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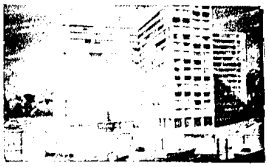
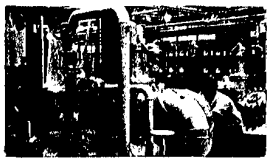
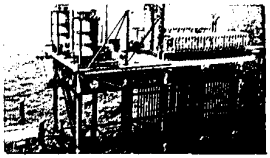




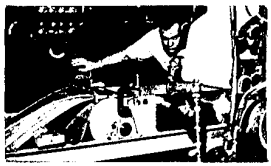
thermino®

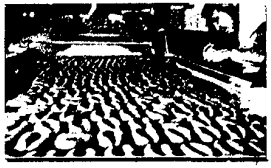
applications unlimited





Monsanto





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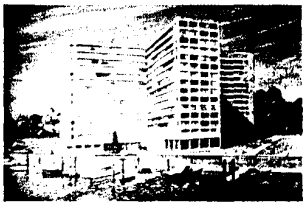
Why Therminol?



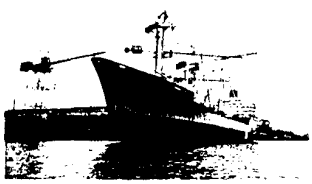
Apartment buildings, offices, hospitals—buildings of all kinds find Therminol an economical alternative to steam.

Does your process need an indirect heating system like steam? Or the high temperatures of a synthetic heat transfer fluid or oil? Perhaps you need to heat and cool with the same system.

But pressurized heating systems need costly equipment. And licensed boiler operators in many areas. Safety isn't the long suit of many fluids and oils, either.

That's why there's Therminol®.

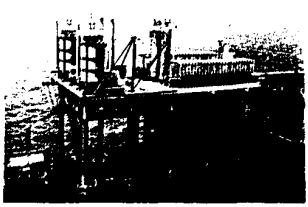
You discover the best of all worlds in Therminol: high and low heat ranges, thermal stability and efficient liquid heat transfer *without* expensive equipment. In short, the safest, most efficient heat transfer systems for your application.



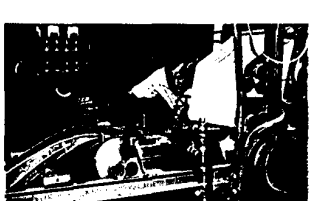
This Dutch tanker uses a Therminol system to heat living quarters as well as cargo.



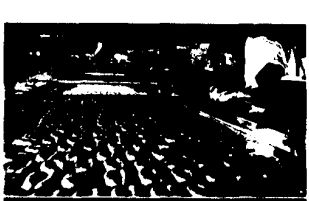
Several resin kettles with various heat needs can be heated from one Therminol system.



Petroleum processors, both on-shore and off-shore, enjoy increased heat transfer safety with Therminol



Rolls in rubber, plastics, textiles and paper get uniform heat with Therminol.



Any food application that can use uniform temperature control can use Therminol.

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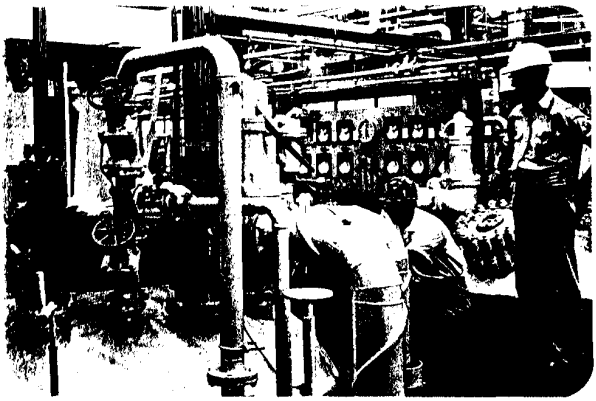
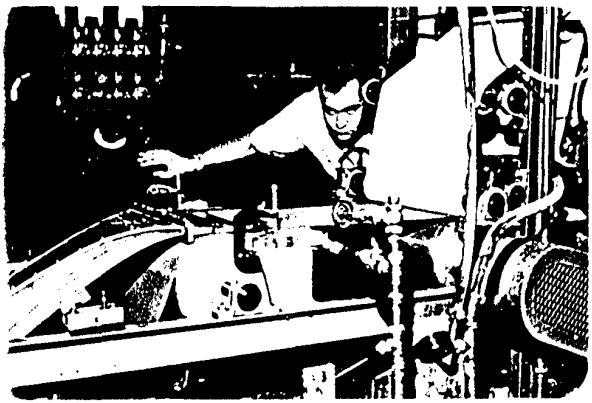


What makes Therminol right for your application? The more than 2500 customers who have specified Therminol for new installations and conversions of existing systems will give you these answers.

SAFETY | Insurance underwriters such as FIA and FM approve the fire resistant Therminols—the *only* heat transfer fluids listed with Underwriters' Laboratory, Inc. And Therminol systems are vented to the atmosphere since they're entirely liquid. Fire safety plus no pressure add up to the safest system you can specify.

LOWER CAPITAL COSTS | Without pressure you can save 25% to 50%. That's because you don't need heavy piping, relief valves or other high pressure devices.

LOWER OPERATING COSTS | No fluid make-up is normally required. Temperature and heat losses expected with vapor simply don't happen. And routine maintenance is minimized. Expensive operating personnel, needed for pressurized systems, can be eliminated.



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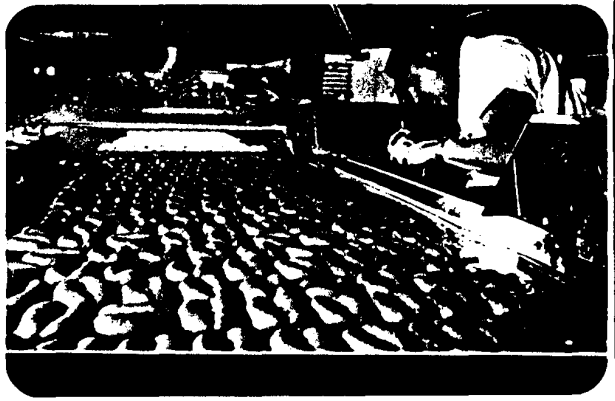
Accurate temperature control (±2°) without hot spots makes for less decomposition of cooking oil. The results are improved throughput and a product that looks and tastes better.

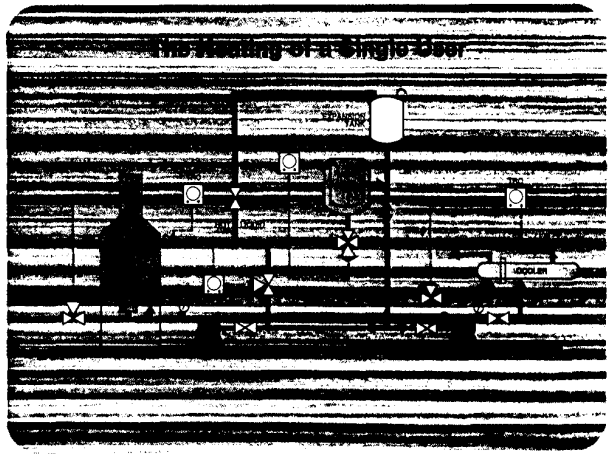
You'll be surprised at how easy it is to work with a Therminol heat transfer system. The middle diagram at the right shows typical Therminol liquid heating and cooling systems used together to maintain very close temperature control at the user. Note that the term "heater" is used rather than "boiler" since we do not boil Therminol in the primary heat source.

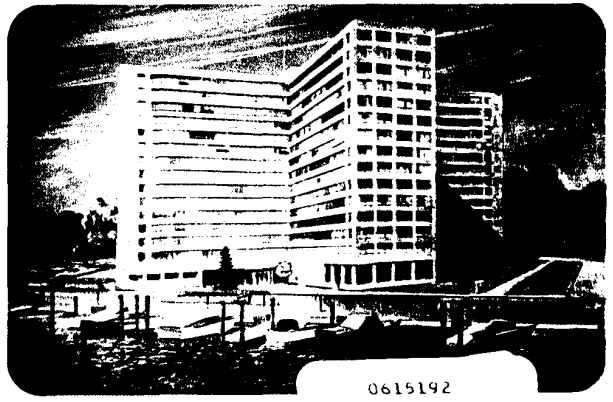


Benefits of a Liquid Heating System

You gain a wide spectrum of benefits with a Therminol liquid heating system.

- In many locations, codes favor Therminol systems, thus eliminating the need for expensive operating personnel.
- Positive circulation through your users ends venting problems; the system remains sealed and flooded.
- Liquid systems respond more rapidly to your system's load changes.
- Install your users at any level in relation to the heater; there's no condensate removal problem.
- You realize a substantial cost savings with smaller pipe. Also, smaller valves control temperature more accurately—down to ±2°F.
- No temperature loss due to pressure drop in the piping; with vapor, any line friction loss results in a lower vapor condensing temperature at the users.
- You can meet different temperature demands in the same user if required by certain processes by adjusting the circulation rate.
- A liquid heating medium, like Therminol, will usually give you higher heat transfer rates in certain types of users, such as shell and tube heat exchangers.
- Cooling can be handled in the same system. Heating systems for Therminol are sold around the world on a competitive basis. Contact your nearest Monsanto office, (listed on the inside back cover) for information and recommendations on the heating equipment that will fit your particular need.





The conversion of the Detroit River House Cooperative from steam boilers to Therminol heating saves $75,000 annually by removing the need for licensed boiler operators and through augmented fuel savings.

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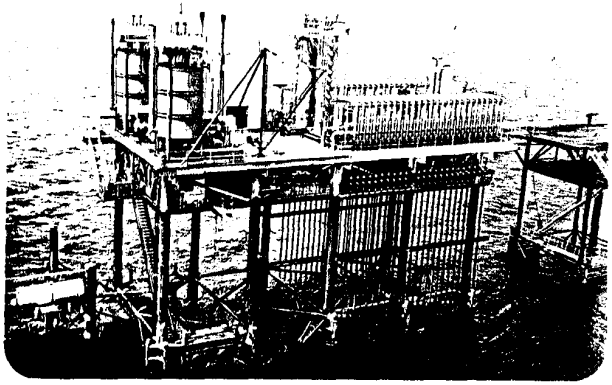


Safety through fire resistance is the keynote on this offshore platform. Its maintenance-free Therminol system offers safety plus heat that's controllable over a wide temperature range. And there's no longer any need to isolate the heating equipment from the processing platform.

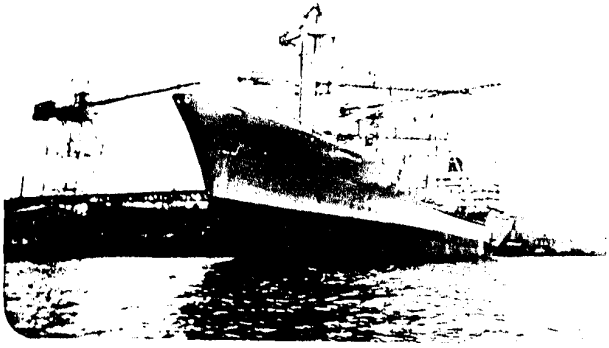
The Therminol Family

You find more design and engineering flexibility with Therminol than with any other heat transfer media because of the wide range of fluids in the Therminol family.

The Therminol series of heat transfer fluids offer an operating range of -40 F. to 800 F. Five are fire resistant . . . they're the only heat transfer fluids listed by Underwriters' Laboratories and approved by FIA and FMA.

Important for the future, as your processes change, you can pick a new Therminol fluid to match your new needs. Most Therminol fluids are interchangeable in your liquid heating system.

The charts on the next two pages detail the broad characteristics of eight members of the Therminol family of fluids.



On both ships and barges, Therminol eliminates licensed boiler operators because it's a non-pressurized system. Therminol's ability to recover waste heat adds to the savings it offers. More important, Therminol is a safe system—fire resistant and non-pressurized, it offers extra protection for both personnel and property.

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THERMINOL FR LO TEMP

Temperature F	Temperature C	Vapor Pressure mm Hg. Absolute	Specific Heat BTU./Lb. F	Thermal Conductivity BTU/Hr. ft² F/ft.	Density Lb./Gal.	Viscosity Cs	Flash °F	Flame °F
[illegible]		[illegible]	0.224	0.0033	12.55	658	[illegible]	[illegible]
[illegible]		[illegible]	0.226	[illegible]	12.50	[illegible]		[illegible]
[illegible]			[illegible]	[illegible]	12.40	65		[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]			[illegible]	[illegible]	[illegible]	3.39		
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1.15		
[illegible]		[illegible]	0.290	[illegible]	[illegible]	0.65		
400		[illegible]	0.310	0.0590	10.38	0.459		

THERMINOL FR-0

Temperature F	Temperature C	Vapor Pressure mm Hg. Absolute	Specific Heat BTU. Lb. F	Thermal Conductivity BTU/Hr. ft² F/ft.	Density Lb./Gal.	Viscosity Cs
5	[illegible]		—	—	—	4545
10	[illegible]		—	—	12.10	1007
40	[illegible]		—	—	11.92	92.55
100	38		0.27	0.061	11.70	8.10
200	93	[illegible]	0.29	0.060	11.17	1.70
300	149	[illegible]	0.31	0.059	10.69	0.95
400	[illegible]	[illegible]	0.33	0.058	10.27	0.60
500	260	315	0.35	0.057	9.76	0.44
600	316	915	0.36	0.056	9.27	0.34

THERMINOL FR-1

Temperature F	Temperature C	Vapor Pressure mm Hg. Absolute	Specific Heat BTU. Lb. F	Thermal Conductivity BTU/Hr. ft² F/ft.	Density Lb./Gal.	Viscosity Cs
50	10	—	0.272	0.06098	11.68	220
100	38	—	0.282	0.06060	11.46	16.9
[illegible]	66	—	0.291	0.06021	11.22	4.9
	93	—	0.3047	0.05976	10.99	2.6
	121	—	0.3151	0.05927	10.76	1.8
	149	—	0.3255	0.05875	10.53	1.1
[illegible]	177	10	0.3359	0.05819	10.30	0.8
[illegible]	204	27	0.3464	0.05760	10.07	0.7
[illegible]	232	65	0.3568	0.05697	9.83	0.5
[illegible]	260	143	0.3672	0.05630	9.60	0.4
550	288	291	0.3776	0.05560	9.37	0.4
600	316	550	0.3880	0.05487	9.14	0.3
650	343	18.6 psia	0.3985	0.05409	8.91	0.3
700	371	31.9 psia	0.4089	0.05329	8.68	0.3

THERMINOL FR-2

Temperature F	Temperature C	Vapor Pressure mm Hg. Absolute	Specific Heat BTU. Lb. F	Thermal Conductivity BTU/Hr. ft² F/ft.	Density Lb./Gal.	Viscosity Cs
50	10	—	0.257	0.05881	12.23	1999
100	38	—	0.265	0.05852	12.00	43.4
150	66	—	0.274	0.05801	11.75	8.2
200	93	—	0.2840	0.05788	11.53	3.6
250	121	—	0.2922	0.05748	11.29	2.1
300	149	—	0.3003	0.05703	11.06	1.4
350	177	6	0.3084	0.05655	10.83	1.0
400	204	15	0.3166	0.05603	10.60	0.8
450	232	37	0.3247	0.05548	10.37	0.6
500	260	84	0.3328	0.05488	10.14	0.5
550	288	173	0.3410	0.05424	9.90	0.4
600	316	340	0.3491	0.05357	9.67	0.4
650	343	615	0.3573	0.05286	9.44	0.4
700	371	20.3 psia	0.3654	0.05211	9.21	0.4

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THERMINOL FR-3

Temperature °F	Temperature °C	Vapor Pressure mm Hg. Absolute	Specific Heat BTU./Lb. °F	Thermal Conductivity BTU/Hr. ft² °F/ft.	Density Lb./Gal.	Viscosity Cs
50	10	—	0.239	0.05700	13.00	—
100	38	—	0.245	0.05680	12.76	420
150	66	—	0.256	0.05634	12.53	28.0
200	93	—	0.2629	0.05620	12.29	6.8
250	121	—	0.2714	0.05598	12.06	3.5
300	149	—	0.2799	0.05558	11.83	2.1
350	177	3	0.2884	0.05513	11.60	1.4
400	204	9	0.2969	0.05466	11.37	1.0
450	232	24	0.3054	0.05415	11.13	0.8
500	260	55	0.3138	0.05360	10.90	0.6
550	288	114	0.3223	0.05302	10.67	0.6
600	316	223	0.3308	0.05241	10.44	0.4
650	343	413	0.3393	0.05176	10.21	0.4
700	371	735	0.3478	0.05107	9.98	0.3

THERMINOL 55

Temperature °F	Temperature °C	Vapor Pressure mm Hg. Absolute	Specific Heat BTU./Lb. °F	Thermal Conductivity BTU/Hr. ft² °F/ft.	Density Lb./Gal.	Viscosity Cs
0	−18	—	0.420	0.0813	7.62	1610
100	38	0.5	0.472	0.0784	7.31	30
200	93	3.0	0.522	0.0753	7.00	5
300	149	10	0.572	0.0724	6.69	2.1
400	204	40	0.620	0.0692	6.39	1.18
500	260	100	0.670	0.0661	6.07	0.80
600	316	250	0.718	0.0630	5.76	0.60

THERMINOL 66

Temperature °F	Temperature °C	Vapor Pressure mm Hg. Absolute	Specific Heat BTU./Lb. F	Thermal Conductivity BTU/Hr. ft² F/ft.	Density Lb./Gal.	Viscosity Cs
0	—	—	0.320	0.0720	8.67	50000
50	10	—	0.350	0.0711	8.51	250
100	38	—	0.380	0.0703	8.34	28.0
150	66	—	0.405	0.0695	8.14	10.0
200	93	0.1	0.430	0.0687	7.91	4.40
250	121	0.5	0.455	0.0678	7.77	2.60
300	149	2.0	0.480	0.0670	7.59	1.70
350	177	5.0	0.505	0.0662	7.39	1.20
400	204	20.0	0.530	0.0653	7.17	0.90
450	232	50.0	0.555	0.0645	7.04	0.69
500	260	100.0	0.580	0.0637	6.75	0.55
550	288	200.0	0.605	0.0628	6.62	0.46
600	316	350.0	0.630	0.0620	6.42	0.40
650	343	760.0	0.655	0.0613	6.24	0.36
700	371	1000	0.680	0.0605	6.09	0.31

THERMINOL 77

Temperature °F	Temperature °C	Vapor Pressure mm Hg. Absolute	Specific Heat BTU./Lb. F	Thermal Conductivity BTU/Hr. ft² F/ft.	Density Lb./Gal.	Viscosity Cs
50	10	—	0.330	0.0793	9.8	—
100	38	—	0.350	0.0781	9.6	181
200	93	—	0.375	0.0760	9.26	7.78
300	149	0.27	0.420	0.0739	8.94	2.65
400	204	1.03	0.455	0.0719	8.58	1.50
500	260	9.2	0.495	0.0698	8.16	0.96
600	316	44	0.530	0.0678	7.76	0.66
700	371	168	0.565	0.0660	7.38	0.46
800	426	530	0.600	0.0640	7.05	0.34

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Therminol®

Applications Unlimited

The pictures on the preceding pages have given you a glimpse of a few typical Therminol applications. On land and sea. In plants and apartment buildings.

But the applications for Therminol are actually unlimited. As unlimited as your needs for safe, uniform, efficient heat delivery.

Here are a few more areas where Therminol has met those needs:

CHEMICAL PROCESSING . . . especially where flammable materials are handled. Therminol has proved particularly successful for heating reactors, autoclaves, heat exchangers, distillation columns, reboilers, mixers, dryers, etc.

[illegible] . . . where a single "circuit" with multiple users and varying temperatures is desirable.

[illegible] . . . where uniform heating, rapid temperature flux and pin-point control is essential such as heating corrugating and drying rolls, crimping presses, calendars, platens and molds.

FOOD PROCESSING . . . for controlled, quality "cooking" of potato chips, precooked/frozen products, other foodstuffs.

PETROLEUM AND OFF-SHORE DRILL [illegible] . . . offers control over a wide temperature range and the ability to accommodate sudden fluctuations in processing loads automated with complete safety.

[illegible] AND BARGES . . . eliminates expensive boiler operators with a system that can heat both cargo and living quarters.

[illegible] HEATING . . . ideal for hospitals, hotels, apartment houses and office buildings where the goal is safety, low maintenance and reduced operating costs.

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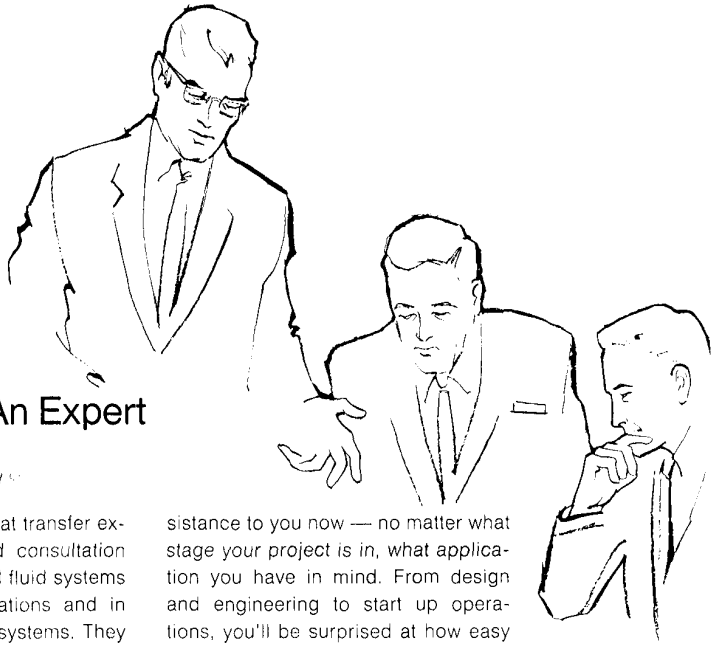

You Don't Have To Be An Expert

We'll loan you ours

Talk to the Monsanto heat transfer experts. They've provided consultation for over 2,500 Therminol fluid systems — in both new installations and in conversions of existing systems. They can point out the benefits of a Therminol system, and offer detailed assistance to you now — no matter what stage your project is in, what application you have in mind. From design and engineering to start up operations, you'll be surprised at how easy it is to work with a Therminol heat transfer system.



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