TECHNICAL BULLETIN FR-O (T)

THERMINOL®
FR-O
FIRE-RESISTANT
HEAT TRANSFER
FLUID

Therminol FR-O liquid phase heat transfer fluid with low temperature pumpability.

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Organic Division / 800 N. Lindbergh Blvd. / St. Louis, Missouri 63166

FUNCTIONAL FLUIDS Monsanto®

0592905

TOWOLDMON0037438
WATER_PCB-00021907

Introducing Therminol FR-O...

Newest member of the growing line of Monsanto heat transfer fluids. Therminol FR-O was formulated specifically to eliminate freeze-up during cold weather shut down for in-transit heating of sulfur, pitch, asphalt, naphthalene, bunker "C" fuel oil, and high melting resin materials. Therminol FR-O eliminates the need for high temperature reheating in order to pump out the material at its destination. Low temperature pumpability makes it ideally suited for space heating applications, outdoor plants in Northern climates, or in any application where good fluidity at low temperatures is a prerequisite.

Fire-Resistance...

Therminol FR-O permits installation of a non-pressurized system operating with a liquid that has no fire point, and will not support combustion ... so fire-resistant, Therminol fluids have achieved recognition by Underwriters' Laboratory, Factory Mutual, and Factory Insurance Association. Because of this extreme fire-resistance and its listing by insurance companies, important savings can be made in designing a process heating system around Therminol FR-O fluid.

Chemically Speaking...

Therminol FR-O fluid is a chlorinated biphenyl, manufactured under exacting process control to rigid specifications for long term thermal stability, specific heat, thermal conductivity, vapor pressure and viscosity. The liquid is an oily, clear, nearly colorless, fluid with a pour point of −15°F and a minimum pumpable temperature of −5°F.

Therminol FR-O fluid is recommended for use up to 500°F and will not show measurable change after years of exposure to such temperatures. The fluid is non-corrosive with all common metals used in heat transfer system designs.

TYPICAL PROPERTIES OF THERMINOL FR-O

	Temperature, °F								
Property	**−5**	**+10**	**40**	**100**	**200**	**300**	**400**	**500**	**600**
Kinematic Viscosity, cs.	4545	1007	92.55	8.10	1.70[a]	0.95	.60	.44	.34
Saybolt Viscosity, SSU	20850	4640	429	52.43	7.99[a]	4.54	—	—	—
Vapor Pressure, mm Hg	—	—	—	—	1.35	13.00	76.0	315	915
Specific Heat, BTU/lb.[b]	—	—	—	0.27	0.29	0.31	0.33	0.35	0.36
Thermal Conductivity, BTU/°F-Ft.-Hr.[b]	—	—	—	0.061	0.060	0.059	0.058	0.057	0.056
Density, g/cc	—	1.45	1.43	1.40	1.34	1.28	1.23	1.17	1.11
Density, lbs./gal.	—	12.10	11.92	11.70	11.19	10.69	10.27	9.76	9.27

[a] Viscosity at 210°F
[b] Calculated values

1.2

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For H. Gilbert

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ENTHALPY THERMINOL FR-0

BASE 32 °F —

CP_{32} = 0.256 Btu/LB °F

$CP_{450°F}$ = 0.340 ΔT 450-32 = 418

CP_{AVG} = .298 ΔH = 124.8

CP_{400} 0.330 ΔT 400-32 = 368

CP_{AVG} = .293 ΔH = 107.9

CP_{425} = 0.335 ΔT 425-32 = 393

CP_{AVG} = .2955 ΔH = 116

Cp_{32} .254

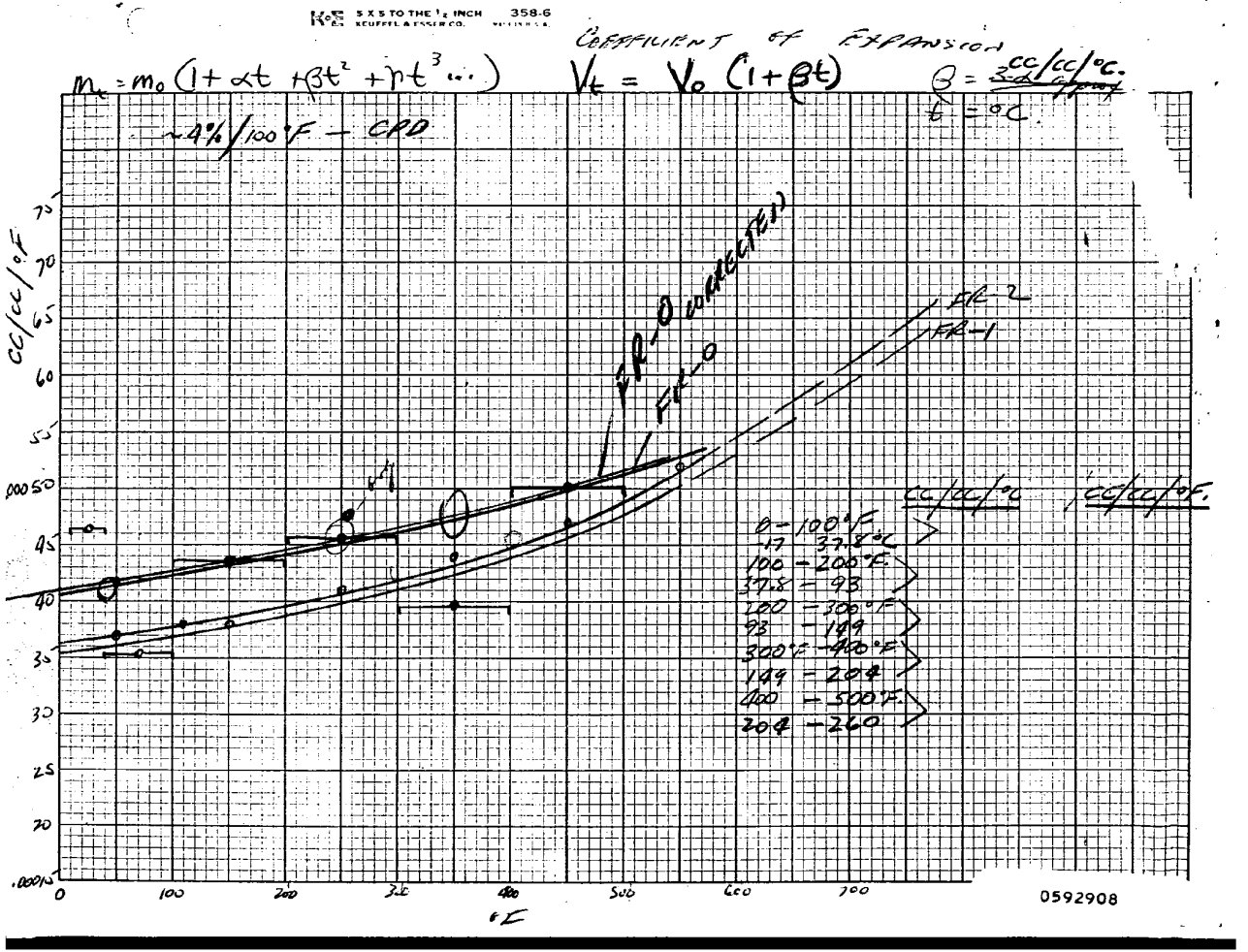
Cp_{400} 3168

2) 5706

.2853 × 368 = 105

1.42

0592907



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WATER_PCB-00021910

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TOWOLDMON0037442
WATER_PCB-00021911

°F	°C	Δ Sp.Gr.	cc/cc/°F	cc/cc/°C.
0 - 100	-17 - 37.8	.06 g/cc	0.000 4181	0.0007526
100	55.5	1.935		
100 - 200	37.8 - 93.0	.06	0.000 4364	0.000 7855
100	55.5	1.375		
200 - 300	93 - 149	.06	0.000 4546	0.000 8182
100	55.5	1.32		
300 - 400	149 - 204	.05	0.000 3968	0.000 7143
100	55.5	1.26	.000 473	.000 855
400 - 500	204 - 260	.06	0.000 500	0.000 9000
100	55.5	1.20		
@ 250°F	engine.		0.000 455	0.000 819

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TOWOLDMON0037443
WATER_PCB-00021912

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Coeff Expansion of FR-0

°F	°C	Sp.Gr - g/cc	cc/cc °C.
+10	-12.2°	1.45	
		1.44	
40	9.45	1.43	
			1.415
100	37.8	1.40	
			1.37
200	93.9	1.34	
			1.31
300	149.2	1.28	
			1.255
400	205	1.23	
			1.20
500	260.5	1.17	
		1.31	

°F	°C	Δ g/cc	Δ°C	Δ°F
+10 to 40	-12.2 to 4.45	0.02	-16.65	30
40 to 100	4.45 to 37.8	0.03	33.35	60
100 to 200	37.8 to 93.9	0.06	55.6	100
200 to 300	93.9 to 149.2	0.06	55.3	100
300 to 400	149.2 to 205	0.05	55.8	100
400 to 500	205 to 260.5	0.06	55.5	100
+10 to 500	-12.2 to 260.5	0.28	248.3	490

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TOWOLDMON0037444
WATER_PCB-00021913

	cc/cc °C	cc/cc °F
$\frac{0.02}{1.99 \quad 16.65}$ =	0.000835	0.000464
$\frac{0.03}{1.415 \quad 33.35}$ =	0.000636	0.000353
$\frac{0.06}{1.37 \quad 55.6}$ =	0.000786	0.000437
$\frac{0.06}{1.31 \quad 55.8}$ =	0.000821	0.000456
$\frac{0.05}{1.255 \quad 55.8}$ =	0.000714	0.000397
$\frac{0.06}{1.20 \quad 55.5}$ =	0.000901	0.000501
$\frac{0.28}{1.31 \quad 298.3}$ =	0.000856	0.000478

835
636
786
821
714
901
856
6 | 4693
782

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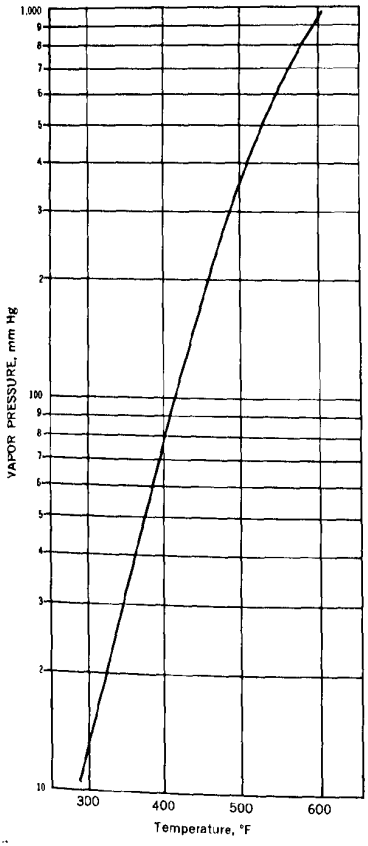
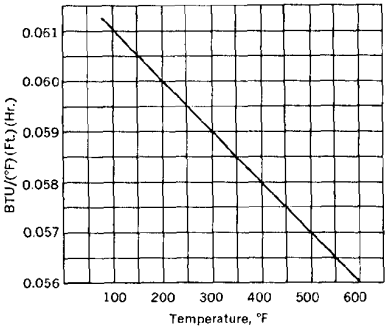
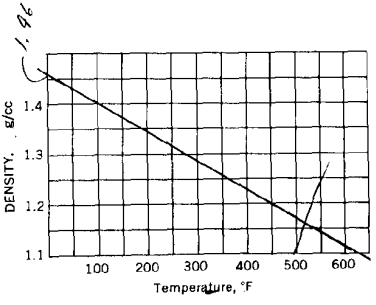
VAPOR PRESSURE



THERMAL CONDUCTIVITY
(calculated)



DENSITY



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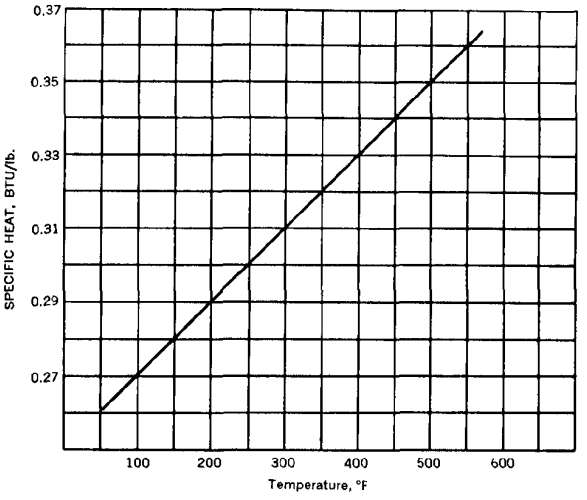
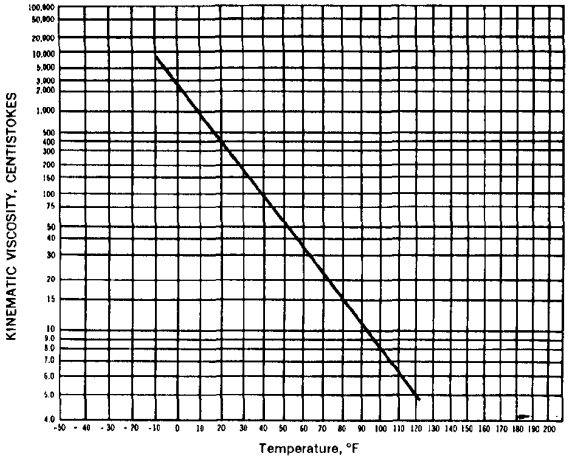
SPECIFIC HEAT



KINEMATIC VISCOSITIES



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2-2099 0166-6 LITHO IN U.S.A.

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