A.4. CARACTERISTICAS DEL ACEITE TERMICO

Paratherm HE

HEAT TRANSFER FLUID

High Flash & Fire Points, Thermally Stable

TYPICAL PROPERTIES*

Physical Properties

Feedstock	Paraffinic Hydrocarbon (Single Cut)
Appearance	Transparent, Pale Yellow
Odor	Faint (oily)
Optimum Use Range	150°F to 600°F (66°C to 316°C)
Flash Point (coc) ASTM D-92	440°F (227°C)
Fire Point (coc) ASTM D-92	500°F (260°C)
Autoignition ASTM D-2155	700°F (371°C)
Atmospheric Boiling Point, 10% Fraction, ASTM D-1160	779°F (415°C)
Vapor Pressure, psia @	
300°F	0.00039
350°F	0.00193
400°F	0.0097
450°F	0.0387
500°F	0.1350
550°F	0.3870
600°F	0.8700
Coefficient of Thermal Expansion**	0.000592/ °F 0.001066/ °C
Heat Of Vaporization (Calculated)	77.19 BTU/lb
Heat Of Combustion	19,550 BTU/lb
API Gravity ASTM D-287	31.7
Specific Gravity @ 15°C ASTM D-1298	0.8651
Density, lb/gal @ 60°F (16°C)	7.22
Viscosity: cSt @ 40°C ASTM D-445	40.25
Pour Point (Crystal Point) ASTM D-97	5°F (-15°C)
Pumpability: Centrifugal @ 2,000 centipoise, nominal	20°F (-7°C)
Color ASTM D-1500	1.0
Molecular Weight ASTM D-2502	445g/mole
Corrosivity (3hr Cu Strip @ 100°C) ASTM D-130	1A

Total Sulfur (Mass%) J-140	0.002
Total Acid Number (T.A.N.) ASTM D-664	0.01

Electrical Properties

Dielectric Strength @ 20°C, nominal	>30 KV/cm

Optical Properties

Refractive Index ASTM D-1747	1.4722

*These are typical laboratory values, and are not guaranteed for all samples.
**Note: Normal practice is to size the expansion tank so that it is 1/4 to 1/3 full when the system is cold, and 2/3 to 3/4 full when the system is at the maximum normal operating temperature.

Tabla de datos (SI Unidades)									Rev. 1000
Temperatura		Densidad		Viscosidad		Calor específico	Conductividad térmica	Presión de vapor	
°C	**°F**	**g/ml**	**kg/m3**	**cSt (m¾/s)**	**cP (mPa-s)**	**cal/(g-°C)**	**W/(m-K)**	**mm Hg**	**kPa**
0	32	0.8755	876	453	396	0.4328	0.1347		
5	41	0.8724	872	303	264	0.4371	0.1343		
10	50	0.8692	869	210	182	0.4415	0.1340		
15	59	0.8660	866	152	131	0.4458	0.1336		
20	68	0.8628	863	112	97	0.4502	0.1332		
25	77	0.8596	860	84	72	0.4545	0.1328		
30	86	0.8564	856	65	55	0.4588	0.1325	0.01	
35	95	0.8533	853	51	43	0.4632	0.1321	0.01	
40	104	0.8501	850	40.3	34.2	0.4675	0.1317	0.01	
45	113	0.8469	847	32.5	27.5	0.4719	0.1313	0.01	
50	122	0.8437	844	26.6	22.4	0.4762	0.1310	0.01	
55	131	0.8405	841	22.1	18.5	0.4806	0.1306	0.01	
60	140	0.8342	837	18.5	15.5	0.4849	0.1302	0.01	
65	149	0.8342	834	15.8	13.1	0.4892	0.1299	0.01	
70	158	0.8310	831	13.5	11.2	0.4936	0.1295	0.01	
75	167	0.8278	828	11.7	9.71	0.4979	0.1291	0.01	
80	176	0.8246	825	10.2	8.44	0.5023	0.1287	0.02	
85	185	0.8214	821	9.01	7.40	0.5066	0.1284	0.02	
90	194	0.8182	818	7.98	6.52	0.5110	0.1280	0.02	
95	203	0.8151	815	7.11	5.79	0.5153	0.1276	0.02	
100	212	0.8119	812	6.37	5.17	0.5196	0.1272	0.02	
105	221	0.8087	809	5.74	4.64	0.5240	0.1269	0.02	
110	230	0.8055	806	5.20	4.19	0.5283	0.1265	0.02	
115	239	0.8023	802	4.74	3.80	0.5327	0.1261	0.02	
120	248	0.7991	799	4.34	3.46	0.5370	0.1257	0.02	
125	257	0.7960	796	3.99	3.17	0.5414	0.1254	0.02	
130	266	0.7928	793	3.68	2.91	0.5457	0.1250	0.03	
135	275	0.7899	790	3.40	2.68	0.5500	0.1246	0.03	
140	284	0.7864	786	3.16	2.48	0.5544	0.1242	0.03	

145	293	0.7832	783	2.94	2.30	0.5587	0.1239	0.03	
150	302	0.7800	780	2.75	2.14	0.5631	0.1235	0.03	
155	311	0.7769	777	2.57	1.99	0.5674	0.1231	0.05	0.01
160	320	0.7737	774	2.41	1.86	0.5718	0.1227	0.07	0.01
165	328	0.7705	770	2.27	1.75	0.5761	0.1224	0.08	0.01
170	337	0.7673	767	2.15	1.64	0.5804	0.1220	0.10	0.01
175	346	0.7641	764	2.03	1.55	0.5848	0.1216	0.12	0.02
180	355	0.7609	761	1.92	1.46	0.5891	0.1212	0.19	0.03
185	364	0.7577	758	1.83	1.38	0.5935	0.1209	0.26	0.03
190	373	0.7546	755	1.74	1.31	0.5978	0.1205	0.32	0.04
195	382	0.7514	751	1.67	1.25	0.6022	0.1201	0.39	0.05
200	382	0.7482	748	1.59	1.19	0.6065	0.1197	0.46	0.06
205	400	0.7450	745	1.52	1.13	0.6108	0.1194	0.68	0.09
210	409	0.7418	742	1.47	1.09	0.6152	0.1190	0.94	0.13
215	418	0.7386	739	1.42	1.05	0.6195	0.1186	1.20	0.16
220	427	0.7355	735	1.37	1.01	0.6239	0.1182	1.46	0.19
225	436	0.7323	732	1.33	0.971	0.6282	0.1179	1.72	0.23
230	445	0.7291	729	1.28	0.931	0.6326	0.1175	2.36	0.31
235	454	0.7259	726	1.23	0.892	0.6369	0.1171	3.09	0.41
240	463	0.7227	723	1.18	0.854	0.6412	0.1167	3.83	0.51
245	472	0.7195	720	1.13	0.815	0.6456	0.1164	4.56	0.61
250	481	0.7164	716	1.09	0.777	0.6599	0.1160	5.30	0.71
255	490	0.7132	713	1.04	0.739	0.6543	0.1156	6.79	0.90
260	499	0.7100	710	0.990	0.702	0.6586	0.1152	8.47	1.1
265	508	0.7068	707	0.960	0.678	0.6629	0.1149	10.2	1.4
270	517	0.7036	704	0.935	0.657	0.6673	0.1145	11.8	1.6
275	526	0.7004	700	0.910	0.637	0.6716	0.1141	13.5	1.8
280	535	0.6973	697	0.880	0.612	0.6760	0.1137	16.5	2.2
285	544	0.6941	694	0.855	0.592	0.6803	0.1134	19.8	2.6
290	553	0.6909	691	0.830	0.572	0.6847	0.1130	23.2	3.1
295	562	0.6877	688	0.805	0.552	0.6890	0.1126	26.5	3.5
300	571	0.6845	685	0.780	0.533	0.6933	0.1122	29.8	4.0
305	580	0.6813	681	0.755	0.513	0.6977	0.1119	34.6	4.6
310	589	0.6782	678	0.730	0.494	0.7020	0.1115	39.3	5.2
315	598	0.6750	675	0.707	0.476	0.7064	0.1111	44.1	5.9
320	607	0.6717	672	0.690	0.463	0.7046	0.1107	49.0	6.5
325	616	0.6685	668	0.674	0.450	0.7029	0.1103	54.0	7.2
330	625	0.6652	665	0.657	0.437	0.7011	0.1099	59.0	7.9
335	634	0.6619	662	0.641	0.424	0.6994	0.1095	64.0	8.5
338	640	0.6587	659	0.625	0.411	0.6977	0.1091	69.0	9.2

Paratherm HE® HEAT TRANSFER FLUID

High Flash & Fire Points, Thermally Stable

ENGINEERING BULLETIN HE 302

Precise, Uniform Temperature Control™ in Closed-Loop Heat Transfer Systems

The Paratherm **HE**® high flash and fire point heat transfer fluid is rated for an optimal service range of 150°F to 600°F (66°C to 316°C). Engineered for higher thermal and oxidative stability, it is efficient and cost effective. Its greater purity allows it to strongly resist degradation while holding thermal properties and maintaining efficiency. This provides for low maintenance and solid performance over an extended operating life. Non-toxic, the **HE** fluid is safe to use and easy to dispose. It can be safely combined with spent lubricating oils and recycled locally. Found in a broad variety of applications, the fluid is recommended, specified and/or approved by a host of equipment manufacturers and thermal fluid heater OEMs for continuously operated systems. Recognized by U.L. *(Underwriters Laboratories, Inc., No. MH17163-N)*, the durable **HE** fluid has a proven record of success under demanding conditions and yet is safe and easy to handle.

Safety in Operation

The Paratherm **HE** fluid has among the highest flash and fire points of any high temperature heat transfer fluid. With a flash point of 440°F, and a fire point of 500°F, it is an extremely safe fluid to have in your system. In many cases, these flash and fire points exceed the system's operating temperature.

The **HE** fluid is Coast Guard approved for molten sulfur service and has passed rigorous Bioassay with 3 species.

Human/Environmental Safety

The Paratherm **HE** fluid is virtually non-toxic. With an Oral LD_{50} rating of >35 (the higher the number, the lower the toxicity), the **HE** fluid is actually safer than most oils. In the event of a release, it can be treated using the same simple clean-up procedures used for light lubricating oils. Once gathered and placed in a container, the **HE** fluid can be combined with the plant's used lubricating oils and sent to the local recycler. Have the Material Safety Data Sheet available for the recycler. Note that the **HE** fluid contains no chlorinated hydrocarbons, and virtually no polar compounds, sulphur, oxides of nitrogen or heavy metals.

Corrosion in the System

The **HE** fluid is manufactured from natural feedstocks, and provides similar metal-coating and lubricating properties as the finest natural oils. However, any water allowed to stand in piping, components or especially expansion tanks of thermal oil systems can cause corrosion. Because the Paratherm **HE** fluid is immiscible with water and also slightly less dense, any water can be easily drained from the system's low point drains. Crack the low-point valve and allow fluid to drain into a beaker or clear water glass. If your see a phase separation (one liquid "floating" on top of the other), continue to drain until no separation is observed.

Typical Properties*

Physical Properties

Feedstock		Paraffinic Hydrocarbon (Single Cut)
Appearance		Transparent, Pale Yellow
Odor		Faint (oily)
Optimum Use Range		150° to 600°F (66°C to 316°C)
Flash Point (coc)	ASTM-D-92	440°F (227°C)
Fire Point (coc)	ASTM-D-92	500°F (260°C)
Autoignition	ASTM-D-2155	700°F (371°C)
Atmospheric Boiling Point, 10% Fraction,	ASTM-D-1160	779°F (415°C)
Vapor Pressure, psia @ 300°F		0.00039
350°F		0.00193
400°F		0.0097
450°F		0.0387
500°F		0.1350
550°F		0.3870
600°F		0.8700
Coefficient of Thermal Expansion**		0.000592/°F 0.001066/°C
Heat of Vaporization (Calculated)		77.19 Btu/lb
Heat of Combustion		19,550 Btu/lb
API Gravity ASTM D-287		31.7
Specific Gravity @ 15°C	ASTM-D-1298	0.8651
Density, lb/gal @ 60°F (16°C)		7.22
Viscosity, cSt @ 40°C	ASTM-D-445	40.25
Pour Point (Crystal Point)	ASTM-D-97	5°F (-15°C)
HE-L/P™ Fluid		-35°F
Pumpability: Centrifugal @ 2,000 centipoise, nominal		20°F (-7°C)
Color	ASTM-D-1500	1.0
Molecular Weight	ASTM-D-2502	445g/mole
Corrosivity (3hr Cu Strip @ 100°C)	ASTM-D-130	1A
Total Sulphur (Mass %) J-140		0.002
Total Acid Number (T.A.N.)	ASTM-D-974	0.01

Electrical Properties

Dielectric Strength @20°C, nominal		>30 KV/cm

Optical Properties

Refractive Index	ASTM-D-1747	1.4722

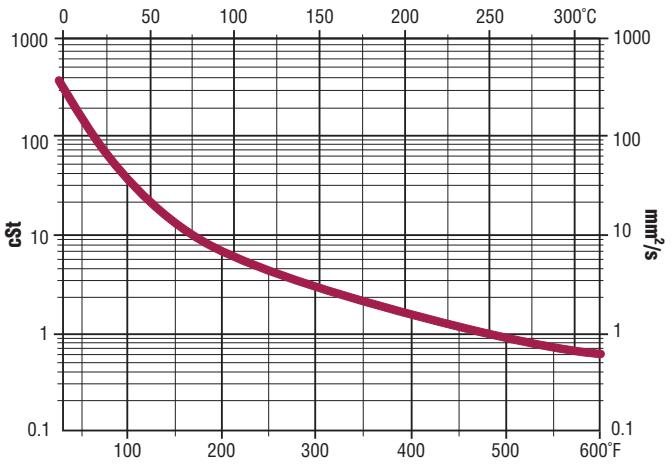
** These are typical laboratory values, and are not guaranteed for all samples.*

*** Note: Normal practice is to size expansion tanks so that they are 1/4 to 1/3 full when the system is cold, and 2/3 to 3/4 full when the system is at the maximum normal operating temperature.*

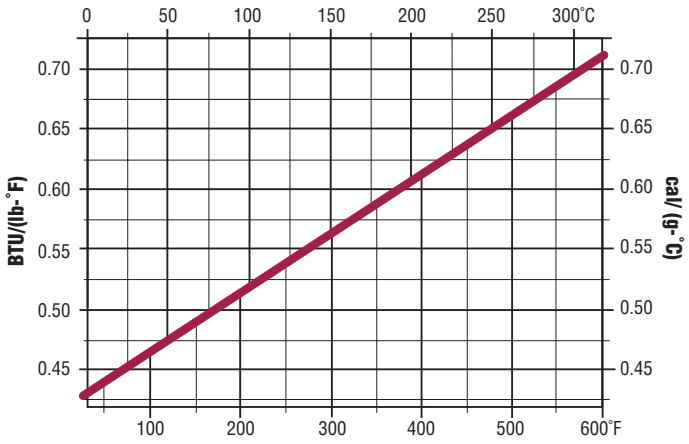
Storing Your Fluid

Drums of heat transfer fluid should be kept in non-hazardous dry areas. Until ready for use, the container's tamper evident safety seals *must* remain intact. Liquids should not be allowed to pool on the tops of the drums. In the afternoon and evening when temperatures cool, the heat transfer fluid will cool and contract slightly. A partial vacuum is created in the drum, and, if the bung's elastomeric seal is not perfect, liquid standing on the top of the drum can be drawn through, contaminating the fluid. If drums must be temporarily stored outside, store them on their sides.

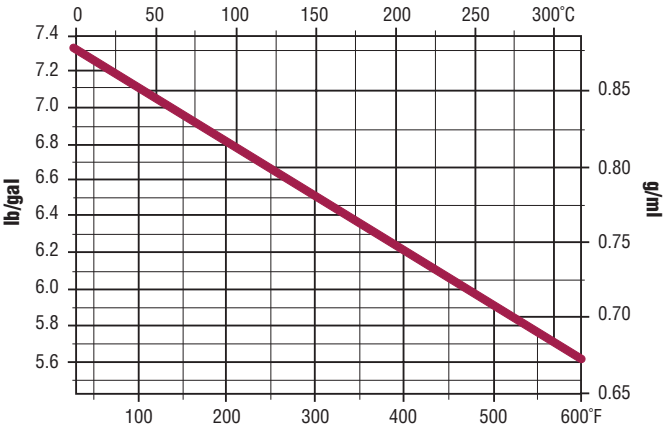
VISCOSITY



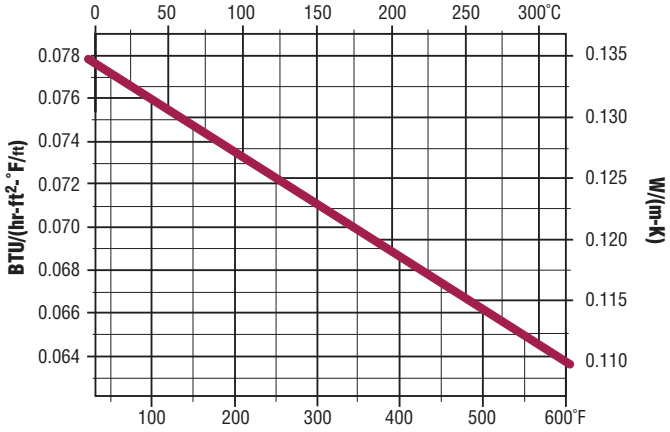
SPECIFIC HEAT



DENSITY



THERMAL CONDUCTIVITY



Pre-Cleaning the System

For optimal performance of both system and its heat transfer fluid, we strongly suggest that piping, valves and other components be thoroughly cleaned before installation. Mill scale, weld spatter and slag, quench oils, protective lacquer and varnish coatings, and dust and dirt can act to degrade the fluid, and can damage pumps and valves. And lodging in restrictions, these contaminants can easily create the same low flow conditions that cause premature failure of systems and fluid.

Inerting the System

Immediately after completing installation of the system, we suggest you purge with inert gas. Such purging can eliminate air and water vapor, and can substantially reduce corrosion. And while purging, you can leak test the system using simple soap-bubble detection. Finally, when you charge the system, any gas that becomes dissolved in the fluid will be inert, and fluid oxidation at start-up will be almost nil.

Charging the System

When charging the system, we suggest you fill from the bottom (a point near pump suction) using a small positive displacement pump — not the system pump. Charging from the system's low point can help reduce trapped air in the system, which will substantially reduce the entrainment of gas bubbles and resultant pump cavitation.

Fluid Disposal

Because Paratherm heat transfer fluids are produced from natural feedstocks, they are exceptionally safe to use. Easy to dispose, used or contaminated Paratherm fluids can be safely combined with spent lubricating oils and recycled locally (EPA, citation 57FR21524). Paratherm strongly encourages recycling of used heat transfer fluid to conserve natural resources and to minimize the problem of liquid waste in landfills. We suggest you check local, state and federal regulations first, of course. *(Note: liquids contaminated with chlorinated solvents or other regulated materials may require special handling, and may not be accepted by recyclers.)*

Fluid Analysis

Overheating, oxidation and contamination of your heat transfer fluid can significantly reduce its ability to perform. Product quality will suffer, and in severe cases considerable damage to your thermal oil system can result. Periodic analysis of your fluid can allow you to detect problems in the early stages and achieve substantial savings.

Quality Control

We thoroughly test each batch of heat transfer fluid to ensure absolute conformance to tight production specifications. Each shipment is traceable to the master batch, with test results archived at Paratherm.

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