Monsanto

Therminol® 75

Pub No. IC/FP-213

Heat Transfer Fluid

0615961

TOWOLDMON0039370
WATER_PCB-00023839

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Expansion of Liquid

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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In certain countries of Western Europe and the Far East, Monsanto sells Therminol® Heat Transfer Fluids under the brand name "Santotherm® Heat Transfer Fluids". Corresponding Therminol and Santotherm heat transfer fluids are identical in composition.

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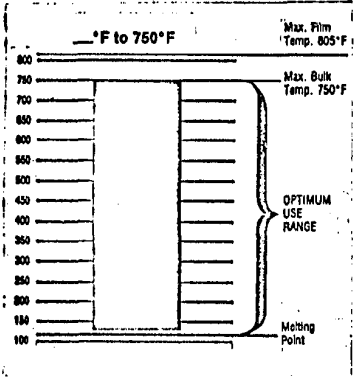
Chemical and Physical Characteristics

Therminol® 75 is a synthetic aromatic heat transfer fluid.

It has a liquid operating temperature range of 160°–750°F (70°–399°C). Because of its high boiling point (725°F), Therminol 75 heat transfer fluid generates very little vapor pressure above ambient pressure at 725°F and can be used in low pressure systems. Under ambient conditions, Therminol 75 is a soft, solid material having a melting range of about 104°–158°F (40°–70°C).

without need of pressurization at 750°F.



Typical Properties*†

too—reduce the wgt. distracting as is.

Composition	Terphenyl/Quaterphenyl
Appearance	Soft, Solid Melting to Yellow Liquid
Melting Range, °F	104°–158°F (40°–70°C) Reluctant to Crystallize
Flash Point, (COC)	390°F (204°C)
Fire Point, (COC)	440°F (232°C)
AIT (D-2155)	1000°F (538°C)
Density @ 122°F	9.08 lbs./gallon
Kinematic Viscosity @ 122°F	97.9 cSt
Coefficient of Thermal Expansion[1]	0.000489/°F (0.000880/°C)
Heat of Vaporization (Calculated)	103 BTU/lb. (57 cal/gm)
Average Molecular Weight	255
Boiling Range: @ 50 mm Hg	10% 255°C; 90% 340°C

[1]Calculated by equation $C = \frac{1}{V_1}\left(\frac{V_2 - V_1}{T_2 - T_1}\right)$ with $T_1 = 140°F$ and $T_2 = 750°F$.

*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 75 heat transfer fluid.

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Therminol® 75

Heat Transfer Fluid

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Introduction

Therminol 75 heat transfer fluid is a new high temperature liquid phase heat transfer fluid having excellent thermal stability. It was developed for use at temperatures of 700°–750°F (371°–399°C) in typical liquid phase heat transfer systems which operate at low pressure (about one and one-half atmospheres or less static pressurization) to maintain the liquid phase at high temperatures. Therminol 75 is non-corrosive to typical heat transfer system materials of construction, has low odor and low mammalian toxicity.

Therminol 75 is not classified as a fire-resistant heat transfer fluid. Consequently, the use of protective devices may be required to minimize fire risk. The insurer of your property should be consulted relative to this matter.

Applications

The design and properties of Therminol 75 make it ideally suited for high temperature heat recovery applications in process and refinery operations, such as providing indirect heat to chemical process, heat recovery from stack gases, as a coolant to remove heat from exothermic reactors and for indirect heating of distillation processes.

Use of Therminol 75 in 700°–750°F (371°–399°C) heat transfer systems can result in savings of capital investment, fluid makeup, utility and maintenance costs as compared with higher pressure liquid-vapor systems.

① circled items need to stand out more. Preferably on a blue by themselves but in print size between text + section headings

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Fluid Parameters and Selection Criteria

In the selection of a heat transfer fluid for high temperature use, it is important that one consider the fluid properties and characteristics. Some of these are listed below:

Stability. Therminol 75 is an exceptionally heat stable fluid; however, care must be taken to avoid overheating the fluid which could lead to decomposition products.

The stability of a fluid is one of the most important considerations in the selection of a heat transfer fluid. The fluid should be capable of withstanding severe thermal stress for long durations of time and provide desirable overall long service life. As such, the chemical makeup or composition of the fluid must resist thermal degradation.

Overheating and exposure of the heat transfer fluid to thermal conditions above the recommended operating range of the fluid can result in increased decomposition of the fluid to low boiling and high boiling products. The low boiling products can result in pump cavitation and localized boiling in the heater. These low boilers should be vented through a pressure relief device on the expansion tank to a non-hazardous area away from personnel and sources of ignition. The high boiling products are generally soluble in the fluid. High boiling products may possibly separate as solids (coke, tar, etc.) and could be detrimental to the operation of the system. Thus when detected they should be removed.

Contamination may accelerate the thermal breakdown of a fluid, thus it is recommended that new and used heat transfer systems be cleaned thoroughly before filling with Therminol 75 heat transfer fluid. It is also important that oxidation of the fluid be kept to a minimum during high temperature operation by use of a positive nitrogen pressure on the expansion tank to which a pressure relief device should always be provided.

Heat Transfer Coefficient. Therminol 75 heat transfer fluid has equivalent or higher heat transfer coefficients than other natural or synthetic liquids in the same boiling range. As with all thermal liquid heat transfer systems, the flow should be fully turbulent in the heater and users to effect efficient heat transfer and avoid hot spot boiling which can lead to fluid decomposition and surface fouling or heat transfer surface burn-out.

Design Recommendations

Besides the design and operation guidance given in Monsanto bulletin IC/FP-204, Therminol 75 heat transfer fluid with its 40°–70°C melting range will require:

- heat tracing of system components for thawing the heat transfer media to the liquid state.
- continuous heat tracing of instrumentation and control lines, system vents and other components which during system operation are cold and would not be operable with solid heat transfer media.
- a thermal heatable storage that can accommodate the heat transfer system volume in case of emergency shut-down of utilities or drum storage which could be thawed out at a later time.
- All system low spots to have drains to facilitate fluid discharge and system cleaning.

Operation Procedures

Start-Up. In addition to suggested start-up procedures in bulletin IC/FP-204, systems using Therminol 75 heat transfer fluid must be preheated as must the Therminol 75 to a temperature above the ~~160°F~~ 158 ~~(70°C)~~ melting point and not be allowed to fall below this temperature. While Therminol 75 is reluctant

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to crystallize, the best operating practice is to have the system start-up temperature above 160°F (~70°C). Two methods or combinations have been employed for preheating the system. The first is to have all components heat traced and the system preheated by the tracing. A second method is to introduce low pressure steam into the expansion tank and allow internal steam heating with condensate and steam exiting the system through the system drains and vents. This is especially useful where heat tracing of large heaters and user components is impractical. All system component temperatures should be monitored to insure complete heating. The Therminol 75 is charged at above 160°F (~70°C) to the system from thermally heated bulk storage or heated drums. The continuous heat tracing of instrumentation lines, system vents and pump shaft seals must be in operation before the system pumps and heaters are started. The expansion tank vents should be open to allow moisture to exit the system from the hot fluid moving through the expansion tank. After the free moisture has left the system, the expansion tank should be inert gas blanketed and normal operation commenced.

Shut-Down. For shut-downs for systems which are not totally heat traced and the minimum system temperature is less than 160°F (~70°C), Therminol 75 heat transfer fluid must be removed from the system and placed in heatable storage. All low point drains must be opened to remove Therminol 75.

① Circled item needs to stand out more. Preferably on a line by itself.

General Design and Maintenance

A design, operating and maintenance guide for liquid phase, low pressure heat transfer systems utilizing Therminol heat transfer fluids is separately available. This brochure (IC/FP-204) discusses many general aspects of heat transfer systems. It may be obtained by contacting your sales representative or Monsanto Industrial Chemicals, St. Louis, Missouri (314-694-1000).

Safe Handling and Disposal

Both animal toxicity studies and manufacturing experience indicate that no special precautions are required in the handling of Therminol 75 heat transfer fluid at ambient temperatures. However, it is suggested that good industrial practice relating to the avoidance of repeated and prolonged skin contact to any industrial chemical, heat transfer fluids, or petroleum product be followed. Vapors on the other hand while not dangerously toxic normally can give rise to discomfort; systems should be made as leak tight as possible. Repairs to leaks of hot fluid should be carried out under well ventilated conditions.

While it is believed that Therminol 75 heat transfer fluid poses no serious problems with respect to the environment, as a concerned supplier to industry, Monsanto urges the user to maintain a tight system, to correct leakage promptly, and to exercise care in the handling and disposal of this and all other such products. A tight maintenance program not only protects the environment, but keeps employes comfortable, the working area clean and the system running smoothly. The most environmentally acceptable means of disposal of used fluids is incineration.

more space between FP's

Material Safety Data Sheets and Sales Specifications may be obtained from Product Acceptability, Specialty Chemicals Division, Monsanto Industrial Chemicals Co.

Monsanto Analytical Service

Should a system experience heat transfer fluid related problems, Monsanto will evaluate the used Therminol or other fluids against IN-USE experience guidelines. In many instances, these analyses have resulted in modest system changes to eliminate problems and in identification of external contamination.

use lower case letters

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Variation of Properties With Temperature*†

Temperature		Density			Specific Heat		Thermal Conductivity		Viscosity		Vapor Pressure	
					BTU	J	BTU	W	Absolute	Kinematic		Torr
°F.	°C.	lb/gal	lb/ft³	Kg/m³	lb°F	kg°K	hr ft°F	m°K	lb/hr-ft	cSt	psia	(mm Hg)
120	49	9.09	67.99	1089	0.390	1633	0.0777	0.1344	284	108		
140	60	9.02	67.49	1081	0.397	1662	0.0776	0.1342	126	48.1		
160	71	8.95	66.99	1073	0.404	1692	0.0775	0.1340	61.8	23.8		
180	82	8.89	66.49	1065	0.411	1721	0.0773	0.1337	36.3	14.0		
200	93	8.82	65.99	1057	0.419	1754	0.0772	0.1335	23.5	9.2		
220	104	8.75	65.49	1049	0.426	1784	0.0769	0.1330	16.4	6.46		
240	116	8.69	64.99	1041	0.433	1813	0.0766	0.1325	12.21	4.85		
260	127	8.61	64.43	1032	0.440	1842	0.0762	0.1318	9.34	3.74		
280	138	8.55	63.93	1024	0.447	1872	0.0758	0.1311	7.43	3.00		
300	149	8.48	63.43	1016	0.454	1901	0.0752	0.1301	6.10	2.48		
320	160	8.41	62.93	1008	0.461	1930	0.0746	0.1290	5.10	2.09		
340	171	8.35	62.43	1000	0.468	1959	0.0740	0.1280	4.31	1.78		
360	182	8.28	61.93	992	0.475	1989	0.0733	0.1268	3.74	1.56		
380	193	8.21	61.43	984	0.482	2018	0.0726	0.1256	3.38	1.42		
400	204	8.14	60.93	976	0.489	2047	0.0719	0.1244	2.90	1.23	0.21	11
420	216	8.08	60.43	968	0.496	2077	0.0712	0.1231	2.53	1.08	0.30	15
440	227	8.01	59.93	960	0.503	2106	0.0705	0.1219	2.30	0.99	0.42	22
460	238	7.94	59.37	951	0.510	2135	0.0699	0.1209	2.07	0.90	0.58	30
480	249	7.87	58.87	943	0.517	2165	0.0692	0.1197	1.89	0.83	0.79	41
500	260	7.80	58.37	935	0.523	2190	0.0685	0.1185	1.72	0.76	1.1	55
520	271	7.74	57.87	927	0.530	2219	0.0678	0.1173	1.57	0.70	1.4	73
540	282	7.67	57.37	919	0.537	2248	0.0671	0.1161	1.47	0.66	1.8	95
560	293	7.59	56.81	910	0.544	2278	0.0664	0.1148	1.34	0.61	2.4	120
580	304	7.53	56.31	902	0.551	2307	0.0657	0.1135	1.24	0.57	3.1	160
600	316	7.46	55.81	894	0.558	2336	0.0651	0.1126	1.17	0.54	3.9	200
620	327	7.39	55.31	886	0.565	2366	0.0644	0.1114	1.09	0.51	5.0	260
640	338	7.33	54.81	878	0.572	2395	0.0637	0.1102	1.02	0.48	6.2	320
660	349	7.26	54.31	870	0.579	2424	0.0630	0.1090	0.97	0.46	7.8	400
680	360	7.19	53.75	861	0.586	2454	0.0623	0.1078	0.92	0.44	9.6	480
700	371	7.12	53.25	853	0.593	2483	0.0616	0.1065	0.88	0.43	11.7	610
720	382	7.05	52.75	845	0.600	2512	0.0610	0.1055	0.84	0.41	14.3	740
740	393	6.98	52.19	836	0.607	2541	0.0603	0.1043	0.81	0.40	17.3	890
750*	399*	6.94	51.94	832	0.610	2554	0.0600	0.1038	0.80	0.40	18.9	980
760	404	6.91	51.69	828	0.614	2571	0.0596	0.1031	0.78	0.39	20.7	1070

*Maximum recommended bulk temperatures: 750°F. (390°C).

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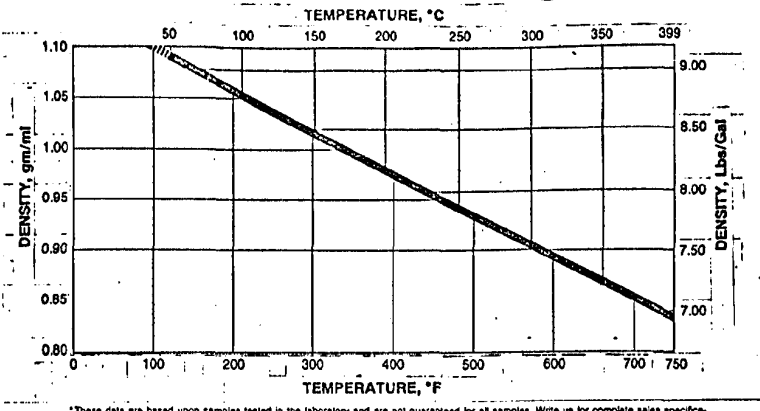
Density, Variation With Temperature*† ← smaller style



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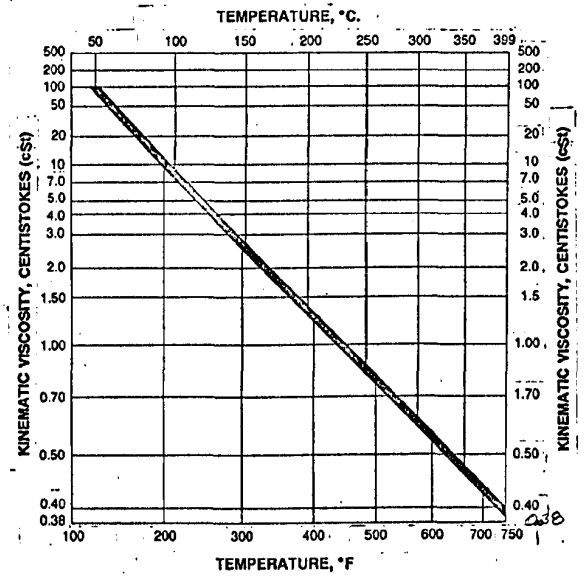
heat transfer

Viscosity, Variation With Temperature*† — smaller style



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heat transfer

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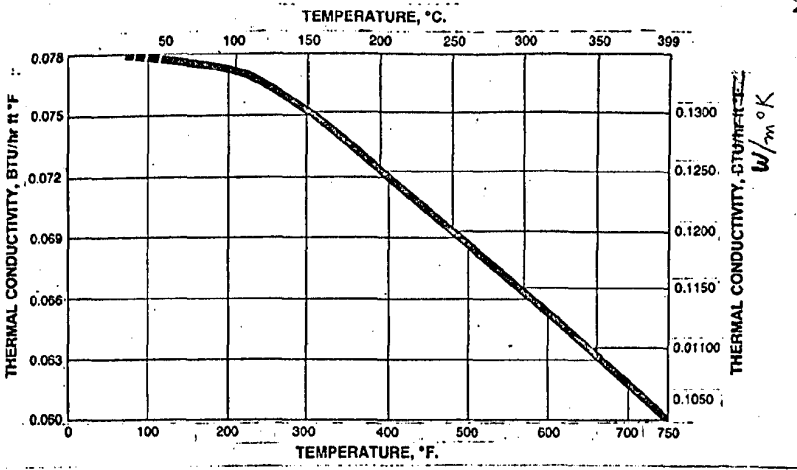
Thermal Conductivity, Variation With Temperature*†



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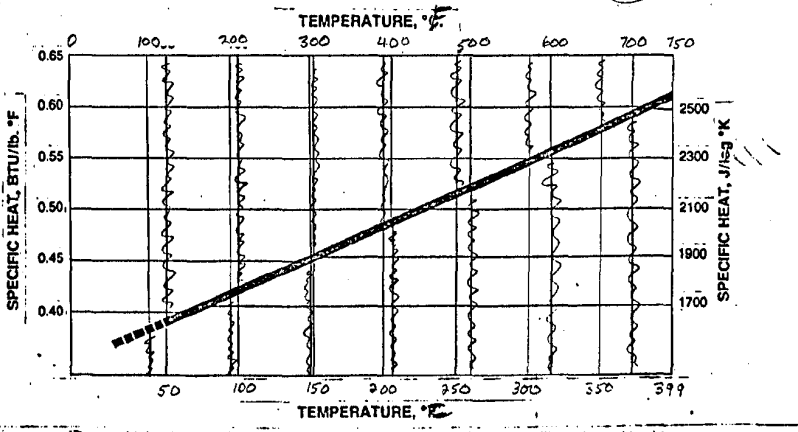
heat transfer

Specific Heat, Variation With Temperature*†



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heat transfer

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small vs.

Density and Volume Variation VS Temperature

Temperature °F	Temperature °C	Density (Pounds/Gallon)	Volume (Gallons/Pound)
122	50	9.079	0.1080
150	66	8.988	0.1113
200	93	8.821	0.1134
250	121	8.645	0.1157
300	149	8.479	0.1179
350	177	8.312	0.1203
400	204	8.145	0.1228
450	232	7.970	0.1255
500	260	7.803	0.1282
550	288	7.628	0.1311
600	316	7.461	0.1340
650	343	7.286	0.1373
700	371	7.119	0.1405
750	399	6.943	0.1440

smaller type

Expansion of Liquid Therminol® 75*†

[Basis: 1 Gallon at 122°F. (50°C.)]

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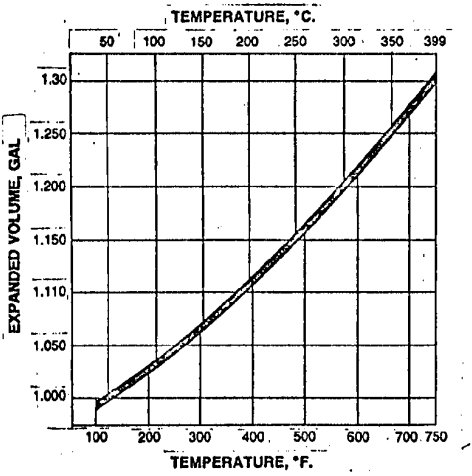

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heat transfer

Enter + blow up.

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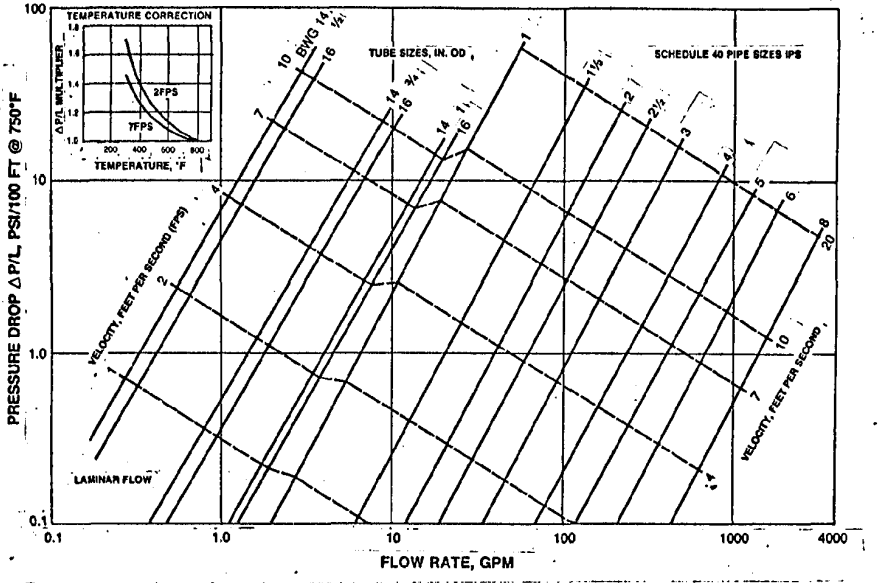
Therminol® 75—Pressure Drop*†
Turbulent Flow Inside Clean, Round Tubing and Piping



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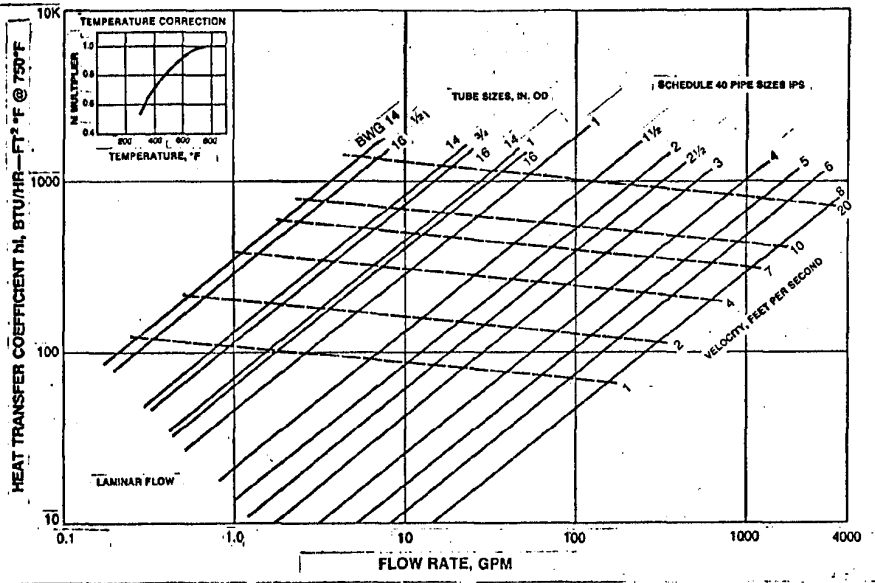
smaller type

Therminol® 75—Heat Transfer Coefficient*†
Turbulent Flow Inside Clean, Round Tubing and Piping



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