Technical Bulletin 7239115B
(Supersedes 7239115A)

VP-1

THERMINOL® VP-1

Heat Transfer Fluid by **Solutia**

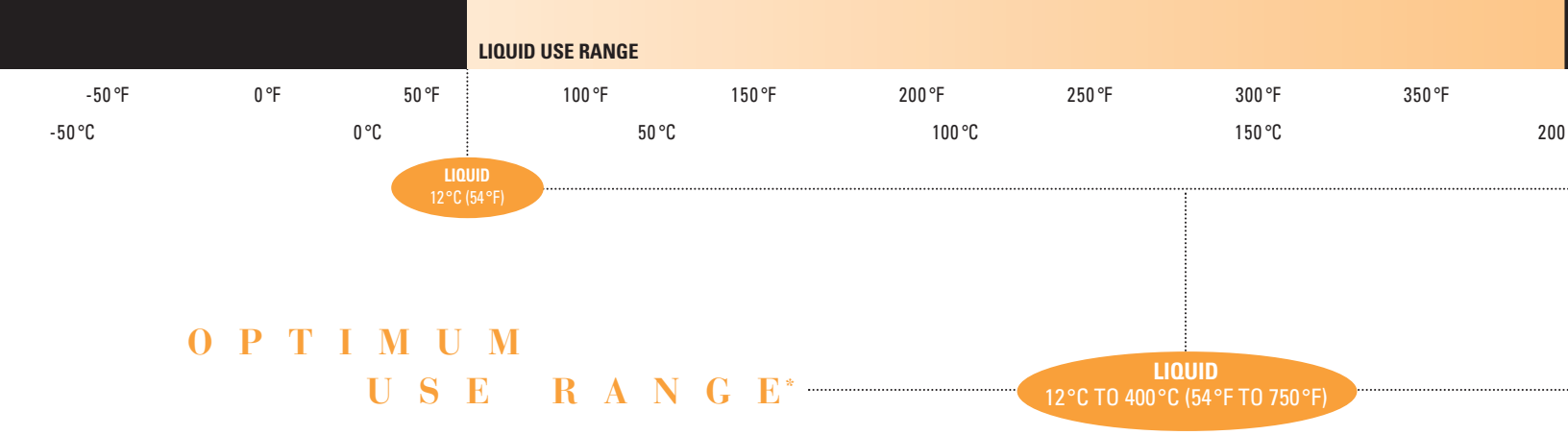
Vapor Phase/ Liquid Phase Heat Transfer Fluid

54 °F to 750 °F

+400 °C
+700 °F
+350 °C
+600 °F
+300 °C
+500 °F
+250 °C
+400 °F
+200 °C
+150 °C +300 °F
+100 °C +200 °F
+50 °C +100 °F
0 °C
0 °F
-50 °C
-100 °F

VAPOR USE RANGE

LIQUID USE RANGE



OPTIMUM USE RANGE*

Therminol® VP-1 heat transfer fluid is specifically designed to meet the demanding requirements of vapor phase systems. It combines exceptional heat stability and low viscosity for efficient, dependable, uniform performance in a wide optimum use range of 12 °C to 400 °C.

THERMINOL® VP-1

Heat Transfer Fluid by **Solutia**

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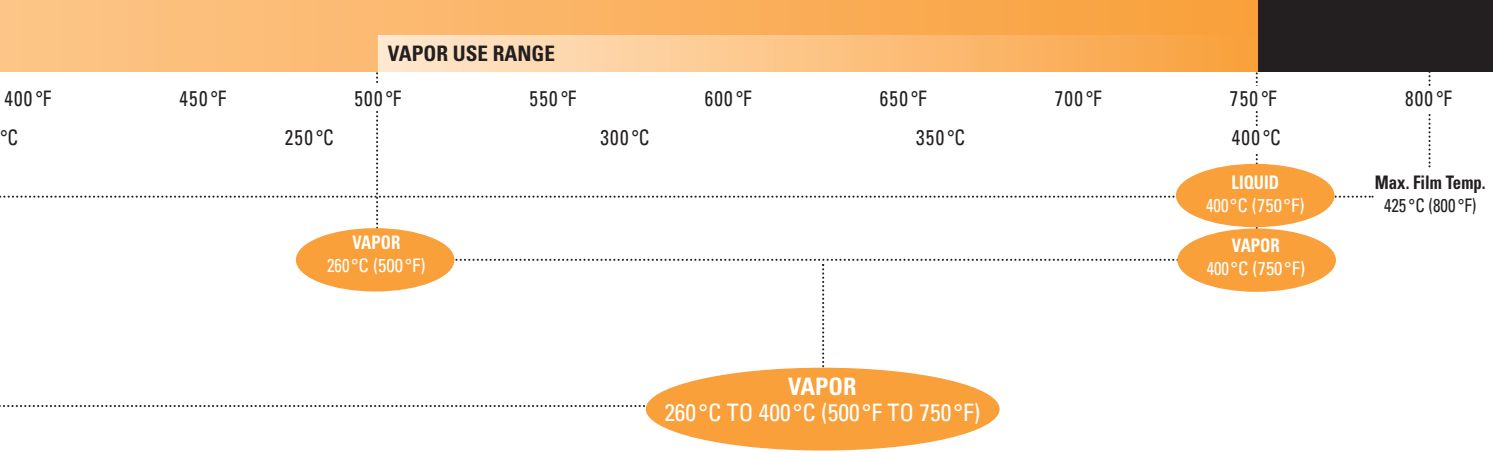

TYPICAL PROPERTIES*†

Appearance	Clear, water-white liquid
Composition	Biphenyl and diphenyl oxide
Moisture Content, Maximum	300 ppm
Chlorine	< 10 ppm
Sulfur	< 10 ppm
Neutralization Number	< 0.2 mg KOH/g
Copper Corrosion (ASTM D-130)	<< 1 a
Flash Point, Open Cup (ASTM D-92)	124 °C (255 °F)
Closed Cup (Pensky-Martens)	110 °C (230 °F)
Fire Point (ASTM D-92)	127 °C (260 °F)
Autoignition Temperature (ASTM D-2155)	621 °C (1150 °F)
Kinematic Viscosity at 40 °C	2.48 mm^2/s (cSt)
at 100 °C	0.99 mm^2/s (cSt)
Density at 25 °C	1060 kg/m^3 (8.85 lb/gal)
Specific Gravity (60 °F/60 °F)	1.069
Coefficient of Thermal Expansion at 200 °C	0.000979/°C (0.000544/°F)
Average Molecular Weight	166
Crystallization Point	12 °C (54 °F)
Volume Contraction Upon Freezing	6.27%
Volume Expansion Upon Melting	6.69%
Surface Tension in Air at 25 °C	36.6 dyn/cm
Heat of Fusion	97.3 kJ/kg (41.8 Btu/lb)
Normal Boiling Point	257 °C (495 °F)
Heat of Vaporization at Maximum Use Temperature 400 °C	206 kJ/kg (88.7 Btu/lb)
Specific Resistivity at 20 °C	6.4×10^{11} ohm-cm
Optimum Use Range, Liquid	12 °C-400 °C (54 °F-750 °F)
Vapor	260 °C-400 °C (500 °F-750 °F)
Maximum Film Temperature	425 °C (800 °F)
Pseudocritical Temperature	499 °C (930 °F)
Pseudocritical Pressure	33.1 bar (480 psia)
Pseudocritical Density	327 kg/m^3 (20.4 lb/ft^3)

* These data are based upon samples tested in the laboratory and are not guaranteed for all samples. Write us for complete sales specifications for Therminol VP-1 fluid.

† Does not constitute an express warranty. See NOTICE on the last page of this bulletin.

LIQUID PROPERTIES OF THERMINOL®

Temperature		Liquid Density			Liquid Heat Capacity		Liquid Enthalpy**	
°F	°C	lb/gal	lb/ft³	kg/m³	Btu/lb-°F [cal/g-°C]	kJ/kg·K	Btu/lb	kJ/kg
54	12	8.93	66.8	1071	0.364	1.52	0.0	0.0
60	16	8.91	66.7	1068	0.366	1.53	2.3	5.4
80	27	8.84	66.1	1059	0.374	1.57	9.8	22.7
100	38	8.76	65.5	1050	0.382	1.60	17.3	40.2
120	49	8.69	65.0	1041	0.390	1.63	25.0	58.2
140	60	8.61	64.4	1032	0.397	1.66	32.9	76.4
160	71	8.53	63.8	1023	0.405	1.69	40.9	95.1
180	82	8.46	63.3	1014	0.412	1.73	49.1	114.1
200	93	8.38	62.7	1004	0.420	1.76	57.4	133.4
220	104	8.31	62.1	995	0.427	1.79	65.9	153.1
240	116	8.23	61.6	986	0.435	1.82	74.5	173.1
260	127	8.15	61.0	977	0.442	1.85	83.3	193.5
280	138	8.07	60.4	967	0.449	1.88	92.2	214.2
300	149	7.99	59.8	958	0.457	1.91	101.2	235.3
320	160	7.91	59.2	948	0.464	1.94	110.4	256.7
340	171	7.83	58.6	939	0.471	1.97	119.8	278.4
360	182	7.75	58.0	929	0.478	2.00	129.3	300.5
380	193	7.67	57.4	919	0.485	2.03	138.9	322.9
400	204	7.59	56.8	909	0.492	2.06	148.7	345.6
420	216	7.50	56.1	899	0.499	2.09	158.6	368.6
440	227	7.42	55.5	889	0.506	2.12	168.7	392.0
460	238	7.33	54.9	879	0.514	2.15	178.9	415.7
480	249	7.25	54.2	868	0.521	2.18	189.2	439.8
495	257	7.18	53.7	860	0.526	2.20	197.0	457.4
500	260	7.16	53.5	857	0.528	2.21	199.7	464.1
520	271	7.07	52.8	847	0.535	2.24	210.3	488.8
540	282	6.97	52.2	835	0.542	2.27	221.1	513.8
560	293	6.88	51.4	824	0.549	2.30	232.0	539.2
580	304	6.78	50.7	812	0.556	2.33	243.0	564.9
600	316	6.68	50.0	800	0.563	2.36	254.2	590.9
620	327	6.58	49.2	788	0.570	2.39	265.5	617.2
640	338	6.47	48.4	775	0.578	2.42	277.0	643.9
660	349	6.36	47.6	762	0.586	2.45	288.7	671.0
680	360	6.25	46.7	749	0.594	2.48	300.5	698.4
700	371	6.13	45.9	734	0.602	2.52	312.4	726.2
720	382	6.01	44.9	720	0.612	2.56	324.6	754.4
740	393	5.88	43.9	704	0.622	2.60	336.9	783.1
750	399	5.81	43.4	696	0.627	2.62	343.1	797.6
760	404	5.74	42.9	687	0.633	2.65	349.4	812.2
780	416	5.59	41.8	670	0.646	2.70	362.2	842.0
800	427	5.43	40.6	651	0.662	2.77	375.3	872.4

* These data are based upon samples tested in the laboratory and are not guaranteed for all samples. Write us for complete sales specifications for Therminol VP-1 fluid.
** The enthalpy basis is liquid at the crystallizing point, 53.6 °F (12 °C).
† Does not constitute an express warranty. See NOTICE on the last page of this bulletin.

VP-1 HEAT TRANSFER FLUID*†

Liquid Thermal Conductivity			Liquid Viscosity			Vapor Pressure				Temperature	
Btu/ ft-hr-°F	kcal/ m-hr-°C	W/m·K	lb/ft-hr	cSt [mm²/s]	cP [mPa·s]	psia	mm Hg	kgf/cm²	kPa	°F	°C
0.0792	0.1179	0.1370	13.26	5.12	5.48					54	12
0.0790	0.1176	0.1367	11.84	4.58	4.89					60	16
0.0784	0.1167	0.1357	8.64	3.37	3.57	0.0004	0.019	0.00003	0.0026	80	27
0.0778	0.1158	0.1346	6.60	2.60	2.73	0.0010	0.054	0.00007	0.0071	100	38
0.0772	0.1148	0.1334	5.23	2.08	2.16	0.0026	0.134	0.00018	0.0178	120	49
0.0765	0.1138	0.1323	4.26	1.707	1.761	0.0059	0.307	0.00042	0.0409	140	60
0.0758	0.1128	0.1310	3.55	1.434	1.467	0.0127	0.655	0.00087	0.0874	160	71
0.0750	0.1117	0.1298	3.01	1.228	1.244	0.0254	1.31	0.00179	0.175	180	82
0.0743	0.1106	0.1285	2.59	1.067	1.071	0.0483	2.50	0.00339	0.333	200	93
0.0735	0.1094	0.1271	2.26	0.938	0.934	0.0872	4.51	0.00613	0.602	220	104
0.0727	0.1082	0.1257	1.990	0.834	0.823	0.151	7.81	0.0106	1.04	240	116
0.0719	0.1070	0.1243	1.769	0.749	0.731	0.251	13.0	0.0177	1.73	260	127
0.0710	0.1057	0.1228	1.585	0.677	0.655	0.404	20.9	0.0284	2.78	280	138
0.0701	0.1044	0.1213	1.430	0.617	0.591	0.629	32.5	0.0442	4.33	300	149
0.0692	0.1030	0.1197	1.298	0.566	0.537	0.951	49.2	0.0669	6.56	320	160
0.0683	0.1017	0.1181	1.185	0.522	0.490	1.40	72.6	0.0986	9.67	340	171
0.0674	0.1002	0.1165	1.086	0.483	0.449	2.02	105	0.142	13.9	360	182
0.0664	0.0988	0.1148	1.001	0.450	0.414	2.85	147	0.200	19.6	380	193
0.0654	0.0973	0.1131	0.926	0.421	0.383	3.94	204	0.277	27.2	400	204
0.0644	0.0958	0.1113	0.859	0.395	0.355	5.35	277	0.376	36.9	420	216
0.0633	0.0942	0.1095	0.800	0.372	0.331	7.15	370	0.503	49.3	440	227
0.0622	0.0926	0.1076	0.748	0.352	0.309	9.41	487	0.661	64.9	460	238
0.0611	0.0910	0.1057	0.700	0.333	0.290	12.2	631	0.858	84.2	480	249
0.0603	0.0897	0.1043	0.668	0.321	0.276	14.7	760	1.03	101	495	257
0.0600	0.0893	0.1038	0.658	0.317	0.272	15.6	808	1.10	108	500	260
0.0588	0.0876	0.1018	0.620	0.303	0.256	19.8	1020	1.39	136	520	271
0.0577	0.0858	0.0998	0.585	0.289	0.242	24.8	1280	1.74	171	540	282
0.0565	0.0841	0.0977	0.553	0.278	0.229	30.7	1590	2.16	211	560	293
0.0552	0.0822	0.0956	0.524	0.267	0.217	37.6	1940	2.64	259	580	304
0.0540	0.0804	0.0934	0.498	0.257	0.206	45.7	2360	3.21	315	600	316
0.0527	0.0785	0.0912	0.474	0.248	0.1958	55.1	2850	3.87	380	620	327
0.0514	0.0765	0.0890	0.451	0.241	0.1866	65.8	3400	4.63	454	640	338
0.0501	0.0746	0.0867	0.431	0.234	0.1781	78.1	4040	5.49	539	660	349
0.0488	0.0726	0.0844	0.412	0.227	0.1703	92.1	4760	6.47	635	680	360
0.0474	0.0705	0.0820	0.394	0.222	0.1630	108	5580	7.58	743	700	371
0.0460	0.0685	0.0796	0.378	0.217	0.1562	125	6490	8.82	865	720	382
0.0446	0.0663	0.0771	0.363	0.213	0.1500	145	7510	10.2	1000	740	393
0.0439	0.0653	0.0759	0.356	0.211	0.1470	156	8060	11.0	1070	750	399
0.0431	0.0642	0.0746	0.349	0.210	0.1441	167	8640	11.7	1150	760	404
0.0417	0.0620	0.0721	0.335	0.207	0.1387	191	9890	13.4	1320	780	416
0.0402	0.0598	0.0695	0.323	0.205	0.1336	218	11300	15.3	1500	800	427

VAPOR PROPERTIES OF THERMINOL®

Temperature		Vapor Density		Vapor Heat Capacity		Heat of Vaporization		Vapor Enthalpy***	
°F	°C	lb/ft³	kg/m³	Btu/lb-°F [cal/g-°C]	kJ/kg·K	Btu/lb	kJ/kg	Btu/lb	kJ/kg
54	12			0.233	0.98	180.3	419.0	180.3	419.0
60	16			0.236	0.99	179.4	417.1	181.8	422.5
80	27	0.00001	0.00017	0.245	1.03	176.8	411.1	186.6	433.7
100	38	0.00003	0.00046	0.254	1.06	174.3	405.1	191.6	445.3
120	49	0.00007	0.00110	0.263	1.10	171.7	399.2	196.8	457.3
140	60	0.00015	0.00245	0.272	1.14	169.2	393.3	202.1	469.8
160	71	0.00032	0.00507	0.280	1.17	166.7	387.5	207.6	482.6
180	82	0.00061	0.00985	0.289	1.21	164.2	381.8	213.3	495.8
200	93	0.00113	0.0181	0.298	1.25	161.8	376.1	219.2	509.5
220	104	0.00199	0.0318	0.306	1.28	159.4	370.4	225.2	523.5
240	116	0.00334	0.0535	0.315	1.32	156.9	364.8	231.4	537.9
260	127	0.00541	0.0866	0.323	1.35	154.5	359.2	237.8	552.7
280	138	0.00846	0.136	0.331	1.39	152.2	353.7	244.3	567.9
300	149	0.0128	0.206	0.340	1.42	149.8	348.2	251.0	583.5
320	160	0.0189	0.303	0.348	1.45	147.4	342.7	257.9	599.4
340	171	0.0273	0.437	0.356	1.49	145.1	337.2	264.8	615.6
360	182	0.0384	0.615	0.363	1.52	142.7	331.7	272.0	632.2
380	193	0.0529	0.848	0.371	1.55	140.4	326.3	279.3	649.1
400	204	0.0717	1.15	0.379	1.58	138.0	320.8	286.7	666.4
420	216	0.0954	1.53	0.386	1.62	135.6	315.3	294.2	683.9
440	227	0.125	2.00	0.394	1.65	133.2	309.7	301.9	701.7
460	238	0.162	2.59	0.401	1.68	130.8	304.1	309.7	719.9
480	249	0.206	3.31	0.408	1.71	128.4	298.5	317.6	738.2
495	257	0.246	3.93	0.414	1.73	126.6	294.2	323.6	752.1
500	260	0.260	4.17	0.416	1.74	125.9	292.7	325.6	756.9
520	271	0.325	5.20	0.423	1.77	123.4	286.9	333.7	775.7
540	282	0.401	6.43	0.430	1.80	120.9	281.0	342.0	794.8
560	293	0.492	7.87	0.437	1.83	118.3	274.9	350.2	814.1
580	304	0.597	9.57	0.444	1.86	115.6	268.7	358.6	833.6
600	316	0.720	11.5	0.451	1.89	112.9	262.3	367.1	853.2
620	327	0.862	13.8	0.458	1.91	110.0	255.8	375.6	873.0
640	338	1.03	16.4	0.464	1.94	107.1	249.0	384.2	893.0
660	349	1.22	19.5	0.471	1.97	104.1	242.0	392.8	913.0
680	360	1.43	22.9	0.478	2.00	101.0	234.7	401.4	933.1
700	371	1.68	26.9	0.485	2.03	97.7	227.1	410.1	953.3
720	382	1.96	31.4	0.492	2.06	94.2	219.1	418.8	973.5
740	393	2.29	36.6	0.500	2.09	90.6	210.6	427.5	993.7
750	399	2.47	39.5	0.504	2.11	88.7	206.2	431.9	1003.8
760	404	2.66	42.6	0.508	2.12	86.8	201.7	436.2	1013.9
780	416	3.08	49.4	0.516	2.16	82.6	192.1	444.9	1034.0
800	427	3.57	57.2	0.526	2.20	78.1	181.6	453.4	1054.0

* Vapor properties given are for saturated vapor.
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VP-1 HEAT TRANSFER FLUID*†

Vapor Thermal Conductivity			Vapor Viscosity			Temperature	
Btu/ ft-hr-°F	kcal/ m-hr-°C	W/m·K	lb/ft-hr	cSt [mm²/s]	cP [mPa·s]	°F	°C
0.0047	0.0069	0.0081	0.0138		0.0057	54	12
0.0048	0.0071	0.0082	0.0140		0.0058	60	16
0.0051	0.0076	0.0088	0.0145		0.0060	80	27
0.0054	0.0081	0.0094	0.0150		0.0062	100	38
0.0057	0.0086	0.0099	0.0156		0.0064	120	49
0.0061	0.0090	0.0105	0.0161	2720	0.0067	140	60
0.0064	0.0095	0.0111	0.0167	1360	0.0069	160	71
0.0068	0.0100	0.0117	0.0172	723	0.0071	180	82
0.0071	0.0106	0.0123	0.0178	405	0.0074	200	93
0.0074	0.0111	0.0129	0.0183	238	0.0076	220	104
0.0078	0.0116	0.0135	0.0189	146	0.0078	240	116
0.0082	0.0121	0.0141	0.0194	92.8	0.0080	260	127
0.0085	0.0127	0.0147	0.0200	61.0	0.0083	280	138
0.0089	0.0132	0.0154	0.0206	41.3	0.0085	300	149
0.0092	0.0138	0.0160	0.0211	28.8	0.0087	320	160
0.0096	0.0143	0.0166	0.0217	20.5	0.0090	340	171
0.0100	0.0149	0.0173	0.0222	15.0	0.0092	360	182
0.0104	0.0154	0.0179	0.0228	11.1	0.0094	380	193
0.0107	0.0160	0.0186	0.0234	8.41	0.0097	400	204
0.0111	0.0166	0.0192	0.0239	6.47	0.0099	420	216
0.0115	0.0171	0.0199	0.0245	5.05	0.0101	440	227
0.0119	0.0177	0.0206	0.0250	3.99	0.0103	460	238
0.0123	0.0183	0.0213	0.0256	3.20	0.0106	480	249
0.0126	0.0187	0.0218	0.0260	2.73	0.0107	495	257
0.0127	0.0189	0.0220	0.0261	2.59	0.0108	500	260
0.0131	0.0195	0.0226	0.0267	2.12	0.0110	520	271
0.0135	0.0201	0.0233	0.0272	1.75	0.0113	540	282
0.0139	0.0207	0.0240	0.0278	1.46	0.0115	560	293
0.0143	0.0213	0.0248	0.0284	1.22	0.0117	580	304
0.0147	0.0219	0.0255	0.0289	1.04	0.0120	600	316
0.0152	0.0225	0.0262	0.0294	0.882	0.0122	620	327
0.0156	0.0232	0.0269	0.0300	0.754	0.0124	640	338
0.0160	0.0238	0.0277	0.0306	0.649	0.0126	660	349
0.0164	0.0244	0.0284	0.0311	0.560	0.0128	680	360
0.0169	0.0251	0.0292	0.0316	0.486	0.0131	700	371
0.0173	0.0257	0.0299	0.0322	0.423	0.0133	720	382
0.0177	0.0264	0.0307	0.0327	0.369	0.0135	740	393
0.0180	0.0267	0.0310	0.0330	0.345	0.0136	750	399
0.0182	0.0270	0.0314	0.0332	0.323	0.0137	760	404
0.0186	0.0277	0.0322	0.0338	0.283	0.0140	780	416
0.0191	0.0284	0.0330	0.0343	0.248	0.0142	800	427

PHYSICAL AND CHEMICAL CHARACTERISTICS

Therminol® VP-1 is a eutectic mixture of 73.5% diphenyl oxide and 26.5% biphenyl. It is usable as a liquid or as a boiling-condensing heat transfer medium up to 750 °F (400 °C). It is miscible and interchangeable (for top-up or design purposes) with other similarly constituted diphenyl-oxide/biphenyl fluids.

Fluid Parameters Which Influence Design

The physical characteristics of Therminol VP-1 heat transfer fluid should be considered in the general arrangement of any heat transfer system in which it is to be used.

Therminol VP-1 has a low viscosity between its melting point (54 °F, 12 °C) and the temperature at which it vaporizes. In geographic areas where the system may be exposed to temperatures below this level, all piping that may contain the fluid in its liquid state should be heat traced.

Therminol VP-1 is exceptionally heat stable. However, care must be taken to avoid overheating, which could lead to deposition of solids on the heating surfaces of the vaporizer. Circulation rates in the heater should be selected to limit skin temperatures to reasonable values, with due consideration to the cost of replacing damaged fluid and the cost of maintaining an adequate heat flux. This is normally accomplished by the vaporizer or heater manufacturer in the course of recommending a particular unit and stipulating its operating parameters.

Under normal operating conditions, a vapor phase fluid will accumulate low-boiling contaminants such as air, water and degradation products. These noncondensables must be vented from the system to avoid aberrations in temperature control. Each user, or group of users if arranged in series, that operates after the same control valve should have at least one vapor accumulator (VA) installed for detecting and venting noncondensables. This is especially true if close temperature control is needed.

The physical and thermodynamic properties of Therminol VP-1 can be found on pages 2-5.

FIRE SAFETY CONSIDERATIONS

Leaks from pipes, valves or joints that saturate insulation are potentially hazardous because of the wicking effect and large surface exposure. Under such conditions, along with high temperatures, many organic liquids can spontaneously ignite. Leaks should be promptly repaired and the contaminated insulation replaced.

Leaks from a direct-fired vaporizer into the fire chamber normally result in burning of the vapor. Obviously, this should be avoided.

When vapor leaks from a pressurized system to the atmosphere, it is condensed by the relatively cold air which it contacts. This causes formation of a fog of tiny liquid droplets. Fogs of combustible liquids, of sufficiently high concentration in air, will burn if ignited. The fogs are flammable even though the overall temperature of the fog-air mixture may be below the flash point of the liquid and even though the vapor saturation concentration is below the flammable level.

The combustion of a fog-air mixture can result in an explosion, much like the combustion of a flammable vapor-air mixture. Such a fog-air mixture, however, does not normally ignite spontaneously. An ignition source is necessary, together with a sufficient concentration of the combustible fog.

Good safety practice in design, maintenance and operation can circumvent the potential dangers associated with pressurized organic vapor systems. In addition, further safeguards can be provided through the installation of special safety systems.

For further information on such safety devices for vapor phase systems, refer to the Solutia Central Engineering Study on this topic, available in reprint from from the American Institute of Chemical Engineers* (CEP Technical Manual, Volume 10, "Loss Prevention").

*1. G. C. Vincent and W. B. Howard, Hydrocarbon Mist Explosions, Part I – Prevention by Explosion Suppression.

*2. G. C. Vincent and R. C. Nelson, W. B. Howard and W. W. Russell, Hydrocarbon Mist Explosions, Part II – Prevention by Water Fog.

START-UP AND SHUT-DOWN PROCEDURES

Vapor System Start-up

There are several ways to start up vapor phase heating systems, but they generally contain these basic steps:

1. Open the vacuum system connection to the vapor system and wait until a steady-state vacuum is reached.
2. Close all valves to isolate the vapor system from the vacuum system.
3. Wait approximately 15 minutes and note any significant increase in pressure in the system. (This step is necessary to ensure that the system is fully closed.)
4. Introduce Therminol VP-1 to the vaporizer (or reboiler) and gradually heat to operating temperature. Periodically open the vacuum connections on the vent accumulators to evacuate the noncondensables. Continue venting until the temperature indicators show that hot vapor has reached the vent accumulators.

System Shut-down, Vacuum Draining

When the system is to be drained to a vacuum vessel, the shut-down procedure is as follows:

1. Cut off the heat source from the system.
2. Open the drain line to the vacuum vessel. (The liquid in the system will continue to flash into the drain until the vapor pressure of the liquid reaches the vacuum being pulled.)
3. When the liquid level stops dropping, introduce nitrogen to break the vacuum. The remaining liquid will drain relatively quickly.

System Shut-down, Pressure Draining

For draining into a pressure vessel, the procedure is only slightly different:

1. Make sure the available nitrogen pressure is less than the relief pressure of the vapor system.
2. Cut off the heat source.
3. Introduce nitrogen to the system.
4. Open the drain line to the pressure vessel.
5. Close the drain line after the system is drained.
6. Open all high-point vacuum connections to purge and help cool the system.

TOXICITY AND HANDLING

Toxicity

The rat acute oral LD50 of Therminol VP-1 heat transfer fluid is 2.05 grams/kilogram, administered as the undiluted material. When held in continuous 24-hour contact with rabbit skin, the dermal LD50 was estimated to be greater than 5.01 grams/kilogram. Thus, Therminol VP-1 is considered to be slightly toxic by ingestion in single doses and practically non-toxic by single dermal applications.

When 0.1 milliliter of undiluted Therminol VP-1 was placed into the conjunctival sac of the rabbit's eye, a slight degree of irritation resulted. The average score of the 24-, 48- and 72-hour readings was 3.8 on a scale of 110.0. All eyes had regained a normal appearance 72 hours after they were dosed.

A mild degree of irritation resulted when 0.5 milliliter of Therminol VP-1 was held in continuous 24-hour contact with intact and abraded rabbit skin. The Primary Irritation Index was 2.9 on a scale of 8.0.

Rats were exposed to a stream of air which was passed through Therminol VP-1 and led directly into the experimental chamber. Due to its low volatility, there was essentially no vaporization of test material, and the animals survived both the six-hour exposure and the subsequent 14-day observation period without observable effects.

THERMINOL® VP-1

Heat Transfer Fluid by **Solutia**

SAFETY AND HANDLING: Material Safety Data Sheets may be obtained from Environmental Operations, Industrial Products Group, Solutia Inc. Heat transfer fluids are intended only for indirect heating purposes. Under no circumstances should this product contact or in any way contaminate food, animal feed, food products, food packaging materials, food chemicals, pharmaceuticals or any items which may directly or indirectly be ultimately ingested by humans. Any contact may contaminate these items to the extent that their destruction may be required. Precautions against ignitions and fires should be taken with this product.

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