# THERMINOL® 77 HIGH-TEMPERATURE HEAT TRANSFER FLUID

TECHNICAL BULLETIN T-77

"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."

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

FUNCTIONAL FLUIDS Monsanto®

0592743

TOWOLDMON0037343

Therminol 77 is a *liquid-phase* heat transfer fluid particularly suitable for continuous use for temperatures up to 700°F. It has been used for several years in commercial scale and pilot plant systems in a diversity of applications; e.g., paint and resin manufacture, high-temperature plastic extrusion, lamination of plastics, chemical processing, laboratory baths, and thermostatic devices.

Unlike Monsanto's Therminol FR line of fire-resistant heat transfer fluids (chlorinated hydrocarbons), Therminol 77 does not contain halogen and is not fire resistant. The recommended design considerations described in the Therminol FR Engineering Manual, such as flow rate, $\Delta T$, heat-flux density, etc., are also applicable to Therminol 77.

Although Therminol 77 does thermally degrade at temperatures above 700°F, it has been used in commercial heat transfer systems up to its atmospheric boiling point of 830°F. Degradation rate is very low at 700°F and increases progressively at increasing temperatures. Therminol 77 degradation products are predominantly polymers which are completely soluble in the bulk fluid and, therefore, do not form insulating deposits in the system. Degraded fluid is, however, more viscous than fresh fluid but can be reclaimed economically to essentially new-fluid condition.

0592744

TOWOLDMON0037344

## THERMINOL® 77 FLUID PROPERTIES

| Temp °F | Vapor Pressure (mm Hg) | Viscosity (cs) | Viscosity (Lbs/Ft-Hr) | Density (g/cc) | Density (Lbs/Gal) |
|---|---|---|---|---|---|
| 100 | — | 181 | 505 | 1.152 | 9.60 |
| 210 | — | 7.78 | 20.8 | 1.106 | 9.26 |
| 300 | 0.27 | 2.65 | — | 1.070 | 8.94 |
| 400 | 1.03 | 1.50 | 3.74 | 1.029 | 8.58 |
| 500 | 9.2 | 0.96 | 2.28 | 0.981 | 8.16 |
| 600 | 44 | 0.66 | 1.49 | 0.931 | 7.76 |
| 700 | 168 | 0.46* | 0.99 | 0.885 | 7.38 |
| 800 | 530 | — | — | — | — |

*Extrapolation

## THERMAL CONDUCTIVITY

| Temp °F | Specific Heat (Btu/LB °F.) | Thermal Conductivity (Cal/cm, °C, sec) | Thermal Conductivity (BTU/°F, Ft-Hr) | Thermal Expansion, (cc/°F) |
|---|---|---|---|---|
| 100 | 0.350 | $32.25 \times 10^{-5}$ | 0.0781 | 0.00034 |
| 200 | 0.375 | $31.40 \times 10^{-5}$ | 0.0760 | — |
| 300 | 0.420 | $30.50 \times 10^{-5}$ | 0.0739 | 0.00037 |
| 400 | 0.455 | $29.65 \times 10^{-5}$ | 0.0719 | — |
| 500 | 0.495 | $28.80 \times 10^{-5}$ | 0.0698 | 0.00049 |
| 600 | 0.530 | — | — | — |
| 700 | 0.565 | — | — | 0.00062 |
| 800 | 0.600 | — | — | — |

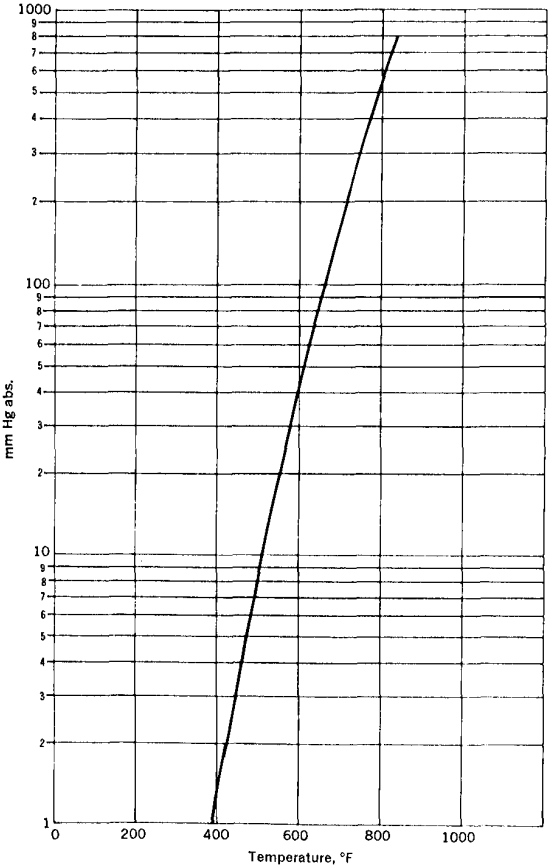
| | | | |
|---|---|---|---|
| Pour Point | +45°F | Fire Point | 540°F |
| Flash Point | 460°F | A. I. T. | 1115°F |
| | | Thermal Decomposition** | 800°F |

**Thermal decomposition was determined by the Isoteniscope method as described in the "Journal of Chemical and Engineering Data," January 1961, Vol. 6, No. 1. It is defined as the temperature at which dp/dt = 0.014 mm Hg per second, or 500 mm Hg per 10 hours.

0592745

TOWOLDMON0037345

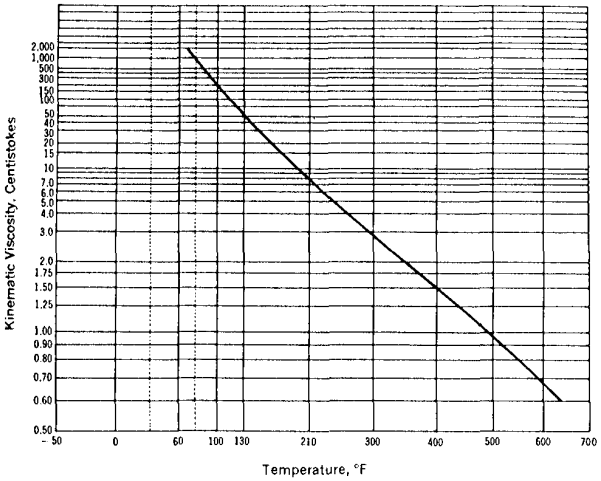
## VAPOR PRESSURE



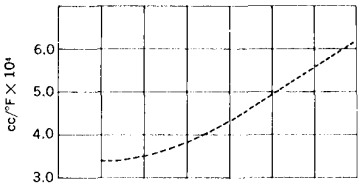

0592746

TOWOLDMON0037346

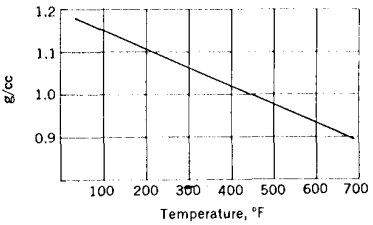
## KINEMATIC VISCOSITY




## COEFFICIENT OF THERMAL EXPANSION



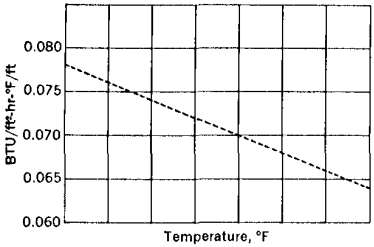

## DENSITY



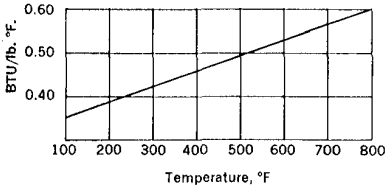

0592747

TOWOLDMON0037347

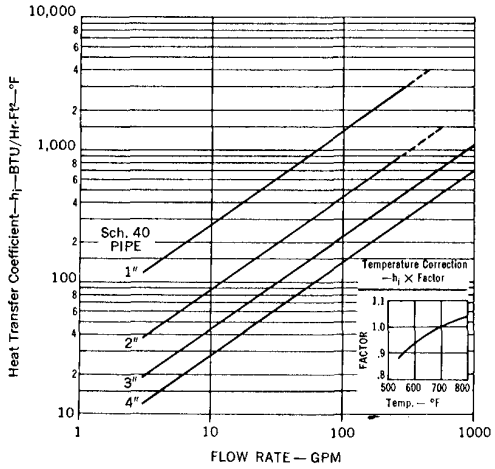
## THERMAL CONDUCTIVITY




## SPECIFIC HEAT




## Inside Film Heat Transfer Coefficient versus Flow Rate at 700°F



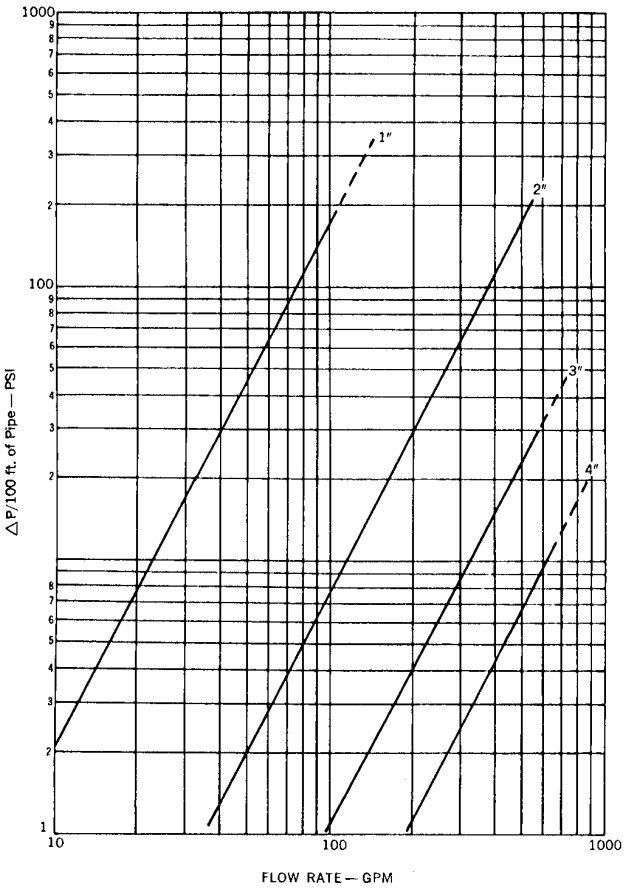

0592748

TOWOLDMON0037348

**Pressure Drop Per 100 Ft. of Pipe**

**versus**

**Flow Rate at 700°F**




0592749

TOWOLDMON0037349

## 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., Indian Orchard, Mass.*
*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

DECATUR, ILLINOIS 62523
207 Decatur Professional Building
363 South Main Street
Tel. (217) 423-6031

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

KANSAS CITY, MISSOURI 64133
701 Blue Ridge Tower
4240 Blue Ridge Boulevard
Tel. (816) 353-8060

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) 276-7811

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) 948-4451

**Organic Division *(Rubber Instruments)***

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

**Plastic Products & Resins Division**

EUGENE, OREGON 97401
P. O. Box 1819
855 Seneca Road
Tel. (503) 342-7201

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***

10/69

0592750

2-2970-1169-6 LITHO IN U.S.A.

TOWOLDMON0037350