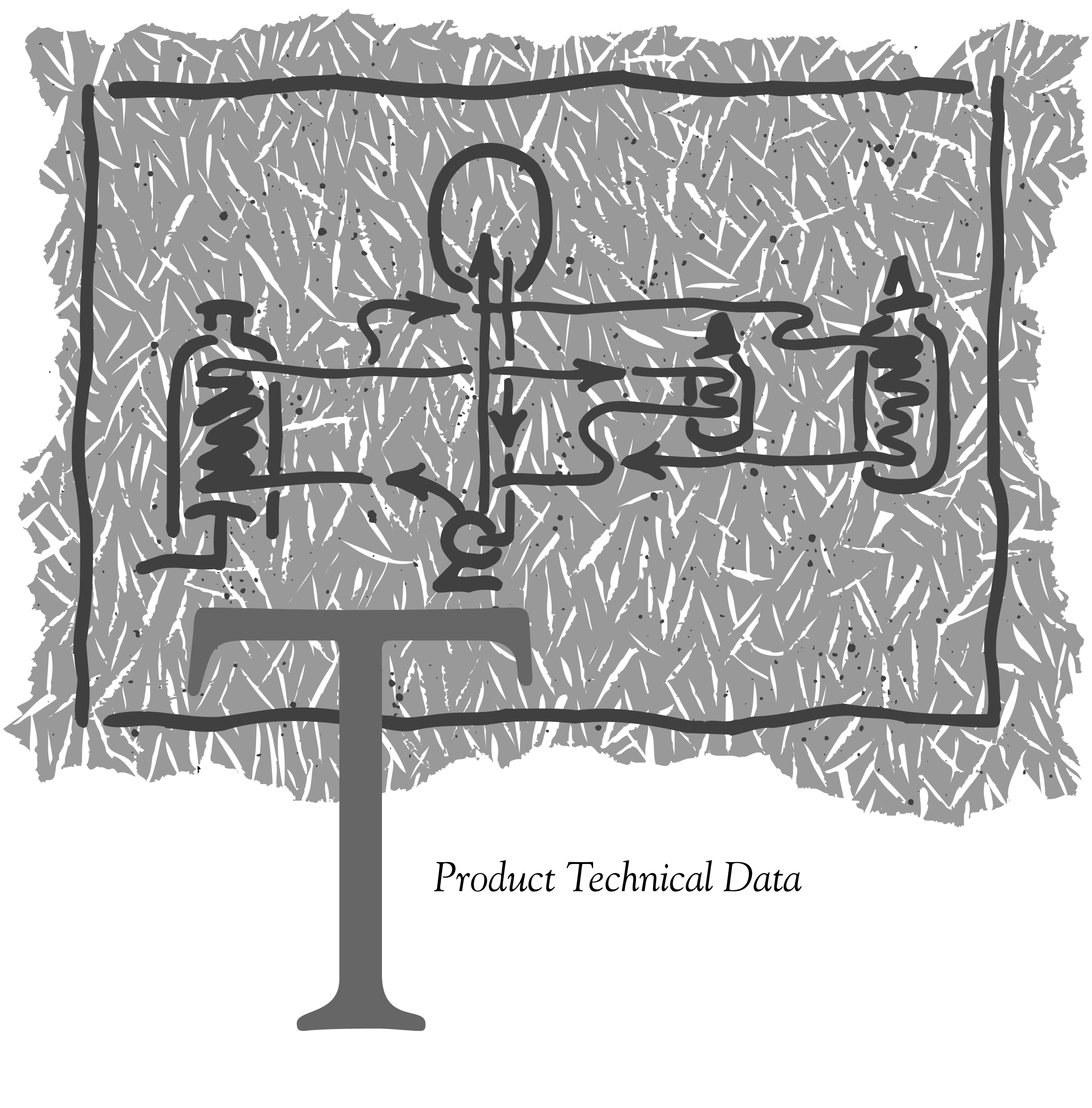
DOWTHERM T
Heat Transfer Fluid



Product Technical Data

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For Information About Our Full Line of Fluids…

To learn more about the full line of heat transfer fluids manufactured or distributed by Dow — including DOWTHERM* synthetic organic, SYLTHERM† silicone and DOWTHERM, DOWFROST*, and DOWCAL* glycol-based fluids — request our product line guide. Call the number for your area listed on the back of this brochure.

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†Trademark of Dow Corning Corporation

DOWTHERM T HEAT TRANSFER FLUID

DOWTHERM T fluid is a liquid phase heat transfer fluid for moderately high operating temperatures from 550°F (288°C) to 14°F (-10°C)

DOWTHERM T fluid has an optimum maximum use temperature of 550°F (288°C). It can be used to an extended bulk temperature of 600°F (316°C). Designed for use in non-pressurized systems, the fluid exhibits favorable physical properties and low vapor pressure at the maximum use temperature. Since the flash and fire points of DOWTHERM T fluid are high — 370°F (188°C) and 410°F (210°C) respectively — its use presents no fire hazard at ambient temperature. The fluid also has good low temperature properties that allow for low-temperature start-up down to 14°F (-10°C). Single dose oral toxicity of the fluid is considered to be very low. The LD_{50} in rats is >15,800 mg/kg.

FLUID SELECTION CRITERIA

Thermal Stability

The thermal stability of a heat transfer fluid is dependent not only on its chemical structure, but also on the design and operating temperature profile of the system in which it is used. Maximum life for a fluid can be obtained by following sound engineering practices in the design of the heat transfer system. Three key areas of focus are: designing and operating the heater and/or energy recovery unit, preventing chemical contamination, and eliminating contact of the fluid with air.

Heater Design and Operation

Poor design and/or operation of the fired heater can cause overheating resulting in excessive thermal degradation of the fluid. Some problem areas to be avoided include:

1. Flame impingement.
2. Operating the heater above its rated capacity.
3. Modifying the fuel-to-air mixing procedure to change the flame height and pattern. This can yield higher flame and gas temperatures together with higher heat flux.
4. Low fluid velocity/high heat flux areas resulting in excessive heat transfer fluid film temperatures.

The manufacturer of the fired heater should be your primary contact for the proper equipment for your heat transfer system needs.

Chemical Contamination

A primary concern regarding chemical contaminants in a heat transfer fluid system is their relatively poor thermal stability at elevated temperatures. The thermal degradation of chemical contaminants may be very rapid which may lead to fouling of heat transfer surfaces and corrosion of system components. The severity and nature of the corrosion will depend upon the amount and type of contaminant introduced into the system.

Air Oxidation

Organic heat transfer fluids operated at elevated temperatures are susceptible to air oxidation. The degree of oxidation and the rate of reaction is dependent upon the temperature and the amount of air mixing. Undesirable by-products of this reaction may include carboxylic acids which would likely result in system operating problems.

Preventative measures should be taken to ensure that air is eliminated from the system prior to bringing the heat transfer fluid up to operating temperatures. A positive pressure inert gas blanket should be maintained at all times on the expansion tank during system operation.

Units can be designed to operate at higher temperatures than 550°F (288°C) in cases where the greater replacement costs of DOWTHERM T fluid — resulting from its increased decomposition rate — can be economically justified. In such units, adequate provision must be made for good circulation and lower heat fluxes.

Fluid Pumpability

The pumpability of the material is fairly good down to 14°F (-10°C) where its viscosity is 252 cps (252 mPa•s).

Corrosivity

DOWTHERM T fluid is non-corrosive toward common materials and alloys used in the construction of equipment. Even at high operating temperatures, equipment in which DOWTHERM fluid is used will have an excellent service life. Most corrosion problems are caused by chemicals introduced into the system during cleaning or from process leaks. The nature and severity of the attack will depend on the amounts and types of contaminants involved.

When special materials of construction are used, extra precaution should be taken to avoid contaminating materials containing the following:

Construction Material	*Contaminant*
Austenitic Stainless Steel	*Chloride*
Nickel	*Sulfur*
Copper Alloys	*Ammonia*

CUSTOMER SERVICE FOR USERS OF DOWTHERM T HEAT TRANSFER FLUID

Fluid Analysis

The Dow Chemical Company, and its subsidiaries, offer an analytical service for DOWTHERM T heat transfer fluid. It is recommended that users send a one-pint (0.5 liter) representative sample at least annually to:

North America & Pacific
The Dow Chemical Company
Larkin Lab/Thermal Fluids
1691 North Swede Road
Midland, Michigan 48674
United States of America

Europe
Dow Benelux NV
Testing Laboratory for SYLTHERM and DOWTHERM Fluids
Oude Maasweg 4
3197 KJ Rotterdam – Botlek
The Netherlands

Latin America
Dow Quimica S.A.
Fluid Analysis Service
1671, Alexandre Dumas
Santo Amaro – Sao Paulo –
Brazil 04717-903

This analysis gives a profile of fluid changes to help identify trouble from product contamination or thermal decomposition.

Fluid Sampling Procedures

When a sample is taken from a hot system it should be cooled to below 100°F (40°C) before it is put into the shipping container. Cooling the sample below 100°F (40°C) will prevent the possibility of thermal burns to personnel; also, the fluid is then below its flash point. In addition, any low boilers will not flash and be lost from the sample. Cooling can be done by either a batch or continuous process. The batch method consists of isolating the hot sample of fluid from the system in a properly designed sample collector and then cooling it to below 100°F (40°C). After it is cooled, it can be withdrawn from the sampling collector into a container for shipment.

The continuous method consists of controlling the fluid at a very low rate through a steel or stainless steel cooling coil so as to maintain it at 100°F (40°C) or lower as it comes out of the end of the cooler into the sample collector. Before a sample is taken, the sampler should be thoroughly flushed. This initial fluid should be returned to the system or disposed of in a safe manner in compliance with all laws and regulations.

It is important that samples sent for analysis be representative of the charge in the unit. Ordinarily, samples should be taken from the main circulating line of a liquid system. Occasionally, additional samples may have to be taken from other parts of the system where specific problems exist.

Used heat transfer fluid which has been stored in drums or tanks should be sampled in such a fashion as to ensure a representative sample.

Table 1 — Physical Properties of DOWTHERM T Fluid†

Composition: C_{14} to C_{30} alkyl benzene derivatives

Color: Clear, yellow liquid

Property	English Units	SI Units
Pour Point	<-40°F	<-40°C
Distillation Range,		
Initial Boiling Point	653°F	345°C
20% by Volume	665°F	352°C
Flash Point, COC[1]	370°F	188°C
Fire Point, COC[1]	410°F	210°C
Autoignition Temperature[2]	707°F	375°C
Estimated Critical Constants:		
T_c	946°F	508°C
P_c	10.2 atm	10.3 bar
V_c	6.9×10^{-2} ft³/lb	4.32 l/kg
Average Molecular Weight	318	
Density at 75°F	54.36 lb/ft³	870.7 kg/m³
Density at 25°C	54.30 lb/ft³	869.8 kg/m³

† Not to be construed as specifications

[1] Cleveland Open Cup

[2] Run by ASTM procedure D-2155-78

Table 2 — Saturated Liquid Properties of DOWTHERM T Fluid (English Units)

Temp. °F	Specific Heat Btu/lb°F	Density lb/ft³	Thermal Conductivity Btu/hr ft²(°F/ft)	Viscosity cP	Vapor Pressure psia
20	0.450	55.66	0.0767	184.8	0.0
40	0.458	55.19	0.0760	77.2	0.0
60	0.466	54.71	0.0752	38.7	0.0
80	0.474	54.23	0.0744	22.1	0.0
100	0.482	53.75	0.0737	13.9	0.0
120	0.490	53.27	0.0729	9.40	0.0
140	0.497	52.80	0.0721	6.71	0.0
160	0.505	52.32	0.0714	5.01	0.0
180	0.513	51.84	0.0706	3.87	0.0
200	0.521	51.36	0.0698	3.07	0.0
220	0.529	50.88	0.0691	2.50	0.0
240	0.537	50.41	0.0683	2.07	0.0
260	0.545	49.93	0.0675	1.74	0.0
280	0.553	49.45	0.0668	1.49	0.0
300	0.561	48.97	0.0660	1.29	0.0
320	0.569	48.49	0.0652	1.13	0.0
340	0.577	48.02	0.0645	1.00	0.0
360	0.585	47.54	0.0637	0.89	0.1
380	0.593	47.06	0.0629	0.80	0.1
400	0.600	46.58	0.0621	0.72	0.2
420	0.608	46.11	0.0614	0.65	0.3
440	0.616	45.63	0.0606	0.60	0.4
460	0.624	45.15	0.0598	0.55	0.6
480	0.632	44.67	0.0591	0.50	0.8
500	0.640	44.19	0.0583	0.47	1.2
520	0.648	43.72	0.0575	0.43	1.7
540	0.656	43.24	0.0568	0.41	2.3
560	0.664	42.76	0.0560	0.38	3.1
580	0.672	42.28	0.0552	0.36	4.1
600	0.680	41.80	0.0545	0.33	5.4

Table 3 — Saturated Liquid Properties of DOWTHERM T Fluid (SI Units)

Temp. °C	Specific Heat kJ/kgK	Density kg/m³	Thermal Conductivity W/mK	Viscosity mPa·s	Vapor Pressure kPa
-10	1.873	893.9	0.133	251.68	0.0
0	1.903	887.0	0.132	106.68	0.0
10	1.932	880.1	0.131	53.64	0.0
20	1.962	873.2	0.130	30.55	0.0
30	1.992	866.4	0.128	19.09	0.0
40	2.022	859.5	0.127	12.80	0.0
50	2.052	852.6	0.126	9.07	0.0
60	2.082	845.7	0.125	6.71	0.0
70	2.111	838.8	0.124	5.15	0.0
80	2.141	831.9	0.122	4.06	0.0
90	2.171	825.0	0.121	3.28	0.0
100	2.201	818.1	0.120	2.70	0.0
110	2.231	811.2	0.119	2.27	0.0
120	2.260	804.3	0.118	1.93	0.0
130	2.290	797.5	0.116	1.66	0.0
140	2.320	790.6	0.115	1.45	0.1
150	2.350	783.7	0.114	1.27	0.1
160	2.380	776.8	0.113	1.13	0.2
170	2.410	769.9	0.112	1.01	0.3
180	2.439	763.0	0.111	0.91	0.4
190	2.469	756.1	0.109	0.82	0.6
200	2.499	749.2	0.108	0.75	1.0
210	2.529	742.3	0.107	0.68	1.4
220	2.559	735.4	0.106	0.63	2.1
230	2.588	728.6	0.105	0.58	3.0
240	2.618	721.7	0.103	0.54	4.3
250	2.648	714.8	0.102	0.50	6.0
260	2.678	707.9	0.101	0.47	8.2
270	2.708	701.0	0.100	0.44	11.0
280	2.738	694.1	0.099	0.41	14.7
290	2.767	687.2	0.097	0.39	19.4
300	2.797	680.3	0.096	0.36	25.2
310	2.827	673.4	0.095	0.34	32.3
320	2.857	666.5	0.094	0.33	41.2

Figure 1 — Calculated Latent Heat of Vaporization of DOWTHERM T Fluid (English Units)

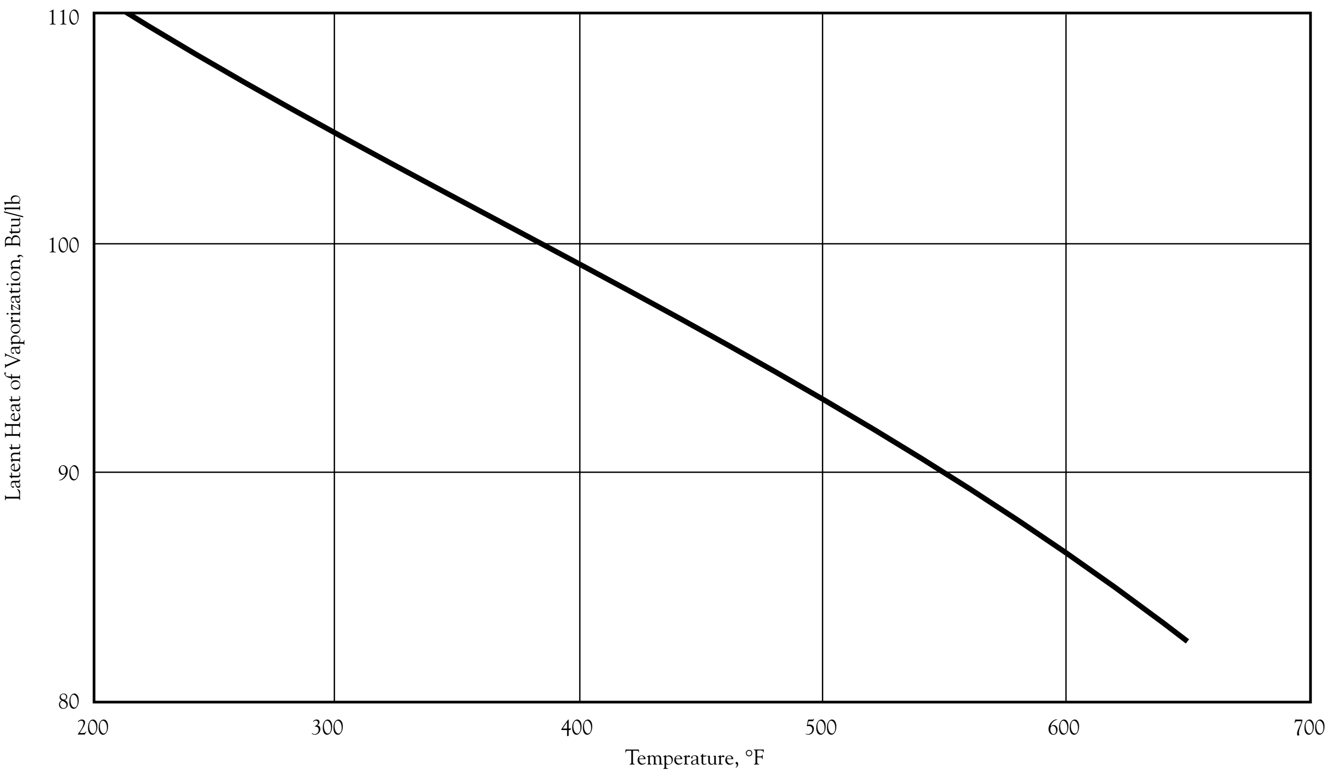


Figure 2 — Calculated Latent Heat of Vaporization of DOWTHERM T Fluid (SI Units)

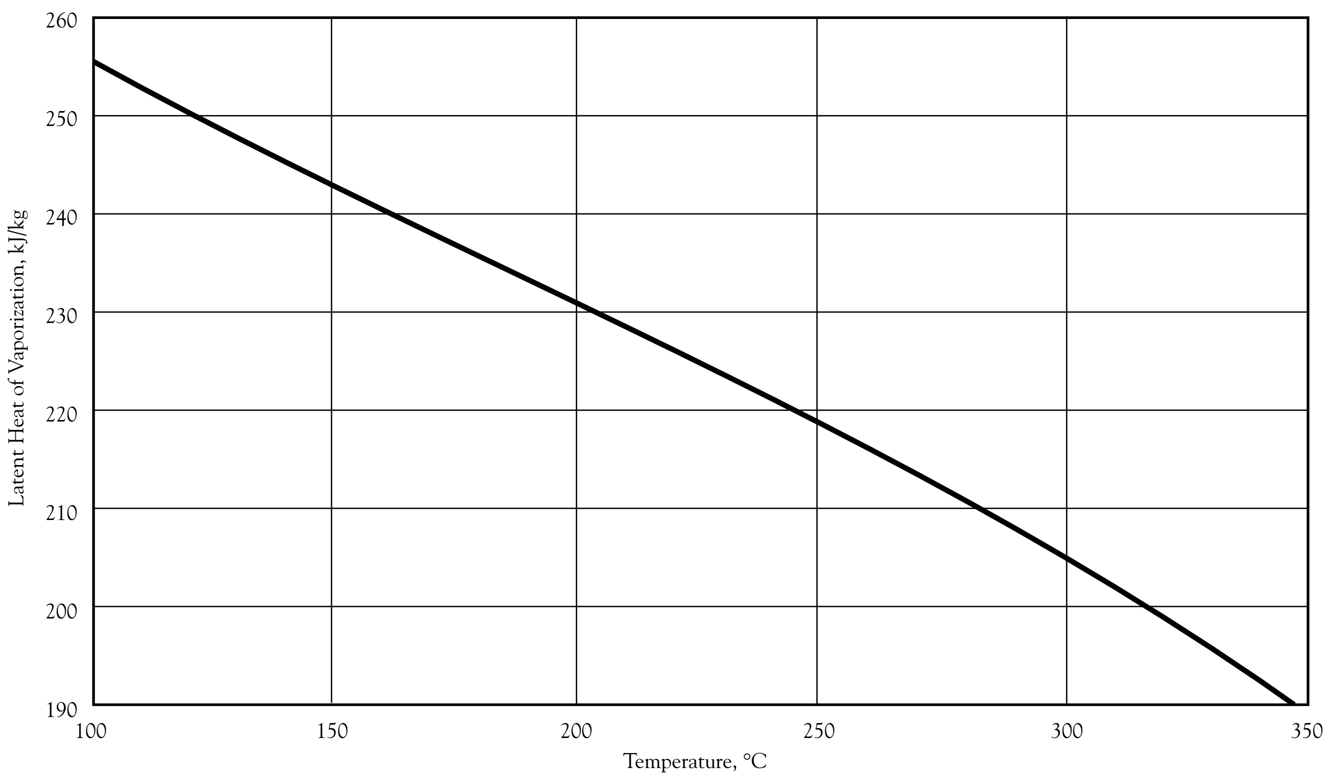
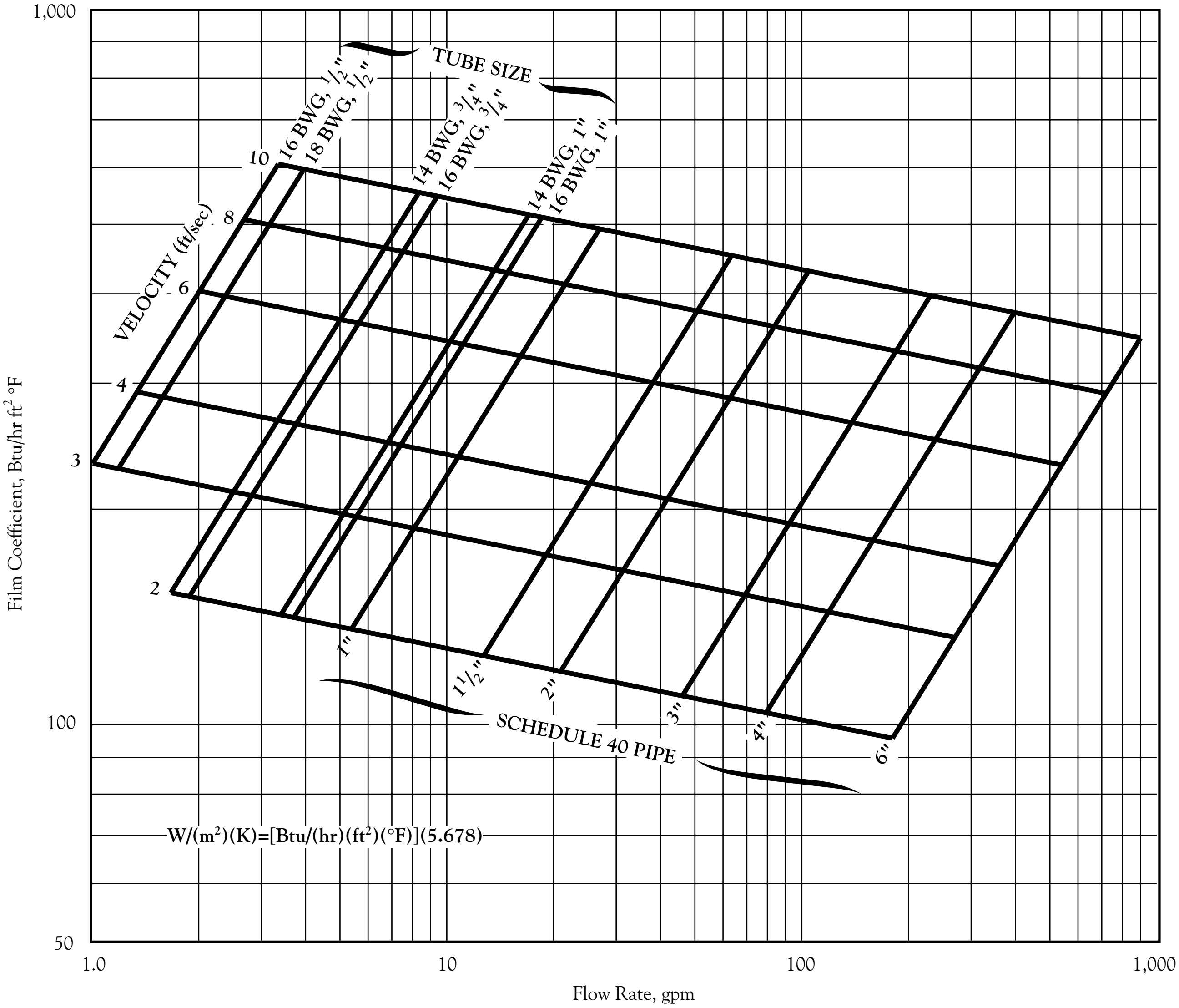
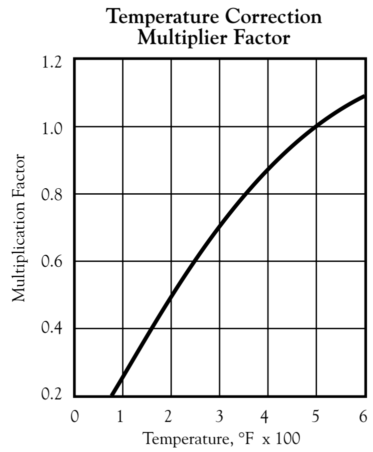


Figure 3 — Liquid Film Coefficient of DOWTHERM T Fluid Inside Pipes and Tubes (Turbulent Flow Only) (English Units)





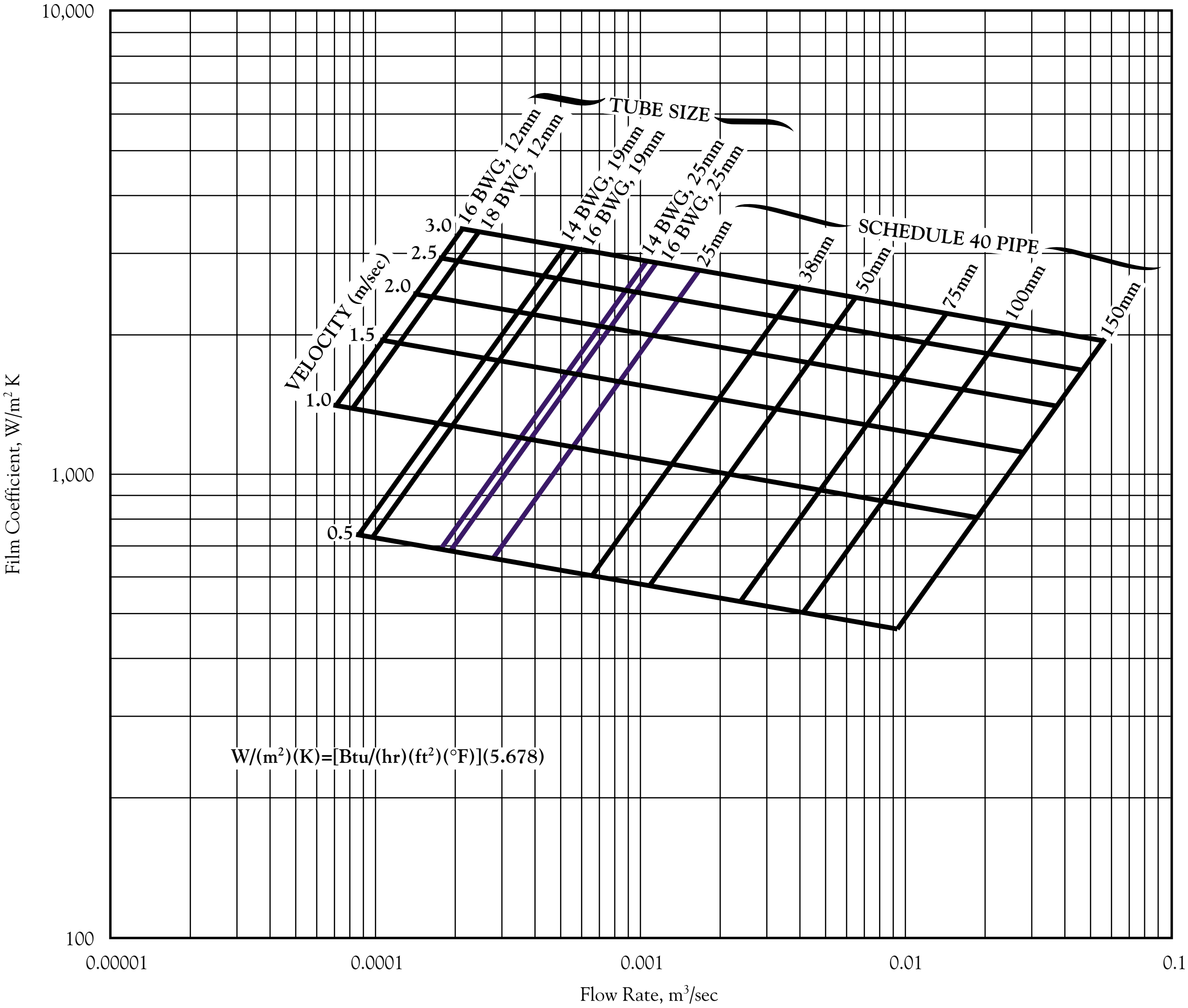
Sieder and Tate equation
Process Heat Transfer,
D.Q. Kern (1950) p. 103

$$Nu = 0.027\, Re^{0.8} Pr^{1/3} \left(\frac{\mu}{\mu_w}\right)^{0.14}$$

Chart based on $\left(\frac{\mu}{\mu_w}\right)^{0.14} = 1$

Note: The values in this graph are based on the viscosity of fluid as supplied.

Figure 4 — Liquid Film Coefficient of DOWTHERM T Fluid Inside Pipes and Tubes (Turbulent Flow Only) (SI Units)



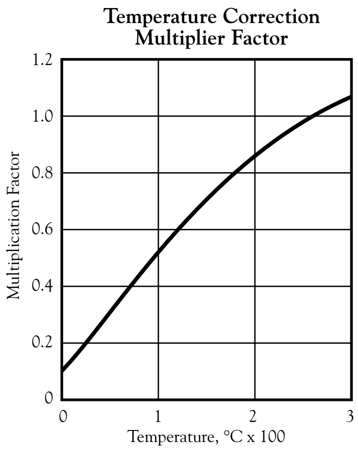


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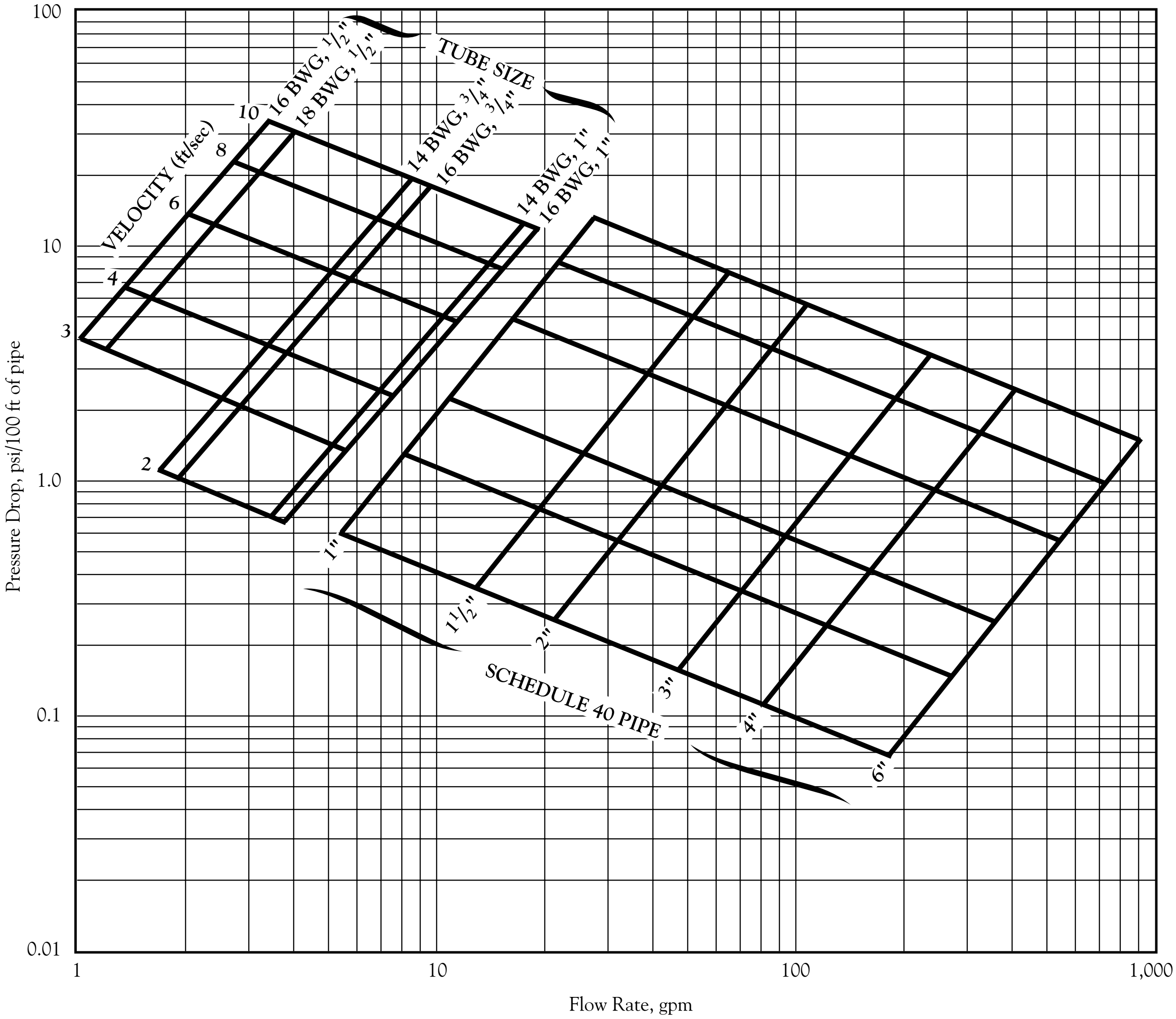
Chart based on $\left(\frac{\mu}{\mu_w}\right)^{0.14} = 1$

Note: The values in this graph are based on the viscosity of fluid as supplied.

Figure 5 — Pressure Drop vs. Flow Rate for DOWTHERM T Fluid in Schedule 40 Nominal Pipe and BWG Tube (English Units)



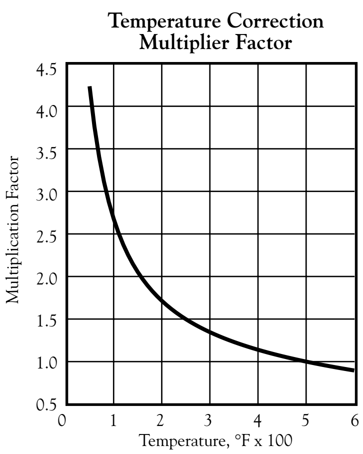
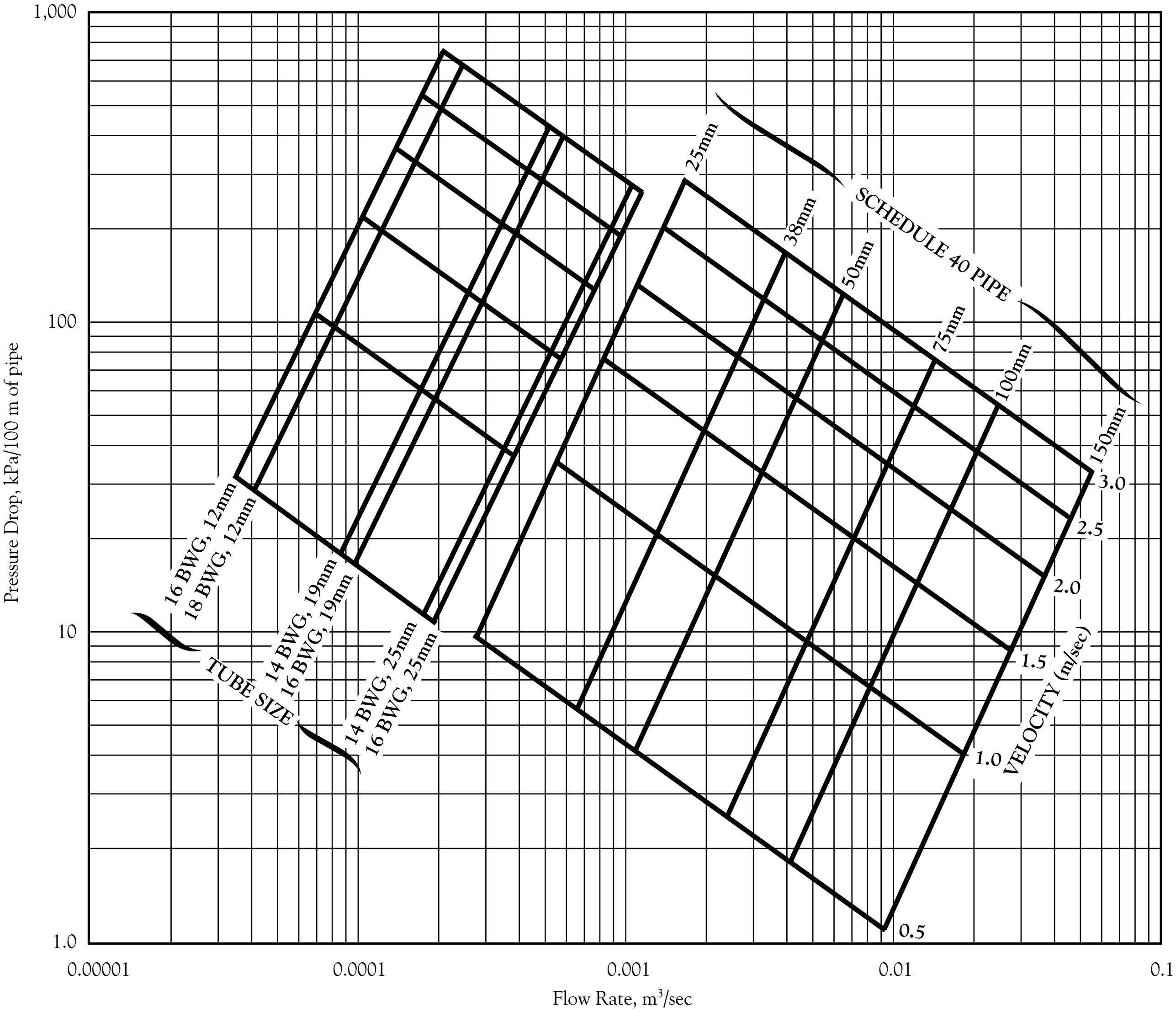
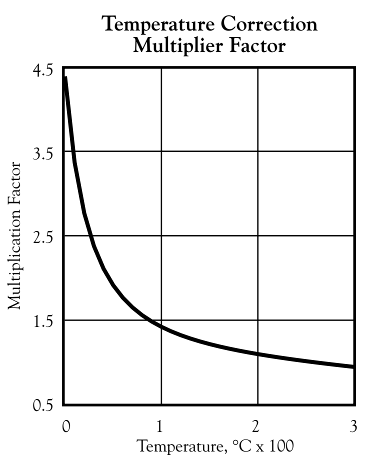


Figure 6 — Pressure Drop vs. Flow Rate for DOWTHERM T Fluid in Schedule 40 Nominal Pipe and BWG Tube (SI Units)





DOWTHERM* T
Heat Transfer Fluid

Product Technical Data

For further information, call...

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www.dowtherm.com

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