseous nitrogen or carbon dioxide, or by protecting the electrical connections and element termination points with a non-conductive, moisture resistive compound such as rated epoxies or RTV gasket sealing material.

If a review is required on a heating device you have considered, consult the Dynalene Engineering Department at +1-610-262-9686 or fax +1-610-262-7437.

5. ***Pump Equipment***

Pump equipment operating with DYNALENE HC should have adequate net suction head pressure in the piping up to the pump inlet, including the pump housing. Inadequate net suction head pressure may hinder pump performance by creating a negative pressure within the pump cavity. Special designed pumps capable of operating at less than normal suction head pressures should be used if inadequate suction pressure is contemplated. DYNALENE HC vapor pressure must be considered when estimating the required net positive suction head (NPSH).

Pump with mechanical seals should be evaluated by the pump manufacturer for use with the dissolved solids in ionic aqueous solutions prior to installation. If a condition could exist that promote seal leakage, seal-less pumps such as totally encapsulated, magnetically driven or canned pumps will eliminate leakage completely. Packing gland or carbon sealing surfaces are not recommended at higher operating temperatures.

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 heat transfer fluid.

6. ***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. Determine the maximum operating temperature difference of DYNALENE HC that could be realized within the system, including intermittent temperature excursions. Refer to the *DYNALENE HC VOLUMETRIC EXPANSION CHART* on page 20 to determine the estimated fluid volume change percent. The DYNALENE HC volume change, plus a maximum additional safety factor of 10% of total volume, must be allowed for head or vapor space within system. Should no additional headspace be available, installation of a pressure rated expansion tank of adequate volume into an existing piped system would be required.

7. ***Proper Venting***

Proper breathing allowances, purging and elimination of air from the DYNALENE HC side of chilled or hot heat transfer fluid system is essential. As with all aqueous based heat transfer fluids, air bubbles can contribute to the damaging effects of erosion and corrosion. Return fluid piping should enter a storage tank below the DYNALENE HC surface level to prevent air entrapment and bubbles.

8. ***Pressure Relief Valve Considerations***

Proper relief valve design must be understood & practiced for every system using DYNALENE HC. As recognized in all system with a potential of pressurization, improperly sized or installed relief valve mechanisms may result in premature equipment failure, rupture or explosion; all of which cause bodily injury or death. The information in this section are minimum guidelines that should be recognized prior to information should be available from the supplier of the relief valve mechanism selected for the application.

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. For relief valves venting vapor and not liquid, the valve can for any non-condensable gas such as air or nitrogen present in the vapor space before the relief event. In extreme circuntances such as a fire, once the water is driven from the system, the remaining solids will not generate pressure until thermal decomposition, above 660°F (349°C), which potentially produce combinations of carbon monoxide, carbon dioxide, and hydrogen at a rate of approximately 0.00052lbs/BTU.

Discharge Piping Design of liquid relief valve discharge (vent) piping requires consideration of the potential for solid deposits from precipitation. If precipitation is allowed to occur, it can hinder the relief valve operation and cause a ion restrict in the discharge piping.

> **WARNING: An improperly sized, restricted or blocked relief valve or associated piping may result in system overpressure, implosion or explosion; all which may cause bodily injury or death**.

Whether precipitation will or will not occur depends on fluid temperature and water partial pressure conditions downstream of the relief valve.

Precipitation occurs when, through vaporization or evaporation, too much water leaves the fluid and the solubility limit of the dissolved solids is reached. Since DYNALENE HC concentration is sufficiently below the solubility limit, some evaporation can occur without any precipitation. Precipitation should not occur during a liquid relief event, even when flashing Dynalene's highest standard concentration fluid (HC-50), from the highest recommended use temperature (425°F), down to atmospheric pressure. However, this hot, flashed fluid can continue to evaporate eater sufficient to cause precipitation if the fluid is allowed to sit in the discharge piping and the water vapor is allowed to escape prior to cooing.

At ambient conditions, the dissolved solids in DYNALENE HC are hygroscopic enough that even after prolonged exposure to typical atmospheric conditions, solids do not precipitate. This will not be true, however, for elevated fluid humidity. Solids are expected to precipitate from exposed fluids under such conditions. When solids do precipitated, they are easily re-dissolved and rinsed away.

As required, design should ensure that any relieved DYNALENE HC fluid is either completely drained from discharge piping or the water vapor pressure is controlled so as to prevent excessive evaporation. Periodic inspection is recommended to ensure relief valve discharge piping do not accumulate precipitation from weeping relief valves or a previous discharge event. New or retrofit installations may include a water flushing port for maintenance flushing after a relief event. Burst or rupture disks alone or in conjunction with other relief devices may be used to ensure reliable relief. Magnesium zinc-plated, zinc or galvanized piping is not compatible with DYNALENE HC and should not be used in relief piping or as material of construction for the relief valve.

9. ***Dynalene HC Quality Check***

The Dynalene technical support group recommends a quality inspection be performed on DYNALENE HC heat transfer fluid at about the sixth month of operation in a system, then once per year thereafter. Once a representative sample of DYNALENE HC has been obtained from the system (see Representative Sample Analysis on page 10), the customer has the option to perform a pH and refractive index evaluation on-site. Normal pH for all standard DYNALENE HC products should remain at 9.5 to 10.5 pH.

Refractive index is one simplistic method of determining if the raw material concentration in DYNALENE HC has changed or has been modified. The refractive index for each DYNALENE HC formulation is listed in the following column. This test requires only a few drops of fluid from a representative sample to be added into the appropriate compartment of a refractometer. A hand held refractometer capable of analyzing all DYNALENE HC heat transfer fluid formulations is available for purchase through Dynalene.

Dynalene Product	Refractive Index
HC-10	1.366 ± 0.002
HC-20	1.373 ± 0.002
HC-30	1.378 ± 0.002
HC-40	1.385 ± 0.002
HC-50	1.392 ± 0.002

Retrofitting for DYNALENE HC:

DYNALENE HC heat transfer fluid has excellent capabilities when used in place of the fluids or refrigerants listed below, if the retrofit process conforms to good engineering practices that includes information contained in this manual.

- Calcium Chloride Brine
- CFC / HFC Based
- Chlorinated Solvents
- Glycols
- Hydrocarbon Based
- Alcohol Derivatives
- 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 heat transfer fluid. Once the original heat transfer fluid is removed, it is not unusual for systems to retain small amounts of residual liquid in low lying areas such as piping traps, inverted coil, pump housing, valve housings, drain pipes, etc. The residual liquids must be removed adequately if DYNALENE HC heat transfer fluid is to function properly as specified.

The preconditioning procedure is particularly important when the spent residual heat transfer fluid is a non-aqueous fluid. DYNALENE HC is miscible with propylene glycol, ethylene glycol and alcohol's; however, proper preconditioning should be followed.

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

- Determine the actual volume of the heat transfer liquid used during the original system charge. Compare against the volume of liquid removed during the retrofit process to determine the amount of residual liquid remaining in the system. Storage tank level readings must also be taken into considerations.
- To remove residual liquids, purge the existing system with compressed air or an inert gas as nitrogen if the residual liquid is combustible. 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. Switch back to purge, then zero pressure minute by minute.

Place a bucket, drum or other method of vented containment at the selected discharge connection of the purge process to accommodate sporadic flows of residual liquid while performing the purging procedure.

WARNING: The purging of any system should be performed in a well-ventilated environment and not in a confined space, that will quickly deplete the oxygen supply necessary to sustain human life, which will cause unconsciousness and death.

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

1. System Evacuation
2. Air and Inert gas Evaporation
3. Dilution

After residual liquid is removed, thoroughly flush the entire system with distilled or deionized water. **Do not use chlorinated tap water, OR water that contains chloride ions.** 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 liquid is the most favored method of determining the effectiveness of the system.

WARNING: Flush water may be contaminated and should be disposed in accordance with local, state and federal regulations.

1. ***System Evacuation*** Systems evacuation is performed by creating a vacuum, usually more than 28"Hg, within the existing system containing the residual liquid at room temperature. As the vacuum within the system increases, the boiling point of the residual liquid will decrease and evaporate. The intent is to evaporate the residual liquid completely by lowering its boiling point to below the internal temperature of the system.

   WARNING: Care must be taken in selecting the vacuum pump and vapor abatement equipment. Improperly

selected or sized vapor combustion, carbon adsorption, refrigeration condensation, or other vapor abatement systems may result in premature equipment failure, fire, or explosion, all of which may cause bodily injury or death. Proper containment static grounding practices must be used when transferring potentially hazardous or combustible residual liquids.

Consult the Dynalene Engineering Department in the USA at +1-610-262-9686 or fax +1-610-262-7437 or e-mail info@dynalene.com.

2. ***Air and Inert Gas Evaporation:*** Liquid evaporation using air or inert gas may be another method of removing residual liquid from an existing piping system. This is performed by allowing an adequate volume of warm compressed air or inert gas, such as nitrogen, to enter the existing system and flow through the inner piped wetted areas, including low points. The intent is to evaporate the residual liquid and allow the effluent to exit the piped system at a point that is generally opposite to the inlet air or inert gas connection.

   WARNING: Do not exceed the working pressure or temperature limitations of any component within the containment system being prepared for retrofitting. If the residual liquid has combustible properties, use inert gas and not compressed air-as the carrying medium.

3. ***Dilution:*** Dilution of residual liquid can be performed in conjunction with the system evacuation or evaporation methods listed in the previous page. Dilution of the residual liquid can be performed by selecting a dilution solvent that has acceptable cleaning capabilities and is miscible with both the residual liquid and water as well as, has a low vapor pressure.

   Insure that most of the residual liquid is removed from the existing system by draining and purging. Introduce an adequate amount of dilution solvent until full miscibility with the residual liquid is obtained. Safely drain, and adequately purge the dilution solvent from the system.

For more information, consult your local authorized representative or the Dynalene Engineering Department in the USA at +1-610-262-9686 or fax +1-610-262-7437. DYNALENE HC used, as a dilution solvent should be reconditioned to reuse as a heat transfer fluid.

Contaminants in DYNALENE HC:

Spent or residual fluid contaminants in particulate form usually can be removed from DYNALENE HC by allowing the fluid to flow through a conditioning canister called a TriModal Canister. The TriModal Canister is available through Dynalene for rent or purchases (see figure 2 page 14). The alteration of DYNALENE HC composition by the addition of any foreign material will alter the characteristics of the material. Consult the Dynalene Technical Support Group at +1-610- 262-9686 or Fax +1-610-262-7437, or e-mail info@dynalene.com.

New systems Using DYNALENE HC:

The following recommendations are provided by the Dynalene Technical Support Group to assist the installer or end user in achieving a proper installation. Only qualified personnel with expertise in safely handling DYNALENE HC, as well as potentially hazardous flush liquids within the compliance of all local, state, and federal regulations should be involved in the work process.

- ***Flush the System*** Systems intending to use DYNALENE HC heat transfer fluid should be properly flushed clean after installing components such as pipes, valves, pumps, etc. Materials from welding operations, excess pipe joint compound, oils, and other unwanted contaminant must be removed completely prior to installing DYNALENE HC. Using a dilution solvent that is completely miscible with water, as well as with the contaminants generated during an installation is one recommended method of flushing a system clean. Thoroughly flush the system with distilled or deionized water until all residual liquid has been properly removed (<100-PPM residual liquid in water). (**Do not use chlorinated tap water, OR water that contains chloride ions).** Small amounts of flush water that remain in

the system are acceptable if free from contaminants. Testing the flush water to detect reminants of residual liquid is the most favored method of determining the efficiency of the system clean up process. Review section related to "Dilution of Residual Liquid" for more information concerning this method.

- ***Install Line Filtration*** DYNALENE HC heat transfer fluid should remain free of debris throughout the operational life of the liquid. Entrained sediment and other solid contaminant accelerate erosion and corrosion, effectively 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 contain or accumulate corrodents that initiate and sustain other types of 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. Redundant strainer / filtration equipment with temporary bypass piping should be installed in a system that cannot tolerate disruptions.

Representative Sample Analysis:

Routine analysis of Dynalene HC used in a system is recommended after the first three (3) months of operation continuing on a yearly basis. Representative samples of DYNALENE HC should be obtained from an active liquid stream at room temperature.

If the samples cannot be obtained from an active liquid stream at room temperature, locate a collection container that is clean, and its materials of construction are compatible with DYNALENE HC. Obtain a sample from an area within the active system and allow the liquid to achieve room temperature. After the sample has attained room canister into an approved shipping container in a timely manner.

WARNING: Operation personnel should wear protective gear and use extreme care to prevent skin burn or frostbite when obtaining a hot or cold representative sample from active heat transfer systems operating at temperatures other than ambient 70°F (20°C).

This free service is offered to all Dynalene HC product purchased through the Dynalene Analytical Department Arrangements can be made by contacting the Dynalene Customer Service Department USA at +1-610-262-9686 or fax +1-610-262-7437 to obtain shipping instructions and a Return Authorization Number (RAN) on the shipping label and on the actual sample container being shipped. ***Do not ship DYNALENE HC sample(s) without fully understanding the shipping and labeling procedures.***

Dilution Capability of DYNALENE HC:

Customers may find it cost effective to dilute the more concentrated versions of DYNALENE HC heat transfer fluid with distilled or deionized water. Large fluid purchasers with easy access to distill freight costs vs. dilution costs) to receive Dynalene HC-MAX, then dilute the fluid on-site to a desired "leaner" concentration.
Note: Dynalene Inhibitor packages most also be included in the dilution process.

Do not use chlorinated tap water or water that contains chloride ion concentrations of more than 25 PPM. Care must be taken to validate the pH, density and refractive index values of the final diluted DYNALENE HC fluid (see page 18) for dilution and refractive index curves) or promptly send a representative sample of the fluid to Dynalene's analytical department (return authorization number will be required).

Please call the Dynalene Engineering Department in the USA at +1-610-262-9686 of fax +1-610-262-7437 or email us at **info@dynalene.com** for more information on diluting DYNALENE HC.

DYNALENE HC Property Comparisons:

The following column illustrates viscosity (Fig 3) and heat transfer coefficients (Figs 4 & 5) for DYNALENE HC, calcium chloride / water solution. The alternate fluids shown in each graph were formulated to provide similar freeze points.

Customers appreciate the additional thermal physical performance inherent in all DYNALENE HC formulations. Systems that retrofit to DYNALENE HC have routinely resolved challenging applications where inadequate heat transfer surface area prevented acceptable thermal performance through the previous use of glycol-based coolants, or the corrosive effect calcium chloride/water solutions.

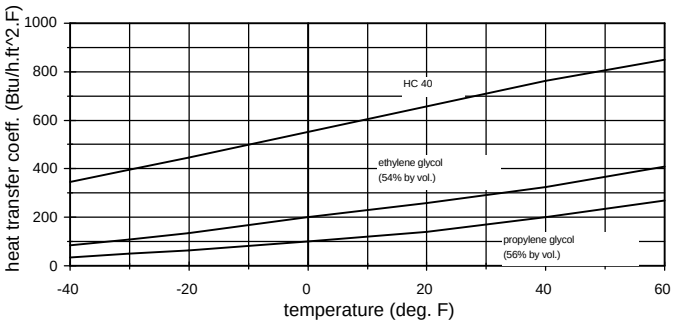


Fig 4: Heat transfer coefficients for Dynalene HC-40, Ethylene Glycol/ water, propylene Glycol/ Water.

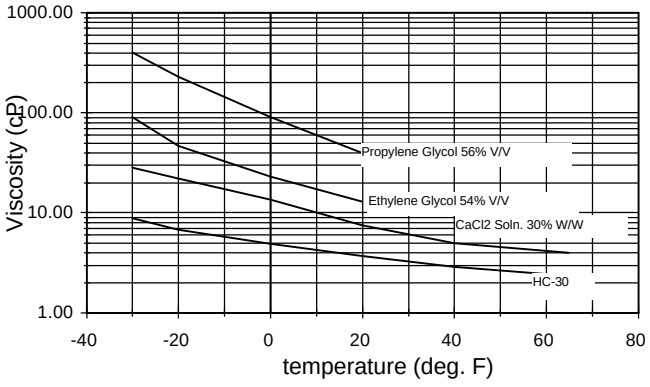


Fig 3: Viscosity vs. Temperature for Propylene Glycol/ Water, Ethylene Glycol/ Water, calcium Chloride/ Water & Dynalene HC

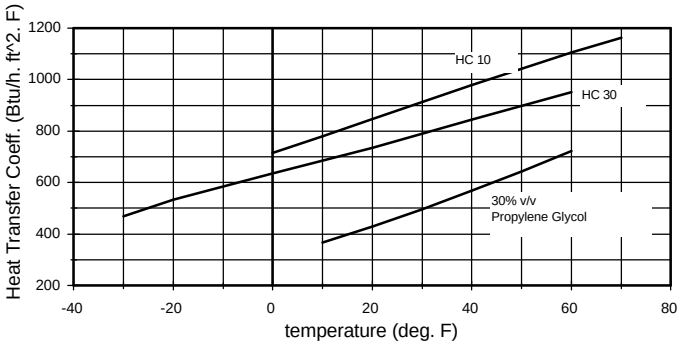


Fig 5: Heat Transfer coefficients for Dynalene HC-10, HC-30 and Propylene Glycol/Water.

Notice to all System Operators

Dynalene HC is a non-toxic, high performance heat transfer fluid currently being used in this system. This product will provide long life and low maintenance service in properly maintained systems. Also ask about our Engineering Guide.

Please practice the following procedures when handling or maintaining systems that contain Dynalene HC:

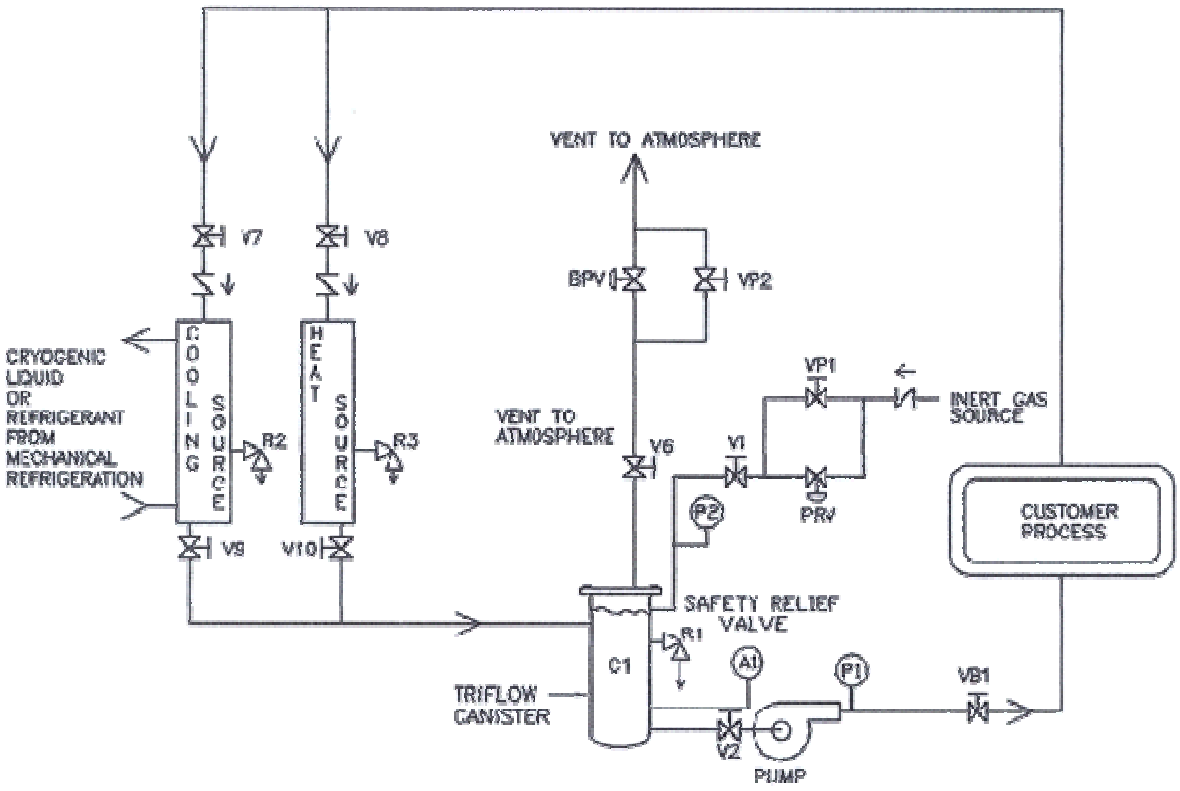
1) Do not use Dynalene HC in systems containing plated metals such as magnesium, zinc, or galvanized metals.

2) To avoid degradation, metal surfaces exposed to air and wetted with Dynalene HC should be promptly rinsed clean with water and dried.

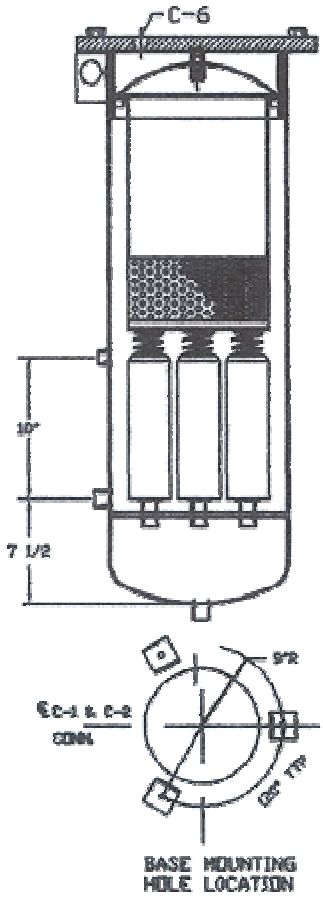
3) To aid in obtaining leak-free pipe thread joints, it is recommended that ALL threads be clean and oil free prior to assembly. Use a quality Teflon thread sealant, and then tightly wrap the entire thread surface area with one pass of Teflon tape. Flanged, welded or brazed joints are the preferred sealing methods.

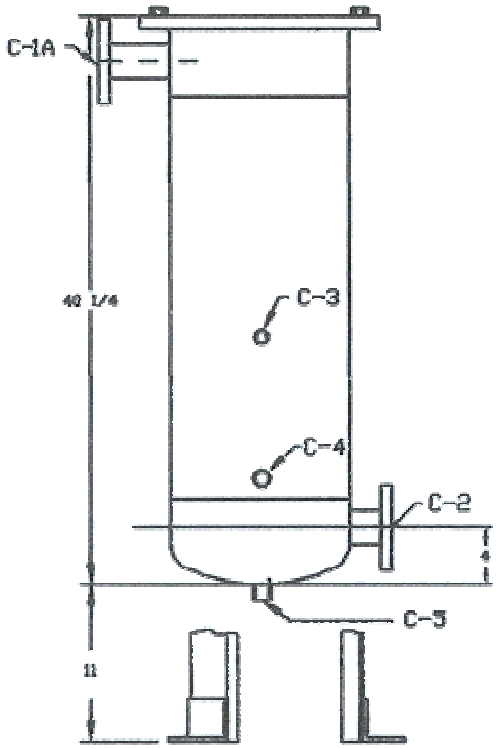
4) Use system components that are approved to operate with ionic fluids similar to Dynalene HC.

Consult the Dynalene engineering office at +1-610-262-9686, Fax +1- 610-262-7437 for more information or a MSDS.

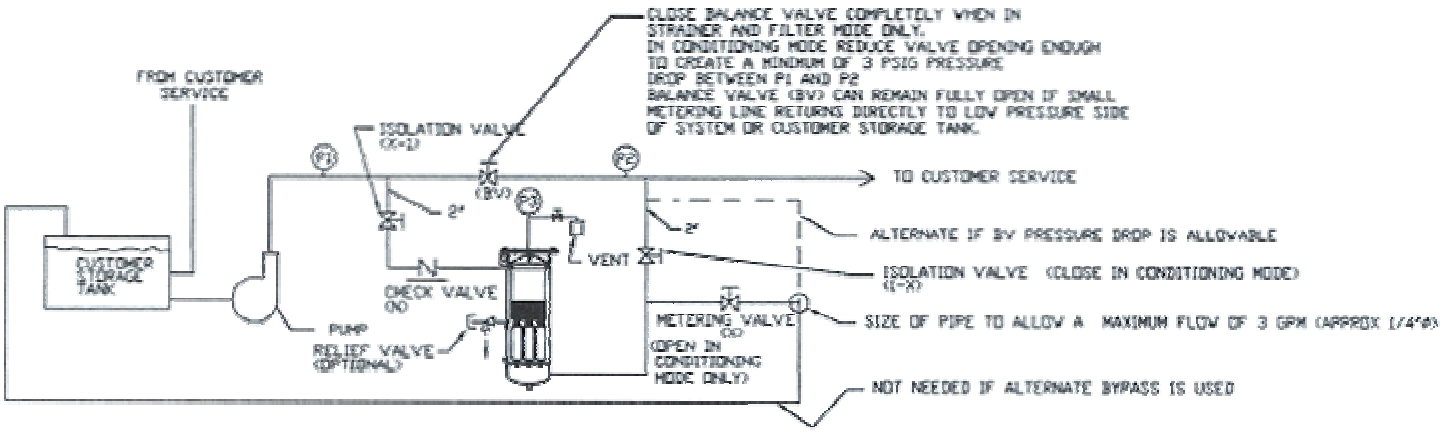


A1	High-Low Level Alarm
BPV	Back Pressure Regulating Valve
C1	Desiccation Canister
P1 - P2	Pressure Gauge
PRV	Pressure Regulating Valve
R1 to R4	Safety Relief Valve
T1	Temperature Gauge
VB1	Balance Valve
VP 1 & 2	Pressure Regulator Valve (Normally Closed)
V1 to V10	Isolation Valve



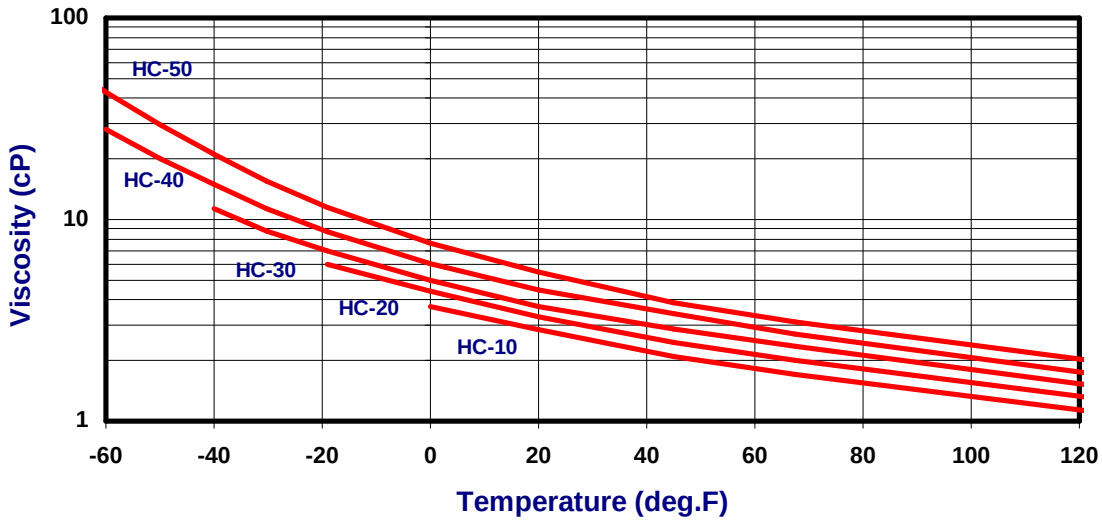


C-1	2" 300# RF	Inlet
C-1A	Not In Use	Inlet
C-2	2" 300# RF	Inlet
C-3	3/4" FPT	Relief/Port
C-4	1" FPT	Flush Drain
C-5	1" FPT	Lower Drain
C-6	1/2" FPT	Pressure Gauge/Vent

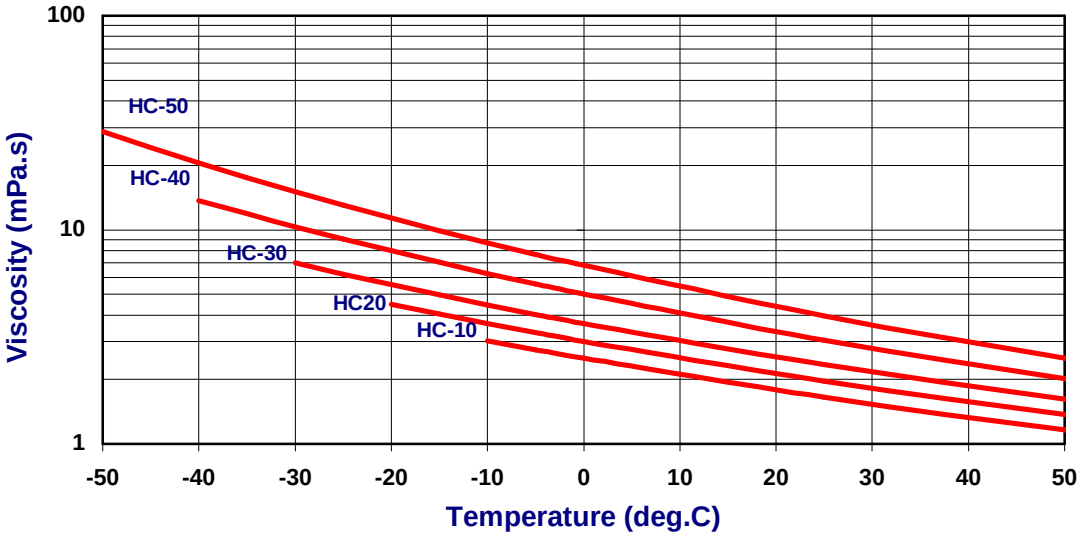


Test Pressure (PSIG)	1.5 x DP
Working Pressure (PSIG)	150 PSIG
Code Designation	ASME-U
Design Temperature	300°F
Vessel Material	SA312, 304SS
Elastomer	Teflex
Inner Hardware Material	304SS
Strainer/Basket Material	304SS
Weight Empty (lbs)	
Working Fluid	Dynalene HC

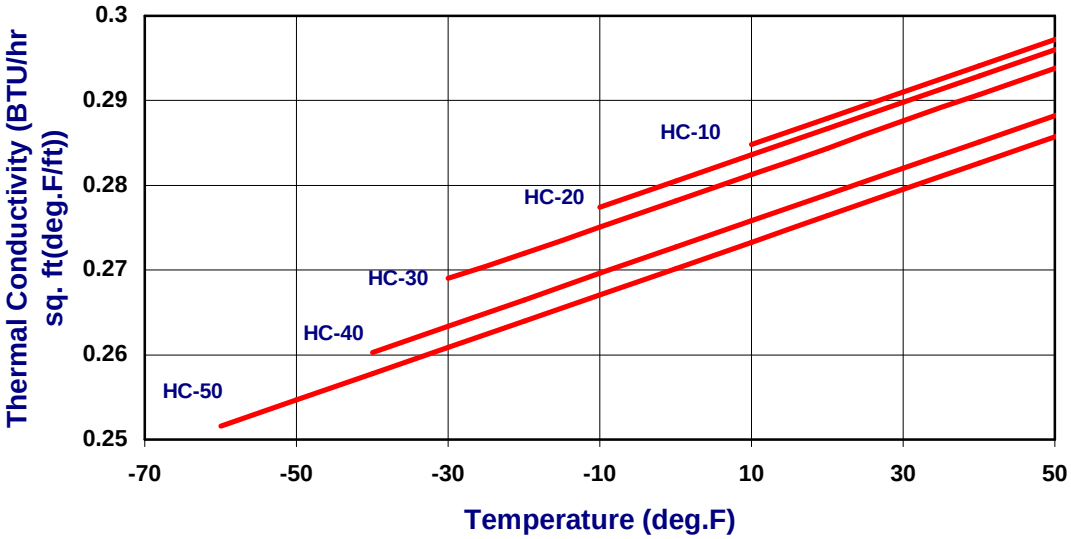
Dynalene HC
Viscosity vs. Temperature



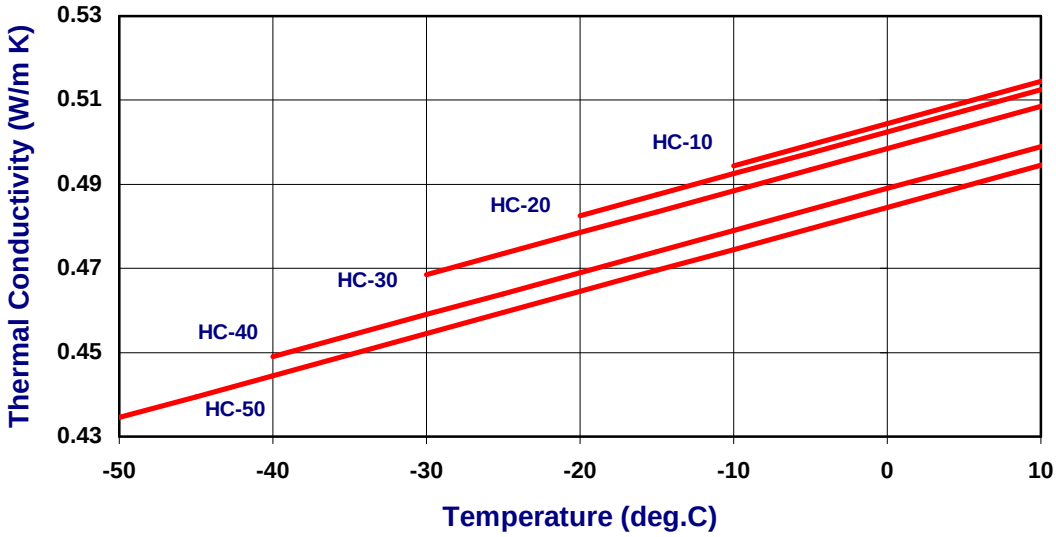
Dynalene HC
Viscosity vs. Temperature



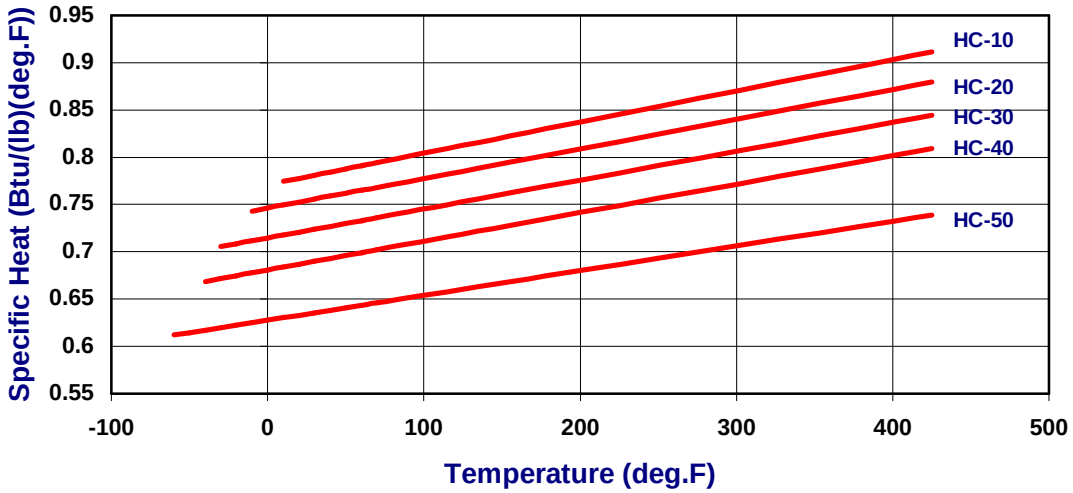
Dynalene HC
Thermal Conductivity vs. Temperature



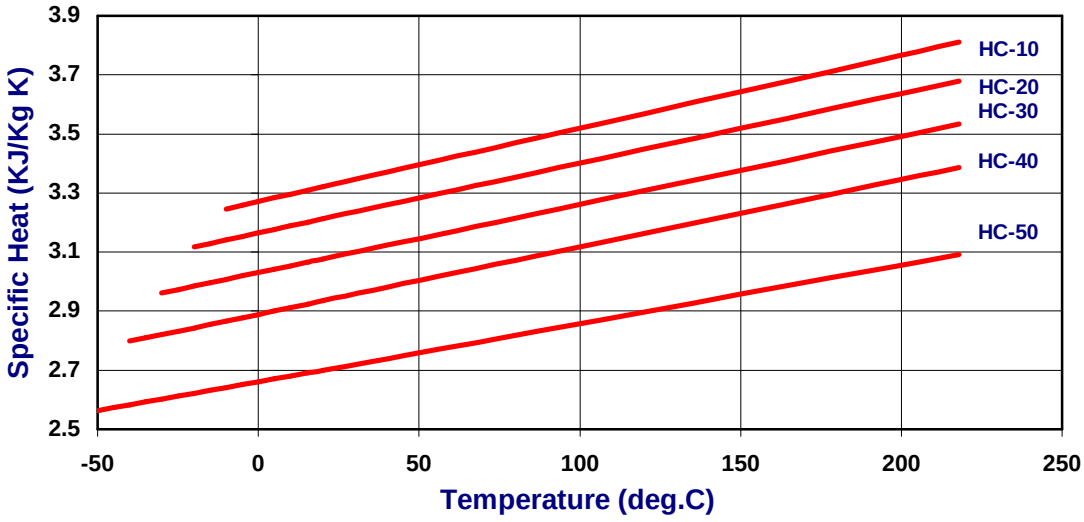
Dynalene HC
Thermal Conductivity vs. Temperature



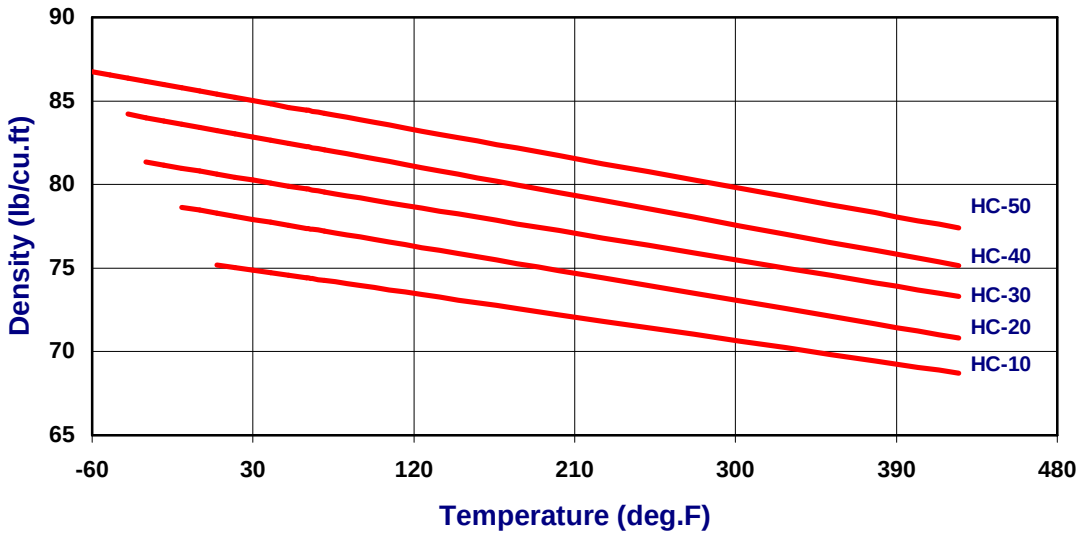
Dynalene HC
Specific Heat vs. Temperature



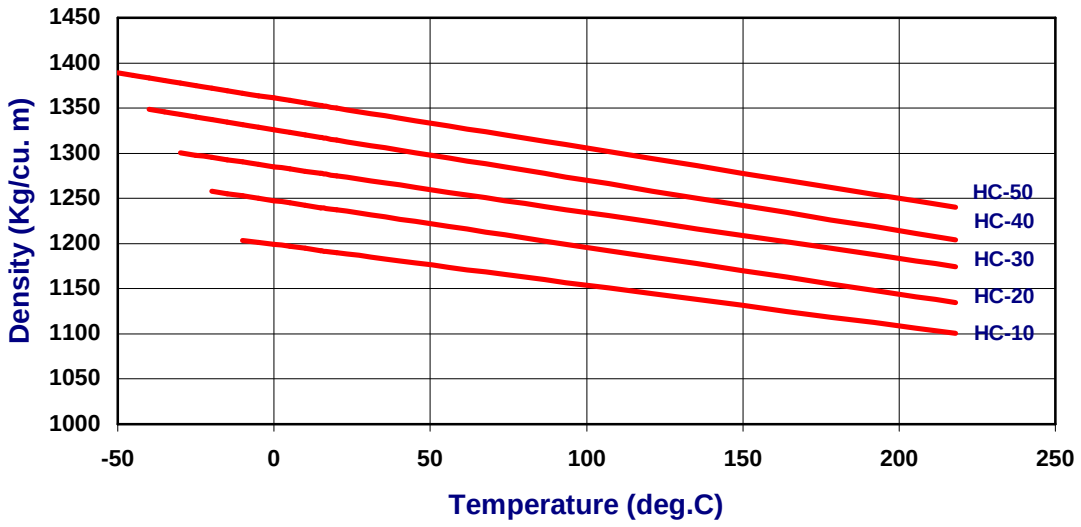
Dynalene HC
Specific Heat vs. Temperature



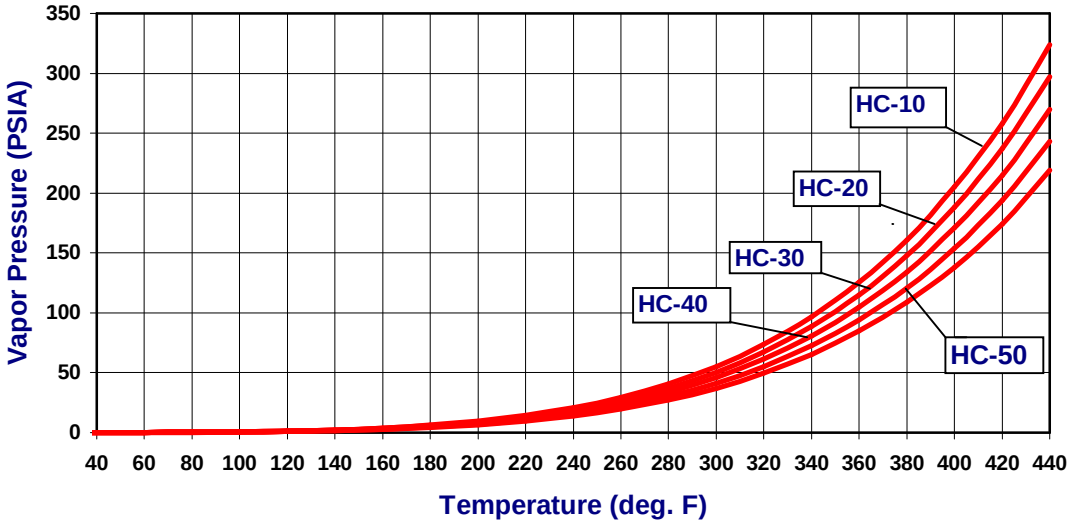
Dynalene HC
Density vs.Temperature



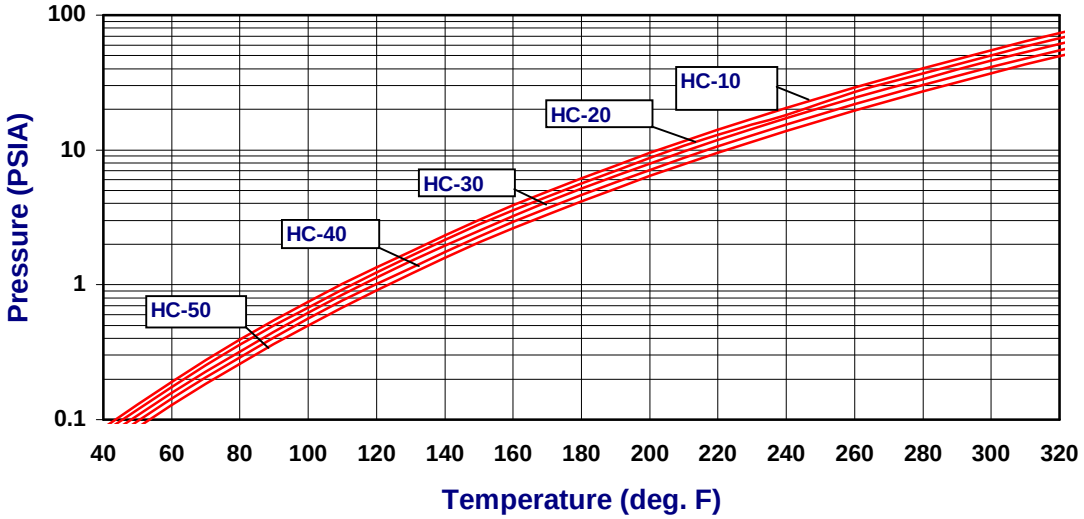
Dynalene HC
Density vs. Temperature



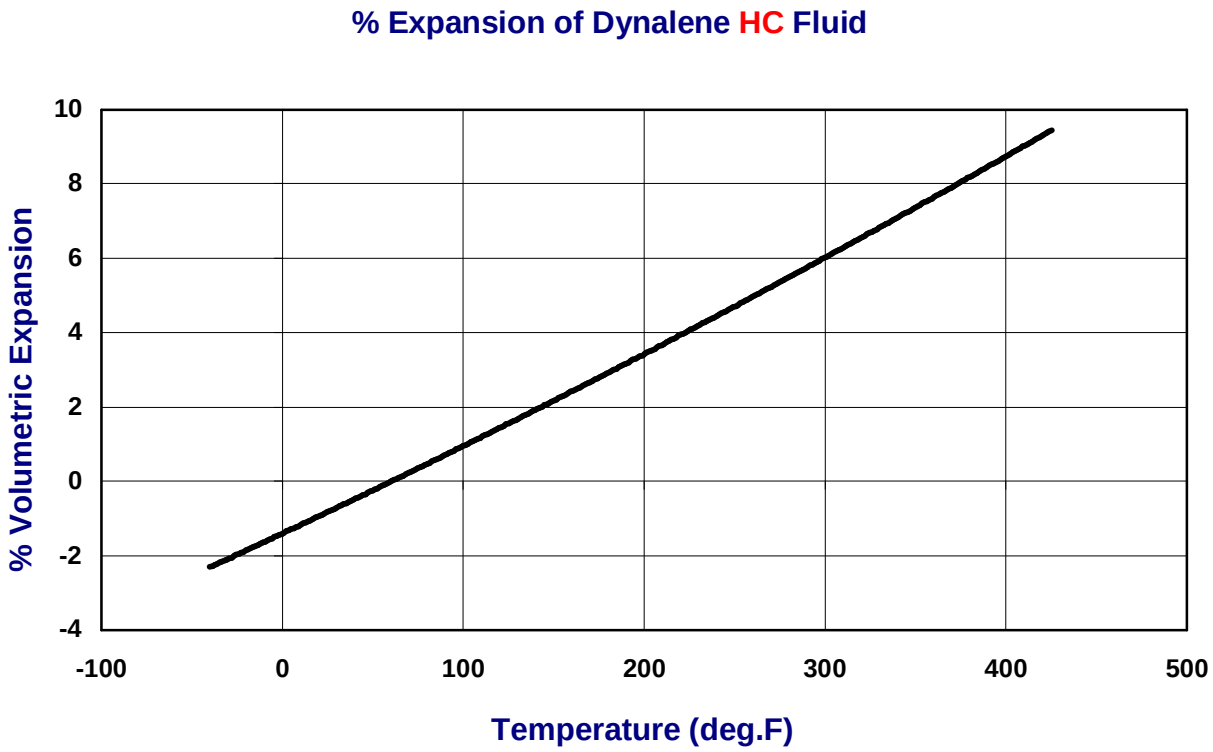
Dynalene HC
Vapor Pressure



Dynalene HC
Vapor Pressure



Dynalene HC
Volumetric Expansion



Dilution of Dynalene HC

Figure 1 provides the dilution of Dynalene HC-50 and Dynalene HC-40 with water that is needed to obtain the desire freezing point. After dilution is carried out, it is essential to determine the pH and the refractive index of the liquid to confirm the quality, pH should be between 9.5 and 10.5, and the refractive index will correspond to the freezing point as shown in Figure 2.

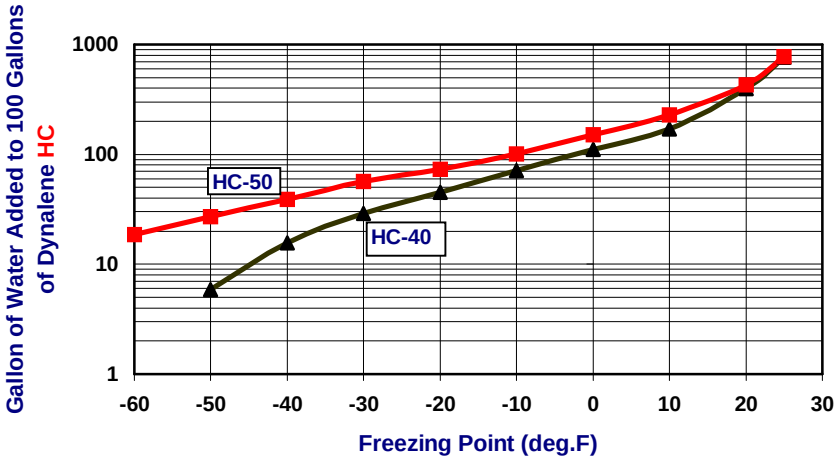


Fig 1: Dilution chart for Dynalene HC-40 & HC-50

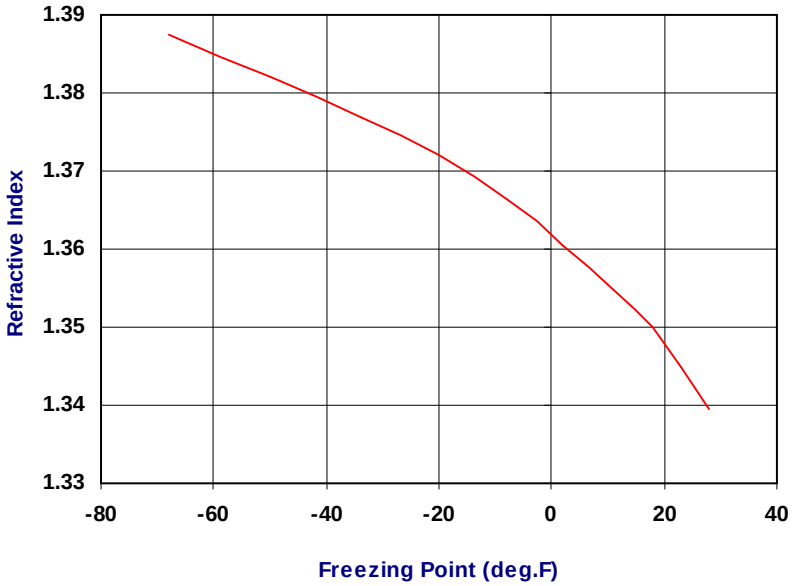


Fig 2: Freezing point of any HC fluid can be determined from refractive index using this figure.

Appendix 1

ABBREVIATED 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.

I. 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.

II. 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 LD_{50} (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 LD_{50} 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.

III. 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. (Carcingenicity: 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

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

TRADE NAME (AS LABELED): **DYNALENE HC®**

PRODUCT USE: Heat Transfer Fluid

SYNONYMS: Mixture; None applicable.

DISTRIBUTOR'S NAME: **Dynalene Heat Transfer Fluids**

ADDRESS: 5250 West Coplay Road
Whitehall, PA 18052

EMERGENCY PHONE: 800/424-9300 (CHEMTREC)

BUSINESS PHONE: +1-610- 262-9686

EFFECTIVE DATE: February 14, 2001

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	% w/w	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA			
			TLV	STEL	PEL	STEL	IDLH	OTHER
			mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3
Dissolved Ionic Solid/Water		Approx. 50/50	NE	NE	NE	NE	NE	NE
Other components each present in less than 2 percent concentration in this product.			None of the other components contributes any significant, additional hazard to this product. All pertinent hazard information has been provided in this Material Safety Data Sheet, per the requirements of the Federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalent standards.					

NE = Not Established C = Ceiling Level See Section 16 for Definitions of Terms Used.

NOTE (1): ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1993 format.

NOTE (2): Information on this product is being claimed as proprietary. All pertinent hazard information has been provided, per the Trade Secret requirements of U.S. Federal Occupational Safety and Health Administration Standards (29 CFR 1910.1200) and Canadian WHMIS (CPR 12 and 19). Information on this mixture will be released when the conditions specified in these Standards are met.

3. HAZARD IDENTIFICATION

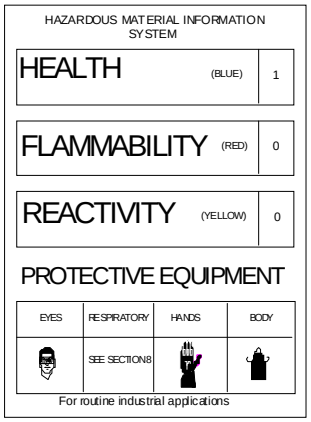
EMERGENCY OVERVIEW: This product is a clear, odorless, colorless to light blue liquid. The primary health hazard associated with this product is the potential for irritation of skin, eyes, or other contaminated tissue. This product is not flammable or reactive under typical emergency response conditions. Emergency responders must wear proper personal protective equipment for the situation to which they are responding.

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: The most significant routes of exposure to this product are by inhalation of mists or vapors generated by the product and contact with the skin and eyes.

INHALATION: Inhalation of the mists or vapors of this product can be irritating to the nose, throat, mucous membranes, and other tissues of the respiratory system. Symptoms of such overexposure can include sneezing and coughing. These symptoms are generally alleviated when overexposure ends.

CONTACT WITH SKIN or EYES: This liquid may cause local redness or irritation of the skin following prolonged exposure. Repeated or prolonged exposure may lead to dermatitis (red, inflamed skin). Contact with the eyes will cause irritation and possibly burning, which is generally alleviated when the product is rinsed from the eyes.

SKIN ABSORPTION: Skin absorption is not known to be a potential route of over-exposure for the components of this product.



INGESTION: Ingestion of this product, while not likely to occur in an industrial setting, may

cause irritation of the mouth and throat, gastric upset, stomach ache, cramps, nausea and vomiting.

INJECTION: Though not an expected route of occupational exposure for this product, injection (via punctures or lacerations in the skin) may cause local reddening, tissue swelling and discomfort.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in **Lay Terms**. Symptoms associated with over-exposure to this product are as follows:

ACUTE: The chief health hazards associated with this product would be the potential for irritation of contaminated skin and eyes.

CHRONIC: Prolonged or repeated skin exposures can lead to dermatitis (dry, chapped skin). Refer to Section 11 (Toxicological Information) for additional information.

TARGET ORGANS: Skin, eyes, respiratory system.

PART II *What should I do if a hazardous situation occurs?*

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4. FIRST-AID MEASURES

SKIN EXPOSURE: If the product contaminates the skin, begin decontamination with running water. Remove exposed or contaminated clothing, taking care not to contaminate eyes. The recommended flushing time is 15 minutes if pain or irritation occurs. Contaminated individual must seek medical attention, especially if irritation or redness develops.

EYE EXPOSURE: If the product enters the eyes, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Contaminated individual must seek immediate medical attention, especially if symptoms persist.

INHALATION: If vapors or mists of the product are inhaled, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Remove or cover gross contamination to avoid exposure to rescuers.

INGESTION: If the product is swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. If professional advice is not available, do not induce vomiting. Contaminated individuals should drink milk, egg whites, or large quantities of water. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having

convulsions, or who is unable to swallow.

Contaminated individual must be taken for medical attention if any adverse reaction occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or health professional with victim.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

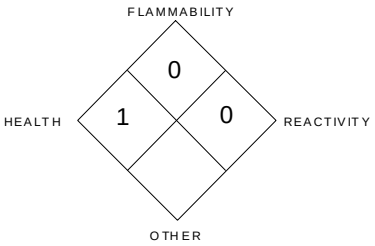
NFPA RATING

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.



FIRE EXTINGUISHING MATERIALS:

Water Spray: Yes

Carbon Dioxide: YES

Dry Chemical: YES

Halon: YES

Foam: YES

Other: Any "ABC"

UNUSUAL FIRE AND EXPLOSION HAZARDS: When involved in a fire, this material may decompose and produce irritating vapors, toxic gases (e.g., oxides of carbon, potassium compounds), soot, and smoke.

Explosion Sensitivity to Mechanical Impact: Not sensitive.
Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural fire fighters must wear Self-Contained Breathing Apparatus and full protective equipment. If possible, prevent run-off water from entering storm drains, bodies of water, or other environmentally areas. Decontaminate fire-response equipment with soap and water solution if necessary.

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used.

SMALL SPILL: Cover with absorbent material (floor absorbent, vermiculite, etc,). Soak up spill and place material into a drum.

LARGE SPILL: Personnel involved with large release should wear protective equipment. Stop spill at source, dike the area surrounding the spill to prevent further exposure. Prevent material from entering sewer system. If pump is available, pump spilled material into 55-gallon drums for proper disposal. If necessary, absorbents such as vermiculite, clay, floor absorbent may be used on spill and shoveled into drums.

Personal Protective Equipment should be **Level D: chemical resistant gloves (rubber gloves, nitrile gloves), and coveralls, safety glasses, safety shield. If heated, this product may displace oxygen in an enclosed area. Monitoring of oxygen level is recommended.** Decontaminate the area thoroughly. If necessary, decontaminate spill response equipment with soap and water solution. Dispose of in accordance with Federal, State, and local hazardous waste disposal regulations (see Section 13, Disposal Considerations)

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Use in a well-ventilated location. Do not eat, drink, smoke or apply cosmetics while handling this material. Use ventilation and other engineering controls to minimize potential exposure to the aerosol, sprays and vapors of this product.

STORAGE AND HANDLING PRACTICES: All employees who handle this material should be trained to handle it safely. Open containers slowly, on a stable surface.

STORAGE AND HANDLING PRACTICES (Continued): Drums and other containers of this product should be properly labeled. Empty containers may contain residual amounts of this product, therefore, empty containers should be handled with care. Store containers in a cool, dry location, away from direct sunlight, or sources of intense heat. Keep containers away from incompatible chemicals (See Section 10, Stability and Reactivity). Keep drums and other containers of this product tightly closed when not in use. Inspect all incoming containers before storage, to ensure containers are properly labeled and not damaged.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely, if necessary. Decontaminate equipment using soapy water before maintenance begins.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to minimize exposure to mists or sprays of this product. Prudent practice is to ensure eyewash/safety shower stations are available near areas where this product is used.

RESPIRATORY PROTECTION: None needed for normal circumstances of use. Maintain airborne contaminant concentrations below exposure limits listed in Section 2 (Composition and Information on Ingredients). If respiratory protection is needed, use only protection authorized in 29 CFR 1910.134, or applicable State regulations. Use supplied air respiration protection if oxygen levels are below 19.5% or are unknown.

EYE PROTECTION: Splash goggles or safety glasses.

HAND PROTECTION: Wear rubber or neoprene gloves for routine industrial use. Use triple gloves for spill response, as stated in Section 6 (Accidental Release Measures) of this MSDS.

BODY PROTECTION: Use body protection appropriate for task.

PERSONAL PROTECTIVE EQUIPMENT LEVEL: D

9. PHYSICAL and CHEMICAL PROPERTIES

RELATIVE VAPOR DENSITY (air = 1): Not available.
EVAPORATION RATE (n-BuAc=1): Similar to water.
SPECIFIC GRAVITY (water = 1): 1.29
FREEZING/MELTING POINT or RANGE: <0EC (<32EF)
SOLUBILITY IN WATER: Soluble.
BOILING POINT: Approximately 100EC (212EF)
VAPOR PRESSURE, mbar @ 20 EC: 23
pH: 8.3-10.5
ODOR THRESHOLD: Not applicable.
COEFFICIENT WATER/OIL DISTRIBUTION: Not available.
APPEARANCE AND COLOR: This product is a clear, odorless, colorless to light blue liquid.
HOW TO DETECT THIS SUBSTANCE (warning properties): The appearance may act as a distinguishing characteristic of this product.

10. STABILITY and REACTIVITY

STABILITY: Stable

DECOMPOSITION PRODUCTS: If this product is exposed to extremely high temperatures, decomposition of this product will generate carbon dioxide, carbon monoxide, and potassium compounds.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong oxidizers.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with strong oxidizers and exposure to extremely high temperatures.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: Considered non-toxic based on recommendations of the Hazardous Substances Labeling Act.
Oral - Rat LD50 > 5000mg/kg
Dermal - Rabbit LD50 >2000mg/kg
Testing of HC40 showed no mortalities and no adverse clinical signs in rats receiving a single oral dose of 5000mg/kg. Testing of HC40 showed no treatment-related mortalities, clinical signs, or gross pathological changes in rabbits receiving a single dermal dose of 2000mg/kg.
.

SUSPECTED CANCER AGENT: The ingredients of this product are not listed on the following lists: FEDERAL OSHA Z LIST, NTP, IARC or CAL/OSHA, and therefore are not considered to be, nor suspected to be, cancer-causing agents by these agencies.

IRRITANCY OF PRODUCT: Repeated or prolonged exposure to this product may cause irritation to contaminated tissues.

SENSITIZATION TO THE PRODUCT: No components of this product are reported to be sensitizers upon prolonged or repeated exposures.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this product and its components on the human reproductive system.

Mutagenicity: This product is not reported to produce mutagenic effects in humans.
Embryotoxicity: This product is not reported to produce embryotoxic effects in humans.
Teratogenicity: This product is not reported to cause teratogenic effects in humans.
Reproductive Toxicity: This product is not reported to cause reproductive effects in humans.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing dermatitis and other skin disorders may be aggravated by skin contact with this product.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce exposures.

BIOLOGICAL EXPOSURE INDICES: Currently, there are no Biological Indices (BEIs) associated with the components of this product.

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: The components of this product will be degraded over time into other organic compounds.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: This product may be harmful to contaminated plant and animal life (especially if large quantities are released). Refer to Section 11 (Toxicological Information) for specific information regarding effects of this product's components on test animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: This product may be harmful to aquatic life if large quantities are released into bodies of water.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. This product, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority.

EPA WASTE NUMBER: Not applicable to wastes consisting only of this product.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION

PROPER SHIPPING NAME:	Not applicable.
HAZARD CLASS NUMBER and DESCRIPTION:	Not applicable.
UN IDENTIFICATION NUMBER:	Not applicable.
PACKING GROUP:	Not applicable.
DOT LABEL(S) REQUIRED:	Not applicable.

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): Not applicable.

MARINE POLLUTANT: No component of this product is listed as a Marine Pollutant (49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS NOT CONSIDERED AS DANGEROUS GOODS.

15. REGULATORY INFORMATION

U.S. SARA REPORTING REQUIREMENTS: The components of this product are not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act.

CANADIAN DSL STATUS: The components listed in Section 2 (Composition and Information on Ingredients) are listed on the DSL Inventory.

U.S. TSCA STATUS: The components of this product listed in Section 2 (Composition and information on Ingredients) are on the TSCA Inventory.

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITIES (RQ): Not applicable.

OTHER U.S. FEDERAL REGULATIONS: Not applicable.

U.S. STATE REGULATORY INFORMATION: Components of this product are covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: No.
California - Permissible Exposure Limits for Chemical Contaminants: No.
Florida - Substance List: No.
Illinois - Toxic Substance List: No.
Kansas - Section 302/313 List: No.
Massachusetts - Substance List: No.
Michigan - Critical Materials Register: No.
Minnesota - List of Hazardous Substances: No.
Missouri - Employer Information/Toxic Substance List: No.
New Jersey - Right to Know Hazardous Substance List: No.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.
Pennsylvania - Hazardous Substance List: No.
Rhode Island - Hazardous Substance List: No.
Texas - Hazardous Substance List: No.
West Virginia - Hazardous Substance List: No.
Wisconsin - Toxic and Hazardous Substances: No.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this solution is on the California Proposition 65 lists.

LABELING (Precautionary Statements): **CAUTION!** MAY CAUSE SKIN AND EYE IRRITATION. FOR INDUSTRIAL USE ONLY. KEEP AWAY FROM CHILDREN. Avoid contact with skin, eyes, and clothing. Avoid prolonged skin contact. Wash thoroughly after handling. Use in well-ventilated area. Use gloves, safety goggles, and appropriate body protection. FIRST-AID: In case of skin or eye contact, flush with water for 15 minutes. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If ingested, do not induce vomiting. Get medical attention if adverse reactions occur. IN CASE OF FIRE: Use water fog, dry chemical, CO_2 or "alcohol" foam. IN CASE OF SPILL: Absorb with an inert material (i.e. polypads), then place in a suitable container. Consult Material Safety Data Sheet for additional information.

CANADIAN WHMIS SYMBOLS: Not applicable.

16. OTHER INFORMATION

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The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Dynalene Heat Transfer Fluids assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, Dynalene Heat Transfer Fluids assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these, which are commonly used, include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits.

TLV - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour **Time Weighted Average (TWA)**, the 15-minute **Short Term Exposure Limit**, and the instantaneous **Ceiling Level**. Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

IDLH - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. **O**ccupational **S**afety and **H**ealth **A**dministration (**OSHA**). NIOSH issues exposure guidelines called **R**ecommended **E**xposure **L**evels (**REL**s). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93BC [100-200BF]); **3** (Class IB and IC flammable liquids with flash points below 38BC [100BF]); **4** (Class IA flammable liquids with flash points below 23BC [73BF] and boiling points below 38BC [100BF]. Reactivity Hazard: **0** (normally stable); 1 (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on

exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the **N**ational **F**ire **P**rotection **A**ssociation (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD_{50}** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC_{50}** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m^3** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause death. **BEI** Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. **Superfund Amendments and Reauthorization Act (SARA)**; the **Canadian Domestic Substances List (DSL)**; the U.S. **Toxic Substance Control Act (TSCA)**; Marine Pollutant status according to the **DOT**; California's Safe Drinking Water Act (**Proposition 65**); the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)**; and various state regulations. This section also includes information on the precautionary warnings which appear on the materials package label.

Product Disclaimer

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