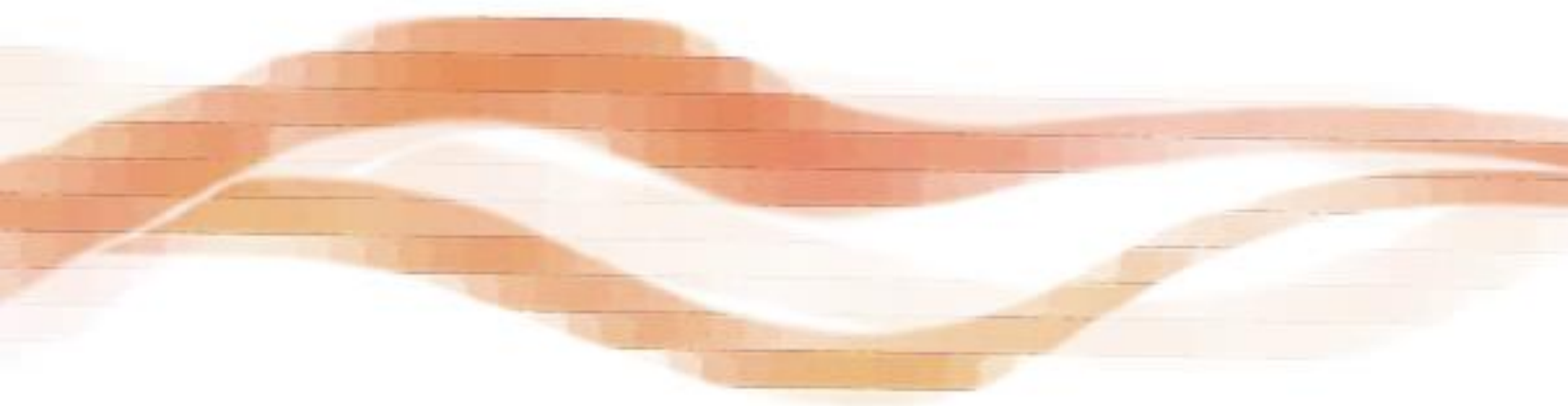


Dynalene HF-LO

engineering guide



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Product Overview

Dynalene HF-LO is a high flash point, low odor, non-toxic heat transfer fluid. It was developed as an alternative to silicone oils for low temperature applications. Dynalene HF-LO heat transfer fluid is also biodegradable and CFC free. Dynalene HF-LO has a recommended use temperature range of -100°F to 400°F for closed systems. It is essential that all personnel handling this product review and understand this manual and the Dynalene HF-LO material safety data sheet (MSDS). Please contact Dynalene for more information.

Freezing & Melting Point

Dynalene HF-LO has a freezing and melting point below -118°C (-180°F), allowing broader application to systems using cryogenic liquids or ultra-low temperature mechanical refrigeration equipment. This results in greater tolerance when lowering the surface film temperature.

Flash Point

Dynalene HF-LO heat transfer fluid has a closed cup flash point of >61°C (>141°F), and an open cup flash point of >68°C (>156°F). When the vapor of a hydrocarbon fluid becomes concentrated and heated above its flash point, the vapor has the potential to ignite if it is exposed to hot surfaces, sparks, open flames, or any other source of ignition.

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. "Air tight" containment is recommended to limit the escape of Dynalene HF-LO vapors to the environment, and to prevent the exposure of the fluid to moisture and oxygen. See Table 1 below for vapor pressures of Dynalene HF-LO at various temperatures.

Table 1. Vapor pressure of Dynalene HF-LO.

Temperature, °C (°F)	Vapor Pressure, mmHG (psi)
0 (32)	0.12 (0.002)
25 (77)	0.71 (0.014)
100 (212)	1.80 (0.035)

General Properties

General properties of Dynalene HF-LO can be found in Table 2.

Table 2. General properties of Dynalene HF-LO.

Property	
Composition	Aliphatic hydrocarbon blend
Appearance	Translucent, clear
Odor	Low hydrocarbon odor
Operating range, closed systems	-73°C to 204°C (-100°F to 400°F)
Operating range, open systems	-52°C to 58°C (-60°F to 135°F)
Max film temperature	232°C (450°F)
Freezing point	<-118°C (<-180°F)
Boiling point	>191°C (376°F)
Flash point (closed)	>61°C (>141°F)
Flash point (open)	>68°C (>156°F)
Fire point	72°C (162°F)
Autoignition temp.	>337°C (>640°F)
Critical temp.	394°C (741°F)
Critical pressure	27 bar (26.7 atm)
Molecular weight	150 g/mol
Dielectric constant	2.1 to 2.2

Packaging & Shipping

Dynalene HF-LO heat transfer fluid is available in 5 gallon pails, 55 gallon drums, and bulk quantities.

The following is the transportation and shipping regulatory information for Dynalene HF-LO:

Land (DOT): Proper shipping name: PETROLEUM DISTILLATES, N.O.S.
Hazard Class and Division: COMBUSTIBLE LIQUID
UN Number: 1268
Packing Group: III

Land (TDG): Not regulated for land transport.

Sea (IMDG): Not regulated for sea transport according to IMDG-code.

Air (IATA): Not regulated for air transport.

Shelf Life

Dynalene HF-LO heat transfer fluid will remain stable for a period of at least one year if:

- (1) It is stored in the original unopened pail or drum
- (2) The storage area is a dry environment below 100°F.

Partially full pails and drums should be blanketed with an inert gas such as nitrogen to eliminate oxygen from the container head space.

Metals Compatibility

Dynalene HF-LO heat transfer fluid has an acceptable compatibility rating when installed in vapor tight systems constructed within the temperature, pressure, and structural limitations of the following metals:

- Aluminum
- Brass
- Bronze (All)
- Carbon Steel
- Cast Steel
- Copper
- Copper Nickel (All)
- Hastelloy (All)
- Inconel
- Incoloy 825
- Monel
- Nickel
- Stainless Steel (All)
- Stainless Steel Clad
- Tantalum

Gasket & Polymer Compatibility

Dynalene HF-LO heat transfer fluid has an acceptable compatibility when used within the temperature and pressure limitation of the following polymers or gasketing materials:

- Acetal
- Aramid Fiber
- Chemraz (FFKM)
- Epoxy
- Fluorocarbon (FILM)
- Fluoroelastomer
- Glass Fiber
- Gylon Style 3500, 3504, & 3510
- Kalrez
- PEEK
- Polytetrafluoro-ethylene
- Teflon (All)
- Teflon Encapsulated Silicone
- Teflon Encapsulated Viton
- Teflon Impregnated Fiberglass
- Kel-F (CTE)
- Viton
- Resin Impregnated Carbon Graphite

General Installation Guidelines

The following recommendations are provided to assist the designer/user in achieving proper installation.

1 Understanding the engineering guide

Prior to purchasing any Dynalene HF-LO, review and understand all of the information contained in this manual—especially the sections titled 'Retrofitting for Dynalene HF-LO' and 'Preparing New Systems Using Dynalene HF-LO'. Only qualified personnel with expertise in safe handling of potentially hazardous liquids (in compliance with local, state, and federal regulations) should be involved with work processes of this nature.

2 Moisture content

Moisture content within Dynalene HF-LO in system operation is recommended to be less than 100 parts per million (.01% H₂O in Dynalene HF-LO). The freezing point, viscosity, and heat transfer coefficient of Dynalene HF-LO may be adversely affected if moisture content is above recommended levels. Moisture is heavier than Dynalene HF-LO and will drop out of the solution at approximately 400 to 500 PPM, depending upon liquid temperature.

In low temperature applications, excessive moisture in Dynalene HF-LO will impair heat transfer; this may result in frozen heat exchangers, seized regulators, etc. Desiccating Dynalene HF-LO as shown in Figure 1 (page 8) is one recommended method of removing moisture from Dynalene HF-LO. If a moisture analysis is required for your Dynalene HF-LO, contact Dynalene at 1-877-244-5525 or email info@dynalene.com.

3 Presence of oxygen

Limit the presence of oxygen within the wetted areas of a piped system. An inert gas, such as nitrogen, is the favored substitute to air in the vapor space. A replenishable supply of air or oxygen in contact with Dynalene HF-LO will promote premature fluid degradation. The basic fluid system sketch illustrated in Figure 1 (page 8), is an example of a typical Dynalene HF-LO heat transfer fluid system using an inert gas purge as a method of excluding oxygen. The inert gas pressure regulator BPV set point should be approximately 50% higher than the maximum Dynalene HF-LO vapor pressure value anticipated with the system.

4 Maximum surface temperature

Surface temperature of heat source components should not exceed 450°F (232°C). Fluid velocity should maintain a minimum of 8 feet per second (2.44 meters per second).

5 Using electric resistance heaters

Electric resistance heaters used in Dynalene HF-LO heat transfer fluid applications are recommended to use a maximum watt density of 28 watts per square inch. If you require a review on the heating equipment you have considered, consult Dynalene.

6 Pump equipment

To eliminate cavitation when using Dynalene HF-LO near its boiling point, apply sufficient inert gas (nitrogen, argon) pressure in the head space.

7 Available ancillary equipment

Dynalene desiccation canisters are available upon request.

8 Safety dos and don'ts

- Handling Dynalene HF-LO in the drum: ensure drums containing Dynalene HF-LO are properly grounded and keep all drums away from sources of ignition, power tools, heat, smoking, and sparks.
- Pumping Dynalene HF-LO into the system: only pump Dynalene HF-LO in well-ventilated areas and wear the required personnel protective equipment as recommended in the Dynalene HF-LO MSDS.
- System maintenance: prior to cutting or welding systems that use Dynalene HF-LO, ensure all residual Dynalene HF-LO and its vapor are removed from the system. This can be accomplished by fully purging and evacuating all fluid and vapors using the methods described in 'Retrofitting for Dynalene HF-LO.'
- Draining Dynalene HF-LO from a system: when draining Dynalene HF-LO from a system, be sure to use sealed connections on all pipes, tubes, and containment to minimize leakage of vapor and mists.

For precautionary measures, all systems using Dynalene HF-LO should be properly grounded.

Retrofitting for Dynalene HF-LO

Dynalene HF-LO heat transfer fluid is an excellent replacement for the fluid chemistries listed below:

- CFC Refrigerant
- Chlorinated Solvent
- HFC Refrigerant
- Hydrocarbon Based
- Alcohols (methanol, ethanol, isopropanol)
- Perfluorocarbon
- Silicone
- d-Limonene

Once the original liquid is removed, systems may retain small amounts of residual liquid in low lying areas such as piping traps, inverted coils, pump housings, valve housings, drain pipes, etc. The residual liquids must be removed for Dynalene HF-LO to function properly as specified.

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

- To determine the actual volume of the heat transfer fluid needed in the retrofit, there are two methods that can be used:
 1. If the system drawing is available, then perform a volume calculation based on size and length of piping, reservoirs, heat exchangers, pumps, and all other wetted components.
 2. Drain the existing heat transfer fluid from the system and measure the volume removed. To account for the residual fluid left after draining, follow the steps in the next section.
- 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.
- Measure the volume of the residual fluid and add to the volume of the drained fluid to determine the total heat transfer fluid volume. Combine the residual fluid and drained fluid into a vented container and dispose accordingly.

Other methods to remove residual liquid:

1 System evacuation

Systems evacuation is performed by creating a vacuum, usually more than 20" 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.

2 Air and inert gas evaporation

Liquid evaporation using air or an inert gas may be another feasible method of removing residual liquid from an existing piped system. This is performed by allowing an adequate volume of dry 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 the inlet air or inert gas connection. Compressed air or inert gas is recommended to have a dew point lower than -95°F, and sufficiently below the evaporation point of liquid being removed.

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.

Preparing New Systems Using Dynalene HF-LO

The following recommendations are provided to assist the installer or end user in achieving a proper installation:

1 Flush the system

Systems intending to use Dynalene HF-LO 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 contaminants must be removed completely prior to installing Dynalene HF-LO.

Using a dilution solvent that is completely miscible with the contaminants generated during an installation is one recommended method of flushing a system clean.

2 Perform a moisture analysis

After installing Dynalene HF-LO and circulating for at least one hour, Dynalene recommends removing a fluid sample for moisture analysis. A pre-labeled sample kit will be provided upon request. Dynalene will perform a moisture analysis and report the necessary actions or corrections that need to be taken. This is to ensure the moisture content is within the recommended level, especially when operating Dynalene HF-LO below 35°F.

3 Install line filtration

Dynalene HF-LO should remain free of debris throughout the operational life of the liquid. An appropriately sized in-line strainer using a perforation size ($1/32$ " or less), 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, combined with an in-line strainer as a prefilter, is the best method of keeping Dynalene HF-LO particulate free. Use of bypass and slip-stream filtration is also acceptable.

Ongoing Fluid Maintenance

Dynalene can provide a pre-labeled sample kit upon request, which includes the sample bottle, an instruction page, and an MSDS sheet. Dynalene offers the first sample analysis free of charge.

For best results:

1. Take a fluid sample when the system is at room temperature to prevent moisture from contaminating the Dynalene HF-LO.
2. Before filling up the sample bottle, allow the fluid to flow out for a few seconds into another container to clear any debris. Leave about one inch of airspace from the top of the sample bottle to minimize leakage. After closing the cap, secure by wrapping electrical tape around it several times.
3. It is best to take a fluid sample while the fluid is circulating.

Basic heat transfer fluid system design

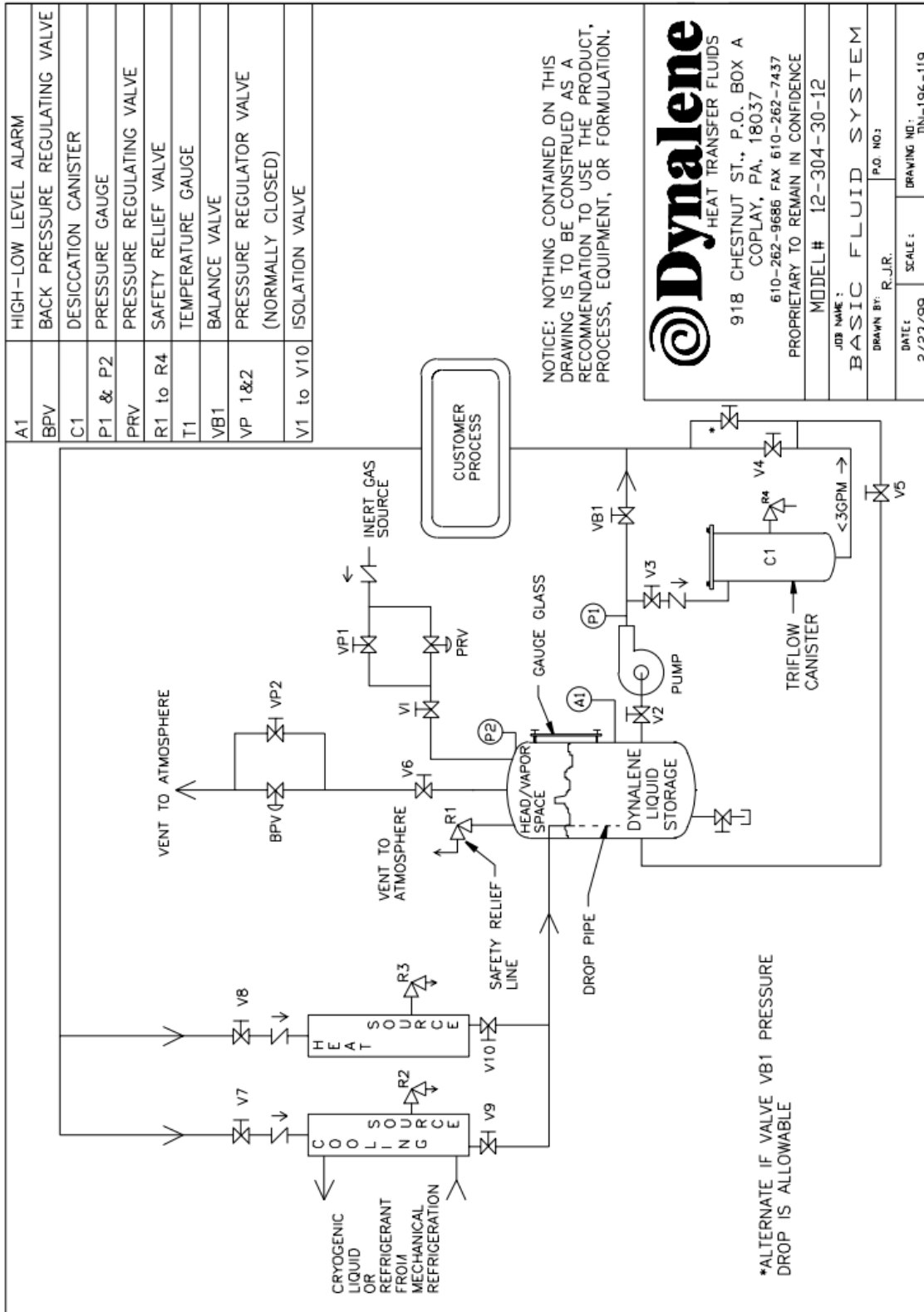


Figure 1. Basic Dynalene HF-LO heat transfer system.

Dynalene HF-LO Properties: SI Units

Properties of Dynalene HF-LO vs. temperature in SI units are given in Table 3.

Table 3. Properties of Dynalene HF-LO.

Temp	Viscosity	Thermal Cond.	Specific Heat	Density
°C	mPa·s	W/m·K	kJ/kg·K	kg/m ³
-73	70.2	0.1272	1.742	833
-70	52.7	0.1266	1.753	831
-60	23.9	0.1246	1.791	823
-50	13.3	0.1226	1.829	816
-40	8.40	0.1206	1.867	808
-30	5.80	0.1186	1.905	800
-20	4.20	0.1166	1.943	793
-10	3.20	0.1146	1.981	785
0	2.50	0.1126	2.019	778
10	2.00	0.1106	2.057	770
20	1.60	0.1086	2.095	762
30	1.40	0.1066	2.133	755
40	1.20	0.1046	2.171	747
50	1.00	0.1026	2.209	740
60	0.87	0.1006	2.247	732
70	0.77	0.0986	2.285	724
80	0.68	0.0966	2.323	717
90	0.60	0.0946	2.361	709
100	0.54	0.0926	2.399	702
110	0.49	0.0906	2.437	694
120	0.44	0.0886	2.475	686
130	0.40	0.0866	2.513	679
140	0.37	0.0846	2.551	671
150	0.34	0.0826	2.589	664
160	0.31	0.0806	2.627	656
170	0.29	0.0786	2.665	649
177	0.27	0.0772	2.692	643

Dynalene HF-LO Properties: English Units

Properties of Dynalene HF-LO vs. temperature in English units are given in Table 4.

Table 4. Properties of Dynalene HF-LO.

Temp	Viscosity	Thermal Cond.	Specific Heat	Density
°F	cP	BTU/hr-ft-°F	BTU/lb-°F	lb/ft³
-100	72.5	0.0749	0.416	51.9
-80	28.0	0.0736	0.426	51.4
-60	14.1	0.0722	0.436	50.9
-40	8.40	0.0709	0.446	50.3
-20	5.50	0.0696	0.456	49.8
0	3.90	0.0683	0.466	49.3
20	2.90	0.0670	0.476	48.8
40	2.30	0.0657	0.487	48.2
60	1.80	0.0644	0.497	47.7
80	1.50	0.0631	0.507	47.2
100	1.20	0.0618	0.517	46.7
120	1.00	0.0605	0.527	46.1
140	0.87	0.0592	0.537	45.6
160	0.76	0.0579	0.547	45.1
180	0.66	0.0566	0.557	44.6
200	0.58	0.0553	0.567	44.0
220	0.52	0.0539	0.577	43.5
240	0.46	0.0526	0.587	43.0
260	0.41	0.0513	0.598	42.5
280	0.37	0.0500	0.608	41.9
300	0.34	0.0487	0.618	41.4
320	0.31	0.0474	0.628	40.9
340	0.28	0.0461	0.638	40.3
350	0.27	0.0455	0.643	40.1

Toxicological Report

For complete toxicological information regarding Dynalene HF-LO, consult the MSDS. The MSDS for Dynalene HF-LO should be understood prior to use.

Product Disclaimer

The information contained in this entire publication is presented in good faith at “no charge” and is believed to be correct as of the date indicated no representations or warranties are made as to its completeness or accuracy. The information listed is supplied upon the condition that the persons receiving it will make their own determination as to its suitability for their purposes prior to use. In no event will the seller be responsible for damages of any nature whatsoever resulting from the use of, or reliance upon, this information or the product to which this information refers. Nothing contained on this page is to be construed as a recommendation to use the product, process, equipment or formulation in conflict with any patent. No representation or warranty, expressed or implied, is made that the use of this product will not infringe any patent.

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