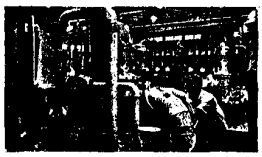
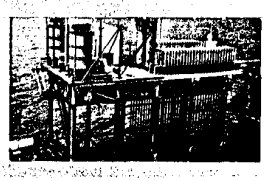


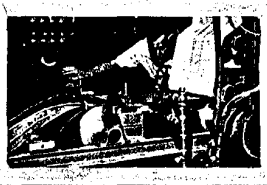
therminol®

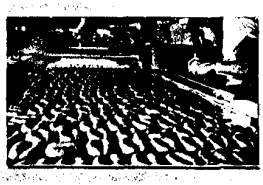
applications unlimited





Monsanto



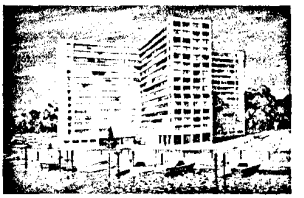


0261567

O/FF-15

TOWOLDMON0028509
WATER_PCB-00012978

Why Therminol?



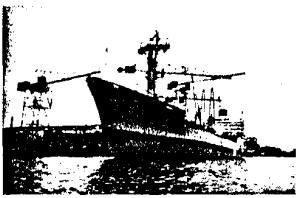
Apartment buildings, offices, hospitals—buildings of all kinds find Therminol an economical alternative to steam.

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.

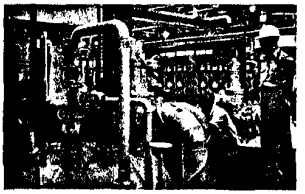
But pressurized heating systems need costly equipment. And licensed boiler operators in many areas. Safety isn't the long suit of many fluids and oils, either.

That's why there's Therminol®

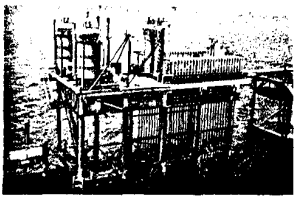
You discover the best of all worlds in Therminol: high and low heat ranges, thermal stability and efficient liquid heat transfer *without* expensive equipment. In short, the safest, most efficient heat transfer systems for your application.



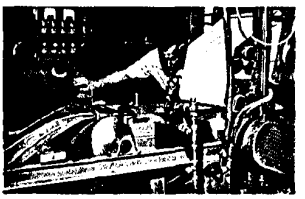
This Dutch tanker uses a Therminol system to heat living quarters as well as cargo.



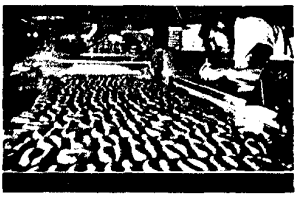
Several resin kettles with various heat needs can be heated from one Therminol system.



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



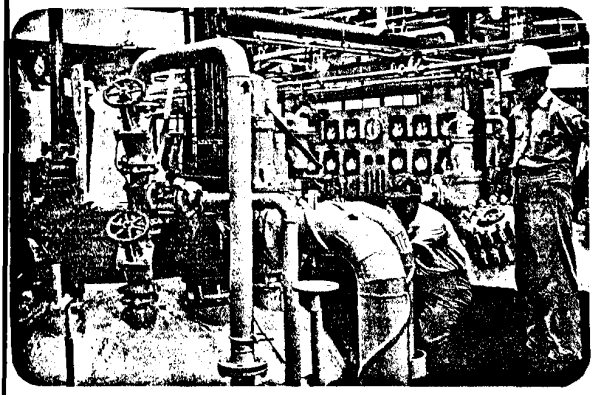
Rolls in rubber, plastics, textiles and paper get uniform heat with Therminol.



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

0261568

TOWOLDMON0028510
WATER_PCB-00012979



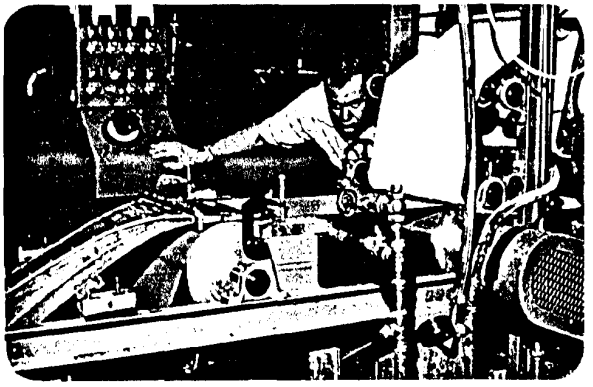
The big plus you get with Therminol in chemical processing, like this resin kettle, is heating and cooling from the same system. This flexibility added to Therminol's fire safety gives you a completely unique heating system.

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.



Since Therminol remains liquid throughout its temperature range, rapid circulation through your rolls helps achieve uniform heat. This has resulted in greater throughput and fewer rejects for Therminol customers producing rubber, plastics, paper and textiles.

0261569

TOWOLDMON0028511
WATER_PCB-00012980

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.

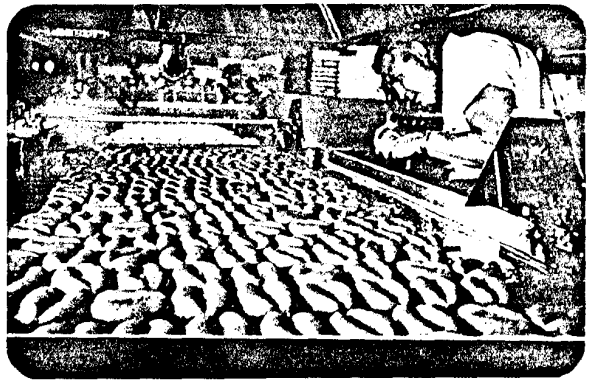
You'll be surprised at how easy it is to work with a Therminol heat transfer system. The middle diagram at the right shows typical Therminol liquid heating and cooling systems used together to maintain very close temperature control at the user. Note that the term "heater" is used rather than "boiler"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

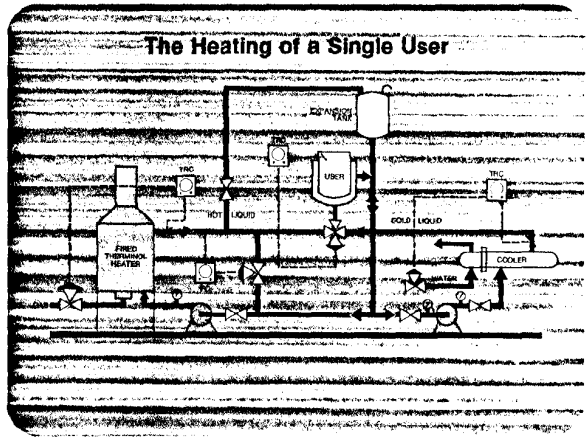
Benefits of a Liquid Heating System

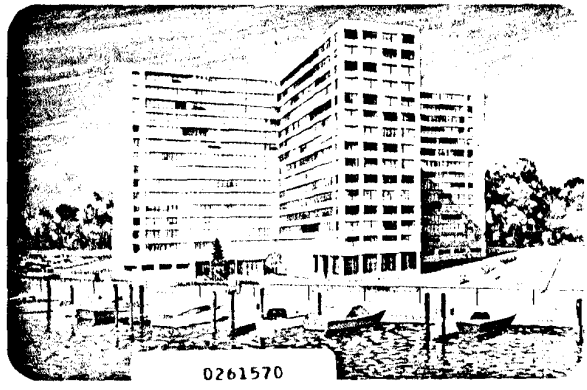
You gain a wide spectrum of benefits with a Therminol liquid heating system.

- 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 $36,000 annually by removing the need for licensed boiler operators and through documented fuel savings.

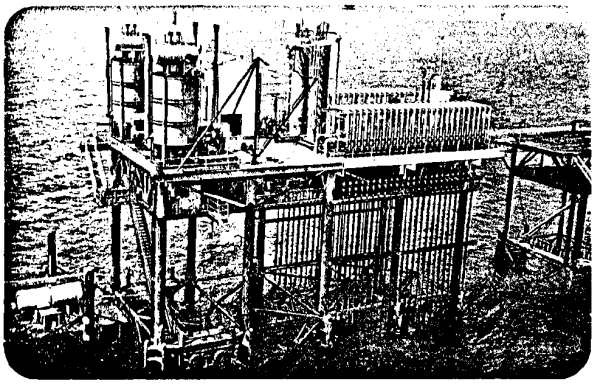






0261570

TOWOLDMON0028512
WATER_PCB-00012981



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.

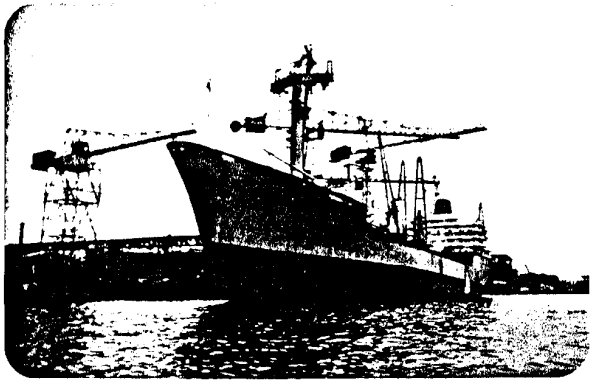
The Therminol Family

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.

0261571

TOWOLDMON0028513
WATER_PCB-00012982

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
−30		1.0	0.224	0.0633	12.55	658
−20		—	0.226	0.0632	12.50	264
0		—	0.230	0.0630	12.40	65
40		1.1	0.238	0.0626	12.20	12.2
100		2.7	0.260	0.0620	11.88	3.39
200		12.6	0.270	0.0610	11.40	1.15
300		69	0.290	0.0600	10.88	0.65
400		300	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	−21	—	—	—	—	4545
+10	−12	—	—	—	12.10	1007
40	4	—	—	—	11.92	92.55
100	38	—	0.27	0.061	11.70	8.10
200	93	1.35	0.29	0.060	11.17	1.70
300	149	13.00	0.31	0.059	10.69	0.95
400	204	76.00	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
150	66	—	0.291	0.06021	11.22	4.9
200	93	—	0.3047	0.05976	10.99	2.6
250	121	—	0.3151	0.05927	10.76	1.8
300	149	—	0.3255	0.05875	10.53	1.1
350	177	10	0.3359	0.05819	10.30	0.8
400	204	27	0.3464	0.05760	10.07	0.7
450	232	65	0.3568	0.05697	9.83	0.5
500	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	18.8 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

0261572

TOWOLDMON0028514
WATER_PCB-00012983

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	—	0.455	0.0678	7.77	2.60
300	149	2.0	0.480	0.0670	7.59	1.70
350	177	—	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

02619573

TOWOLDMON0028515
WATER_PCB-00012984

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.

RESIN PROCESSING . . . where a single "circuit" with multiple users and varying temperatures is desirable.

PLASTICS AND RUBBER MOLDING; PAPER AND TEXTILES . . . 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.

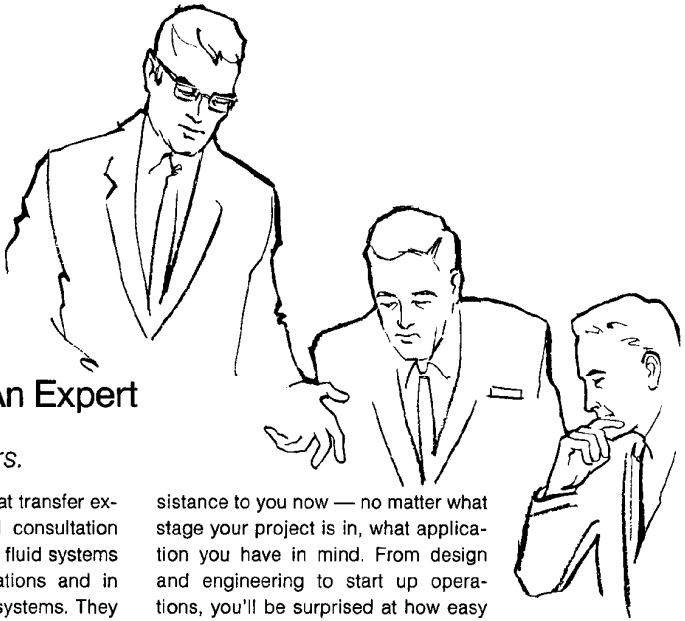
PETROLEUM AND OFF-SHORE DRILLING . . . offers control over a wide temperature range and the ability to accommodate sudden fluctuations in processing loads automated with complete safety.

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

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

0261574

TOWOLDMON0028516
WATER_PCB-00012985



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.



0261575

TOWOLDMON0028517
WATER_PCB-00012986

DISTRICT SALES OFFICES ALL DIVISIONS

AKRON, OHIO 44313
260 Springside Drive
Montrose Development Park
Tel. (216) 666-4111

ATLANTA, GEORGIA 30326
Lenox Towers East
3400 Peachtree Rd. N. E. — Suite 1711
Tel. (404) 577-2260

BOSTON, MASSACHUSETTS 02149
Everett Station
Tel. (617) 387-5010

CHICAGO, ILLINOIS
3158 Des Plaines Ave.
Des Plaines, Illinois 60018
Tel. (312) 296-6688

CINCINNATI, OHIO 45206
1501 Madison Road
Tel. (513) 751-6707

DETROIT, MICHIGAN 48235
500 Northland Towers East
Tel. (313) 357-0910

HONOLULU, HAWAII 96812
205 Pacific International Bldg.
677 Ala Moana Blvd., P. O. Box 3824
Tel. (808) 531-2744

HOUSTON, TEXAS 77027
1301 Post Oak Tower
5051 Westheimer Road
Tel. (713) 621-9550

LOS ANGELES, CALIFORNIA 90022
6670 E. Flotilla St.
Tel. (213) 723-2492

NEW YORK, NEW YORK 10017
277 Park Avenue
Tel. (212) 922-4111

ST. LOUIS, MISSOURI 63166
800 N. Lindbergh Blvd.
Tel. (314) 694-1000

SAN FRANCISCO BAY AREA
2710 Lafayette, Santa Clara, Calif. 95052
Tel. (408) 243-0414

SEATTLE, WASHINGTON 98104
911 Western Avenue
Tel. (206) 622-4203

SPRINGFIELD, MASSACHUSETTS 01101
730 Worcester Ave.
Tel. (413) 788-6911

WILMINGTON, DELAWARE 19803
2005 Concord Pike, Fairfax
Tel. (302) 658-6531

Additional District Offices are maintained by:

Agricultural Division

ALLENTOWN, PENNSYLVANIA 18104
Park Professional Building
2200 Hamilton Street
Tel. (215) 437-5471

DES MOINES, IOWA 50310
312 Merle Hay Tower
Tel. (515) 276-8503

FREMONT, NEBRASKA 68025
150 South Main Street
Tel. (402) 727-1230

INDIANAPOLIS, INDIANA 46205
Suite 218, 4000 Meadows Drive Building
Tel. (317) 547-9148

LULING, LOUISIANA 70070
P. O. Box 174
Tel. (504) 784-6263

MANKATO, MINNESOTA 56001
111 Madison East
Tel. (507) 387-3406

MEMPHIS, TENNESSEE 38104
303 Union Plaza Building
1835 Union Avenue
Tel. (901) 278-7811

MUSCATINE, IOWA 52761
P. O. Box 473
Tel. (319) 263-1331

Hydrocarbons & Polymers Division-Lion Oil

EL DORADO, ARKANSAS 71730
Lion Oil Building
Tel. (501) 863-3111

JACKSON, MISSISSIPPI 39209
P. O. Box 10937, Westland Station
Tel. (601) 352-3648

N. LITTLE ROCK, ARKANSAS 72119
410 West 8th Street, P. O. Box 5821
Tel. (501) 376-2437

MEMPHIS, TENNESSEE 38113
1023 Riverside Drive, P. O. Box 13248
Tel. (901) 948-4461

Organic Division *(Rubber Instruments)*

AKRON, OHIO 44311
920 Brown Street, P. O. Box 2307
Tel. (216) 434-1962

Plastic Products & Resins Division

KENILWORTH, NEW JERSEY 07033
North Seventh St. & Monroe Ave.
Tel. (201) 276-2900

Textiles Division

ATLANTA, GEORGIA 30303
Atlanta Merchandise Mart
240 Peachtree St., N. W.
Tel. (404) 577-2260

CHARLOTTE, NORTH CAROLINA 28210
6230 Fairview Road, Suite 400
Tel. (704) 364-0110

GREENVILLE, SOUTH CAROLINA 29606
McAlister Plaza
P. O. Box 5564, Station B
Tel. (803) 239-9171

NEW YORK, NEW YORK 10001
350 Fifth Ave.
Tel. (212) 556-5100

MONSANTO, 800 N. LINDBERGH BLVD., ST. LOUIS, MISSOURI 63166

0261576

TOWOLDMON0028518
WATER_PCB-00012987

"Nothing contained herein is to be construed as a recommendation to use any product in conflict with any patent. MONSANTO MAKES NO WARRANTIES AS TO THE FITNESS OR MERCHANTABILITY OF ANY PRODUCTS REFERRED TO, no guarantee of satisfactory results from reliance upon contained information or recommendations, and disclaims all liability for any resulting loss or damage."

Monsanto

Monsanto Company / Functional Fluids / 800 North Lindbergh Blvd. / St. Louis, Missouri 63166

2169—IGI—LRA LITHO IN USA

0261577

TOWOLDMON0028519
WATER_PCB-00012988