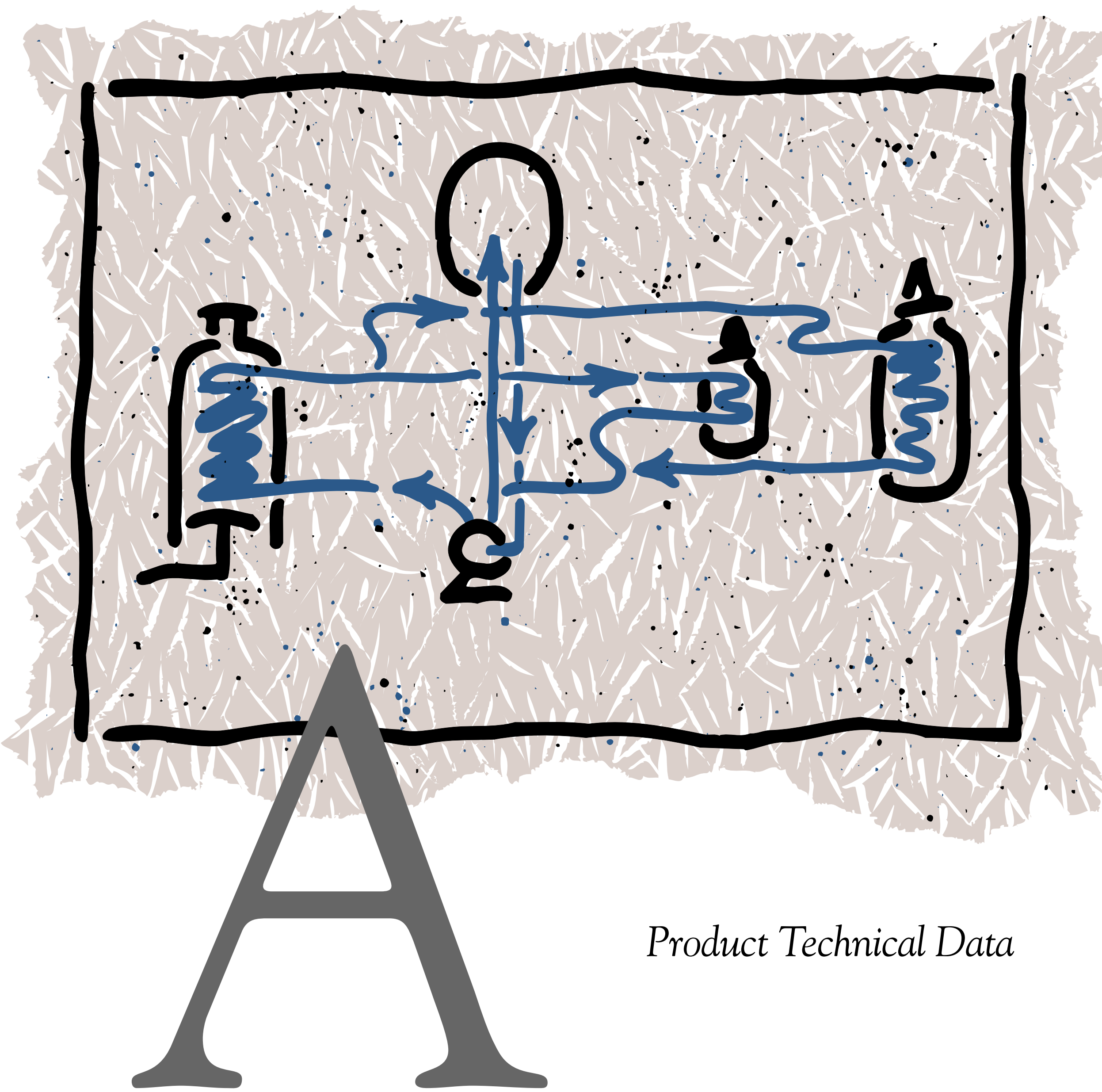
DOWTHERM A
Heat Transfer Fluid



Product Technical Data

CONTENTS

VERSATILE, STABLE, AND PREFERRED—DOWTHERM A HEAT TRANSFER FLUID

DOWTHERM* A heat transfer fluid is a eutectic mixture of two very stable organic compounds, biphenyl ($C_{12}H_{10}$) and diphenyl oxide ($C_{12}H_{10}O$). These compounds have practically the same vapor pressures, so the mixture can be handled as if it were a single compound. DOWTHERM A fluid may be used in systems employing either liquid phase or vapor phase heating. Its normal application range is 60°F to 750°F (15°C to 400°C), and its pressure range is from atmospheric to 152.5 psig (10.6 bar).

Unsurpassed Thermal Stability and Efficiency with Technical Backup and Support to Match

DOWTHERM A fluid, which has been employed in industrial heat transfer systems for over 60 years, is the preferred product for a wide range of indirect heat transfer applications. It is stable, does not decompose readily at high temperatures, and can be used effectively in either liquid or vapor phase systems.

The low viscosity throughout the entire operating range results in efficient heat transfer; start-up and pumping problems are minimized. The fluid is noncorrosive to common metals and alloys.

Of equal importance, but often overlooked, is the support provided by the fluid manufacturer. Dow's assistance to industry is unequaled. This includes technical backup in the design phase, during operation and after shutdown, as needed. Moreover, free analytical testing is provided to monitor fluid condition.

When it is time to change out your DOWTHERM A heat transfer fluid, Dow's Fluid Return Program allows you to return the old fluid and receive credit toward the purchase of your new fluid charge.

Finally, the capability of the manufacturer to supply quality product in a timely fashion must be considered. Dow's large manufacturing capacity and strategically placed warehouses make DOWTHERM A fluid available when and where you need it.

For Information About Our Full Line of Fluids…

To learn more about the full line of Dow Heat Transfer Fluids—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.

*Trademark of The Dow Chemical Company

†Trademark of Dow Corning Corporation

Fluid Selection Criteria

Four important properties that help determine the viability of a heat transfer fluid in a particular application are stability, vapor pressure, freeze point, and viscosity. These are discussed below.

1. Stability

DOWTHERM A fluid possesses unsurpassed thermal stability at temperatures of 750°F (400°C). The maximum recommended film temperature is 800°F (425°C).

2. Vapor Pressure

DOWTHERM A fluid may be used in vapor phase heat transfer applications from 495°F (257°C) to 750°F (400°C). It may be used in the liquid phase from 60°F (15°C) to 750°F (400°C). Its vapor pressure is 3.96 psia at 400°F (0.24 bar at 200°C) and 152.5 psia (10.6 bar) at the maximum recommended use temperature.

3. Freeze Point

DOWTHERM A fluid has a freezing point of 53.6°F (12°C) and can be used without steam tracing in installations protected from the weather.

4. Viscosity

The viscosity of DOWTHERM A fluid is low and changes only slightly between the melting point of the product and its top operating temperature. As a result, start-up problems are minimized.

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: operating and designing 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 misoperation 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 reduce the flame height and pattern. This can yield higher flame and gas temperatures together with higher heat flux in the shorter flame area.

4. Low velocity/high heat flux areas resulting in excessive heat transfer fluid film temperatures.

The manufacturer of the fired heater should be the primary contact in supplying you with 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 are dependent upon the chemical structure of the heat transfer fluid as well as the temperature and the degree of mixing. Undesirable byproducts of this reaction may include carboxylic acids which would likely result in system operating problems. Preventive 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.

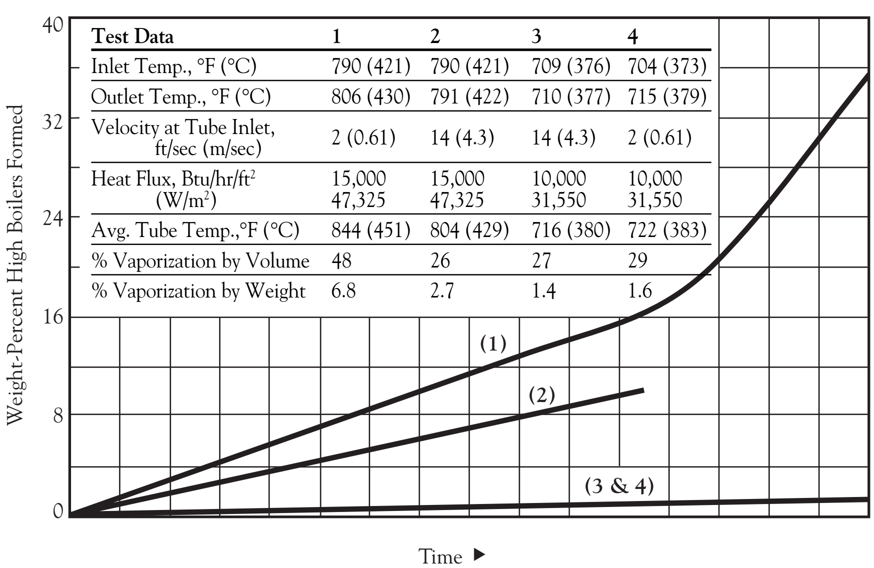
The rate of decomposition of DOWTHERM A fluid is also highly dependent upon conditions in the vaporizer or fired heater. The data in Figure 1 show the impact of high heat flux and low fluid velocity on the formation of degradation products in a diphenyl oxide/biphenyl eutectic mixture. Curve 1 shows the results obtained at an accelerated temperature, a high heat flux, and a low tube velocity. These conditions tend to cause high film temperatures. Curve 2 was obtained utilizing the same operating temperature and heat flux but a high tube velocity. The latter condition reduced the excessive film temperatures. Curves 3 and 4 illustrate the long fluid life that can be expected when units are operated under moderate conditions with the proper relationship between heat flux and tube temperature.

Units can be designed to operate at higher temperatures than those presently recommended in cases where the greater replacement costs of DOWTHERM A fluid—resulting from its increased decomposition rate—can be economically justified. In such units, adequate provision must be made for good circulation, lower heat fluxes, and frequent or continuous purification.

When units are operated at high temperatures, liquid velocities in heaters should be a minimum of 6 feet per second (2m per sec.); a range of 6–10 feet per second (2–3m per sec.) should cover most cases. The actual velocity selected will depend on an economic balance between the cost of circulation and heat transfer surface as well as the replacement cost for new fluid. Operating limitations are usually placed on heat flux by the equipment manufacturer. This heat flux is determined for a maximum film temperature by the operating conditions of the particular unit. Removal of decomposed heat transfer medium can be accomplished by continuous or semi-continuous reclamation of medium. This is accomplished by passing a small side stream from the heater or vaporizer through a flash still.

Flash distillation serves to reduce high-boiling fractions to a minimum and to keep fluid quality and subsequent film coefficients at a maximum.

Figure 1—Impact of Heat Flux and Fluid Velocity on the Thermal Stability of a Diphenyl Oxide/Biphenyl Eutectic Mixture



Test Data	1	2	3	4
Inlet Temp., °F (°C)	790 (421)	790 (421)	709 (376)	704 (373)
Outlet Temp., °F (°C)	806 (430)	791 (422)	710 (377)	715 (379)
Velocity at Tube Inlet, ft/sec (m/sec)	2 (0.61)	14 (4.3)	14 (4.3)	2 (0.61)
Heat Flux, Btu/hr/ft^2 (W/m^2)	15,000 47,325	15,000 47,325	10,000 31,550	10,000 31,550
Avg. Tube Temp.,°F (°C)	844 (451)	804 (429)	716 (380)	722 (383)
% Vaporization by Volume	48	26	27	29
% Vaporization by Weight	6.8	2.7	1.4	1.6

Radiation Stability

DOWTHERM A fluid is stable up to dosages of 10^{10} rads. At higher dosages, a polymerization similar to thermal degradation begins to occur.

Corrosivity

DOWTHERM A heat transfer fluid, in both the liquid and vapor form, is noncorrosive toward common metals and alloys. Even at the high temperatures involved, equipment usually exhibits excellent service life. Original equipment in many systems is still being used after 30 years of continuous service.

Steel is used predominantly, although low alloy steels, stainless steels, Monel alloy, etc. are also used in miscellaneous pieces of equipment and instruments.

Most corrosion problems are caused by chemicals introduced into the system during *cleaning* or from *process leaks*. The severity and nature of the attack will depend upon the amounts and type of contamination 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*

Flammability

DOWTHERM A heat transfer fluid is a combustible material but has a relatively high flash point of 236°F (113°C) (SETA), a fire point of 245°F (118°C) (C.O.C.), and an autoignition temperature of 1110°F (599°C) (ASTM, E659-78). The lower flammable limit is 0.6% (volume) at 175°C, while the upper limit is 6.8% at 190°C.

A leak from a vapor system into the combustion chamber of a furnace will result only in burning of the vapors; the percentage of carbon dioxide usually present will not permit the formation of an explosive mixture. A leak from a liquid system into a furnace compartment results in the burning of the liquid and the production of a large amount of black smoke due to incomplete combustion.

Vapor leaks to the atmosphere are also sometimes encountered. Such leaks, however small, should not be tolerated because of the cost of replacing lost medium. Experience has shown that leaking vapors have usually cooled well below the fire point and fire has rarely resulted. Due to the strong odor of the medium, such leaks rarely go undetected without corrective action.

Leaks from pipelines into insulation are likewise potentially hazardous as they can lead to fires in the insulation. It has been found, for example, that leakage of organic materials into some types of insulation at elevated temperatures may result in spontaneous ignition.

Vapors of DOWTHERM A fluid do not pose a serious flammability hazard at room temperature, because the saturation concentration is so far below the lower flammability limit.

If used and maintained properly, installations employing DOWTHERM A fluid should present no unusual flammability hazards.

Under extremely unusual circumstances, flammable mists are possible. In order for flammable mists to form, several variables must be within certain, very narrow ranges:

1. Time of exposure to an ignition source.
2. Temperature of the ignition source and atmosphere.
3. Volume of fuel and air mixture.
4. Fuel to air ratio.
5. Mist particle size.

Liquid and Vapor Phase Technology

In choosing between liquid phase and vapor phase heating with DOWTHERM A heat transfer fluid, it is necessary to consider the overall process, the heat tolerance of the product, the equipment, and the overall economics. In many cases, the overall costs for the two types of systems will not differ significantly, and the choice must be based on other considerations.

With vapor phase systems, heat is transferred at the saturation temperature of the vapor. As a result, such units can provide uniform, precisely controlled temperatures. The heating of synthetic fiber spinnerettes represents just one of the many applications that take advantage of these vapor properties.

In liquid phase systems, the temperature of the heating medium decreases as it gives up its sensible heat. Thus, the temperature of the medium at the inlet will be higher than its temperature at the outlet. This nonuniformity of temperature can be harmful to heat-sensitive products, even when it is reduced by increasing the circulation rate of the medium. However, for heat-insensitive products, such changes in temperature are of little consequence.

In systems with multiple heat users, a combination of both vapor and liquid phase may be superior to either by itself. Economics is the deciding factor when considering line sizing, distances, pressure drop, type of equipment, method of temperature control, and temperature requirements.

Forced circulation units may be used with both liquid phase and vapor phase systems. Such units require a pump; hence, both initial and operating costs may, in some cases, be higher than equivalent costs for gravity systems with natural circulation vaporizers. However, costs should be investigated for each system since this may not always hold true. In a liquid phase system, the pump for the forced circulation heater must be sized large enough for the entire system. If a forced circulation vaporizer is used, a pump may or may not be required to return the condensate, depending on the liquid head available.

Many systems use DOWTHERM A fluid for cooling, either by circulating it or by allowing it to boil and extracting the latent heat at a constant temperature. In addition, many use DOWTHERM A fluid for heating and cooling the same piece of equipment. Where unusually accurate and uniform cooling is required, baffles may be placed in the jacket to direct the liquid flow, or cooling may be accurately controlled by boiling DOWTHERM A at the controlled pressure.

Advantages of Liquid Phase Heating with DOWTHERM A Fluid

1. Unlike vapor phase systems, those employing liquid DOWTHERM A fluid require no condensate return equipment. This factor becomes more important when there are multiple users operating at widely differing temperatures.

2. Where alternate heating and cooling are necessary, liquid phase heating allows the use of simpler, more easily operated systems.

3. There is no temperature gradient due to pressure drop in the supply piping.

4. Liquid systems give a positive flow through the user with a minimum of venting.

5. Liquid phase heating eliminates the problem of condensate removal in such units as platen presses and horizontal sinuous coils.

Figure 4 shows a liquid phase heating system employing DOWTHERM A fluid.

Advantages of Vapor Phase Heating with DOWTHERM A Fluid

1. Vapor phase systems provide much more heat per unit mass of heat medium passed through the user (Figures 2 and 3).

2. Vapor systems, with their condensing vapor, provide a more uniform heat source and precision temperature control of the user. An equivalent liquid system would have to be operated at extreme flow rates in order to maintain the same close temperature uniformity. This is illustrated in Figures 2 and 3.

3. Vapor phase heating has an advantage where it is difficult to control liquid flow pattern and velocity; e.g., in kettle jackets.

4. No pumps are needed when a gravity return condensate system is used with a natural circulation vaporizer.

5. A vapor system requires less working inventory of DOWTHERM A fluid since the line to the user, and the user, are filled with vapor rather than liquid.

6. With heat-sensitive products, where the maximum temperature of the heat transfer medium must be limited, heating may be accomplished more economically with condensing vapor than with liquid at high mass flow rates.

Figure 5 shows a vapor phase heating system employing DOWTHERM A fluid.

Figure 2—Comparison of Liquid vs. Vapor Mass Flow Rates for DOWTHERM A Fluid at Various Liquid Δt's

Basis: 600°F with 5°F Subcooling for Condensate of DOWTHERM A Fluid

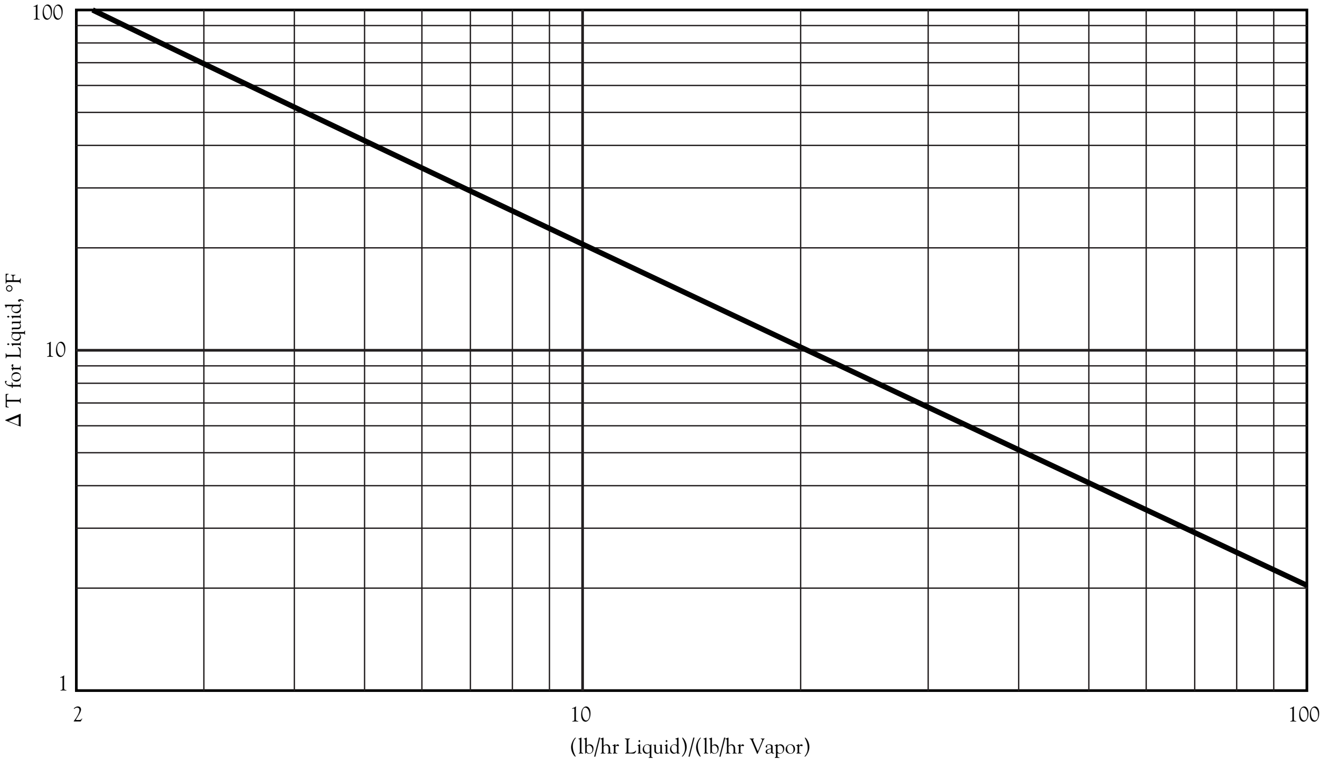


Figure 3—Comparison of Liquid vs. Vapor Mass Flow Rates for DOWTHERM A Fluid at Various Liquid Δt's

Basis: 315°C with 3°C Subcooling for Condensate of DOWTHERM A Fluid

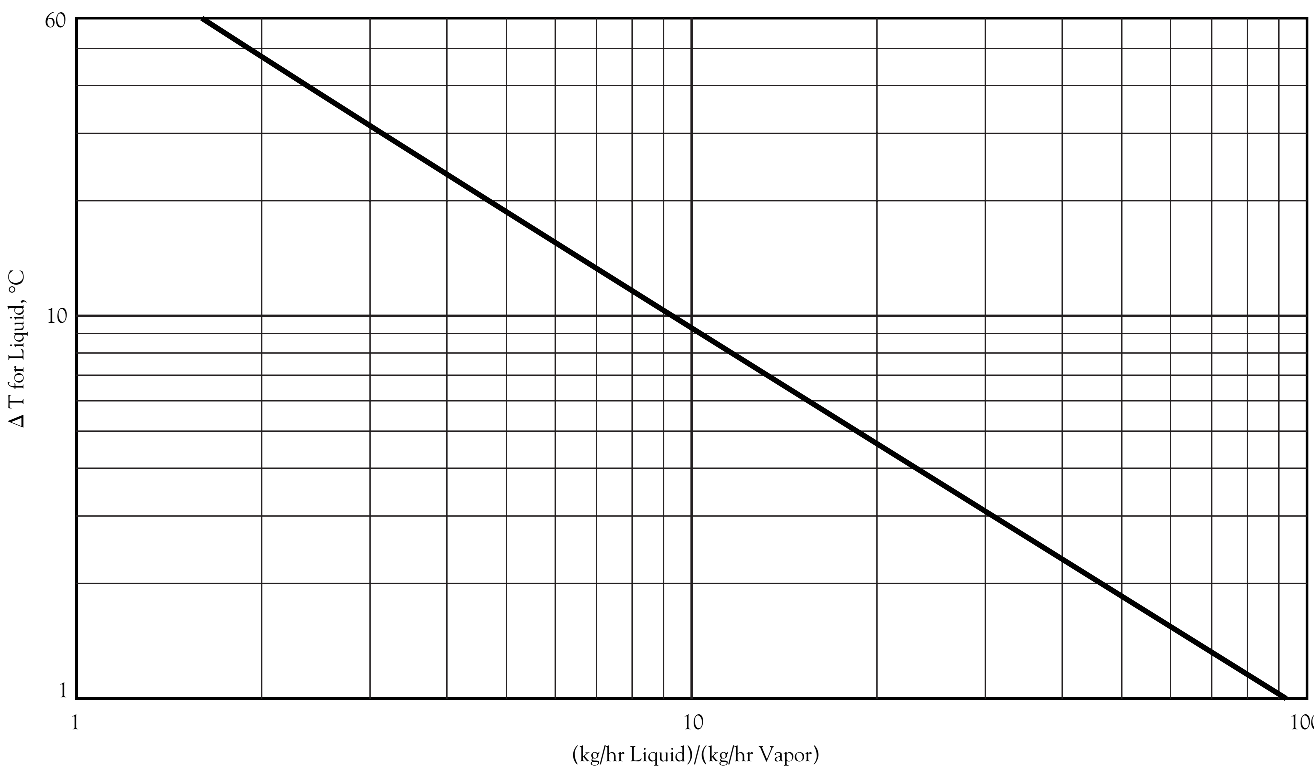


Figure 4 — Liquid Phase Heating with DOWTHERM A Fluid

Instrument Legend

BA – Burner Alarm
BC – Burner Control
BE – Burner Element (Fire-Eye)
FI – Flow Indicator (Orifice)
FRC – Flow Recording Controller
FSL – Flow Switch Low
$LA^{H}/_{L}$ – Level Alarm–High/Low
LI – Level Indicator
LC – Level Controller
LSL – Level Switch Low
PCV – Pressure Control Valve
PI – Pressure Indicator
PIC – Pressure Indicating Controller
PRV – Pressure Relief Valve
PSH – Pressure Switch High
PSL – Pressure Switch Low
TIC – Temperature Indicating Controller
TRC – Temperature Recorder Controller
TSH – Temperature Switch High

——— Principal Circuits with DOWTHERM Fluid
– – – Electrical Lines
–//–//– Instrument Air Lines

(A) – External heating required if fluid pumpability is limiting in cold weather.

(B) – Thermal tracing system on vent and safety valve lines if ambient temperature = <80°F (27°C).

(C) – Heat exchanger #2 is cooled with DOWTHERM A fluid to avoid any possibility of contaminating the process fluid with water in the event of a tube leak.

(D) – Process fluid freezes at 350°F (177°C).

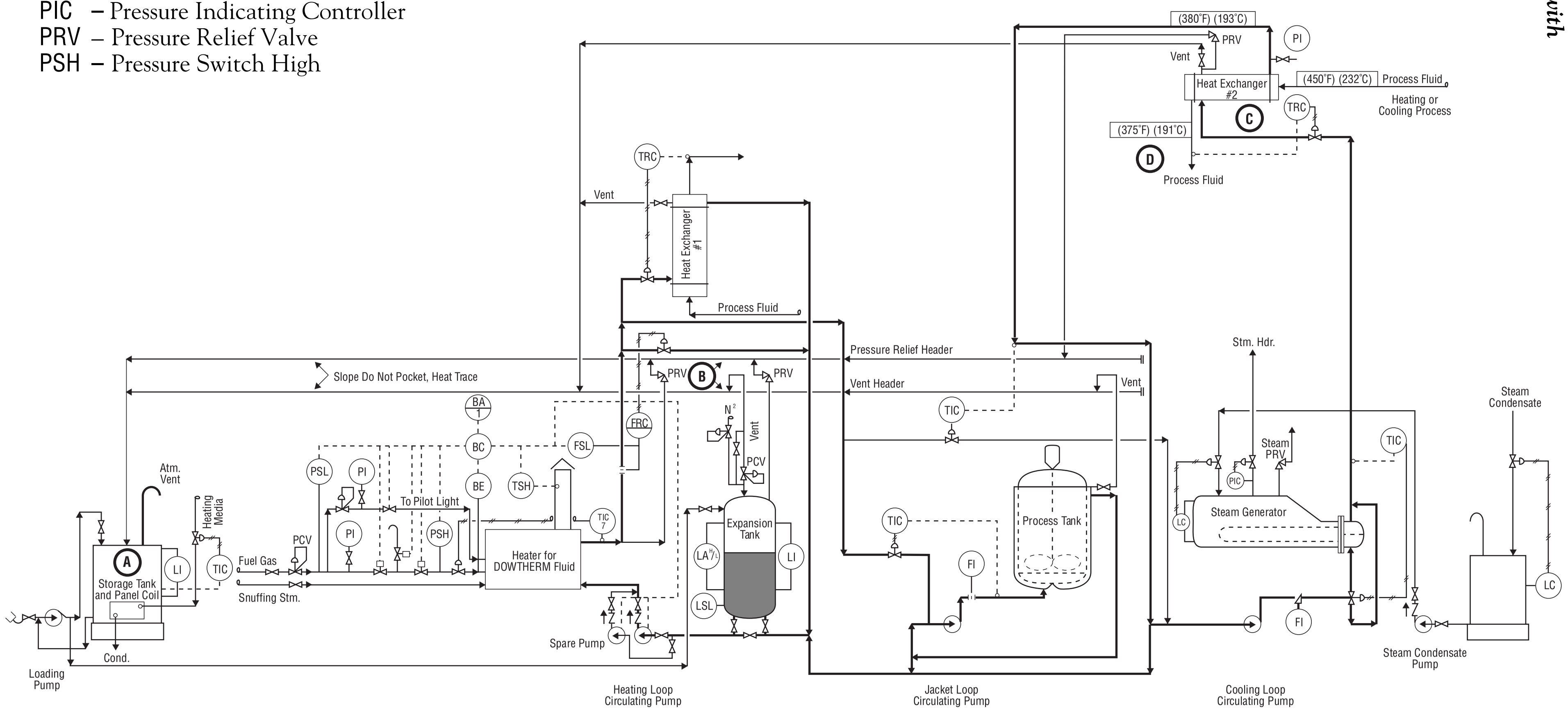


Figure 5 — Vapor Phase Heating with DOWTHERM A Fluid

Instrument Legend

BA – Burner Alarm
BC – Burner Control
BE – Burner Element (Fire-Eye)
FI – Flow Indicator (Orifice)
FRC – Flow Recording Controller
FSL – Flow Switch Low
LA H/L – Level Alarm–High/Low
LI – Level Indicator
LC – Level Controller
LSL – Level Switch Low
PCV – Pressure Control Valve
PI – Pressure Indicator
PIC – Pressure Indicating Controller
PRV – Pressure Relief Valve
PSH – Pressure Switch High
PSL – Pressure Switch Low
TIC – Temperature Indicating Controller
TRC – Temperature Recorder Controller
TSH – Temperature Switch High

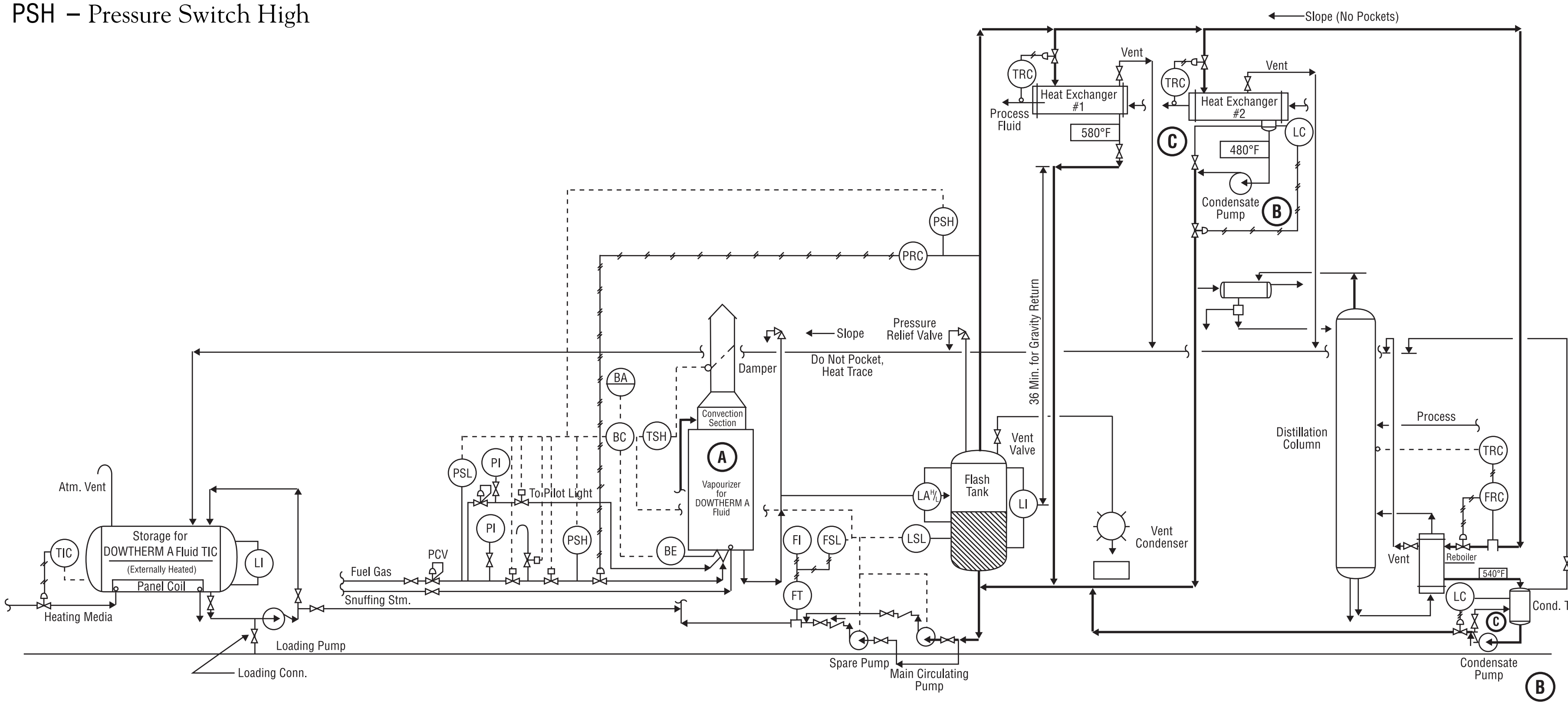
——— Principal Circuits with DOWTHERM Fluid
– – – Electrical Lines
–//–//– Instrument Air Lines

Thermal Tracing System required if ambient temperature = <60°F (15°C).

(A) – Vaporizers for DOWTHERM A fluid utilize both natural and forced circulation.

(B) – A pump is required where there is insufficient elevation between vaporizer and heat user to return condensate by gravity.

(C) – Hand-throttled bypass required to prevent pump heat-up.



Health and Environmental Considerations

A Material Safety Data Sheet (MSDS) for DOWTHERM A heat transfer fluid is available by calling the number listed on the back of this brochure. The MSDS contains complete health and safety information regarding the use of this product. Read and understand the MSDS before handling or otherwise using this product.

Health Considerations

Inhalation. Animal studies indicate that DOWTHERM A fluid has a low order of inhalation toxicity. Limited studies in rats, rabbits, and guinea pigs did not show significant effects from exposures of 7–10 ppm, 7 hours a day, 5 days a week for 6 months. These were the highest vapor concentrations that could be maintained without condensation and fogging.

DOWTHERM A fluid has a striking odor that becomes quite disagreeable, even irritating to the eyes and nose, at concentrations far below 7 ppm. This odor serves as a warning to prevent excessive exposure to vapors and fumes. The OSHA standard for this mixture is 1 ppm. The ACGIH TLV is 1 ppm TWA, 2 ppm STEL for the diphenyl oxide component and 0.2 ppm TWA for the biphenyl component.

Whenever accidental or unusual conditions result in higher concentrations of vapors or fumes, workers should wear respiratory protection suitable for organic mists and vapors. Where there is a possibility of oxygen deficiency, workers should use an air-supplied mask or positive pressure, self-contained breathing apparatus. In regular operations, concentrations of vapors in the atmosphere should be kept at levels that are not disagreeable. If ill effects occur from accidental exposure to heavy concentrations in the air, remove the victim to fresh air and get immediate medical attention.

Ingestion. Oral administration of DOWTHERM A heat transfer fluid to laboratory rats has revealed a low order of systemic toxicity. The single-dose oral LD50 in female rats is 2487 mg/kg. Limited studies show no significant toxicity in rats that received daily oral doses, 5 days a week for 1 to 6 months, of 100 mg/kg DOWTHERM A fluid. Liver and kidney effects were observed at higher doses.

Ingestion of small amounts of DOWTHERM A heat transfer fluid incidental to handling should not cause injury. It should, however, be recognized that ill effects will result if substantial amounts are swallowed. Induce vomiting if large amounts of DOWTHERM A fluid are ingested. Consult with medical personnel immediately.

Eye Contact. Contact with DOWTHERM A in both the liquid and vapor form may be painful, but otherwise is only slightly irritating to the eyes and will not cause corneal injury. Whenever there is the potential for gross eye contamination, face shields or chemical workers' goggles should be worn to avoid discomfort that might result from direct contact. Safety glasses are recommended for everyday use. If the eyes are accidentally contaminated with fluid, they should be thoroughly washed with flowing water for 5 minutes and medical attention obtained if there is any evidence of irritation.

If the fluid is contaminated with material being processed or with other materials, additional treatment may be required.

Skin Contact. Single exposures to DOWTHERM A in liquid form are not irritating to the skin. However, prolonged or repeated skin contact may cause irritation and should therefore be avoided. Fluid that has been used at high temperatures for extended periods of time can cause skin irritation or dermatitis.

The product is not likely to be absorbed in toxic amounts.

Contaminated skin should be immediately and thoroughly washed with soap and water. Contaminated clothing and shoes should be removed at once and the clothing decontaminated before reuse.

Environmental Considerations

Stability. DOWTHERM A fluid has a 5-day BOD of 1.70 parts/part, 62% of its theoretical oxygen demand. Its COD is 2.53 parts/part. This indicates that it is biodegradable and non-persistent in the environment. There is no evidence that harmful products are formed as a result of biodegradation. Once its bacteria are acclimated, a waste treatment system should achieve a high degree of removal of fluid before the waste-water effluent reaches the receiving body of water.

Movement. The water solubility of this material is very low—only 14 ppm at ambient temperatures—and if amounts exceeding this limit are mixed with water, the medium will settle to the bottom. Of course, turbulence and the presence of other materials may affect the physical condition of the solution. It is also possible that an emulsion may form under certain conditions.

Data indicate that a large percentage of the medium present in water will be stripped out during aeration in the primary stage of a waste treatment facility.

Bioconcentration. Dow studies have shown that both components of DOWTHERM A fluid—biphenyl and diphenyl oxide—bioconcentrate in trout, but that when these trout are exposed to fresh water, the compounds disappear from their tissues in a relatively short time.

Should this material be discharged into a body of water, it may bioconcentrate in fish, but at a significantly lower level than compounds such as polychlorinated biphenyl. Furthermore, because of the speed with which the material is cleared from the tissues and biodegrades, it is unlikely to pose a serious problem.

Customer Service for Users of DOWTHERM A Heat Transfer Fluid

Fluid Analysis

The Dow Chemical Company offers an analytical service for DOWTHERM A 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
SYLTHERM† and DOWTHERM
Testing Laboratory
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.

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. A detailed method for analyzing the fluid to determine its quality is available upon request.

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.

Fluid Return Program for DOWTHERM Fluids

In the unlikely event that you need to change out DOWTHERM A fluid, Dow offers a fluid return program. If analysis of a particular fluid sample reveals significant thermal degradation of the medium, the customer will be advised to return the fluid in his system to Dow. If the fluid is contaminated with organic materials of low thermal stability, it may not be acceptable for Dow processing and will not qualify for the return program. In this case, Dow will advise the customer that the fluid cannot be processed and therefore should not be returned to Dow. No material should be sent to Dow until the fluid analysis has been completed and the customer informed of the results.

If the analysis shows fluid change-out is necessary, the customer should order sufficient new material to recharge the system before sending the old fluid to Dow. Under the fluid return program, Dow will credit the customer for all usable material recovered.

The Dow fluid return program permits customers to minimize their heat transfer fluid investment, handling downtime and inventory, while assuring that replacement fluid is of the highest quality.

Before returning material for credit, contact Dow at the number for your area listed on the back of this bulletin for details.

For further information, please contact your nearest Dow representative or call the number for your area listed on the back of this brochure. Ask for DOWTHERM A Fluid.

†Trademark of Dow Corning Corporation

Table 1—Physical Properties of DOWTHERM A Fluid

(Laboratory values not to be confused with, or substitutes for, specifications). None of below are specifications.

Property	English Units	SI Units
Atmospheric Boiling Point	494.8°F	257.1°C
Freezing Point	53.6°F	12.0°C
Flash Point, SETA	236°F	113°C
Fire Point, C.O.C.†	245°F	118°C
Auto Ignition Temp.††	1110°F	599°C
Density at 75°F	66.0 lb/ft^3	1056 kg/m^3 @ 25°C
	8.80 lb/gal. @ 25°C	
Volume Contraction upon Freezing	6.63%	
Volume Expansion upon Melting	7.10%	
Heat of Fusion	42.2 Btu/lb	98.2 kJ/kg
Specific Resistivity	1.2 x 10^{12} ohm cm @ 32°F	1.2 x 10^{12} ohm cm @ 0°C
	6.4 x 10^{11} ohm cm @ 68°F	6.4 x 10^{11} ohm cm @ 20°C
	3.9 x 10^{11} ohm cm @ 104°F	3.9 x 10^{11} ohm cm @ 40°C
Dielectric Constant at 75°F (24°C)		
frequency 10^3	3.26	3.26
frequency 10^4	3.27	3.27
frequency 10^5	3.27	3.27
Dissipation Factor at 75°F (24°C)		
frequency 10^3	0.0012	0.0012
frequency 10^4	0.0001	0.0001
frequency 10^5	0.0001	0.0001
Dielectric Strength at 75°F (24°C)	530 volts/mil	20,866 volts/nm
Surface Tension in Air	40.1 Dynes/cm @ 68°F	40.1 Dynes/cm @ 20°C
	37.6 Dynes/cm @ 104°F	37.6 Dynes/cm @ 40°C
	35.7 Dynes/cm @ 140°F	35.7 Dynes/cm @ 60°C
Critical Temperature	927°F	497°C
Critical Pressure	30.93 atm	31.34 bar
Critical Volume	0.0508 ft^3/lb	3.17 l/kg
Heat of Combustion	15,500 Btu/lb	36,053 kJ/kg
Molecular Weight (Avg.)	166.0	

†Cleveland Open Cup

††ASTM E659-78

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

TEMP °F	VAPOR PRESS. psia	VISCOSITY cP	SPECIFIC HEAT Btu/lb °F	THERMAL COND. Btu/hr ft²(°F/ft)	DENSITY lb/ft³	TEMP °F	VAPOR PRESS. psia	VISCOSITY cP	SPECIFIC HEAT Btu/lb °F	THERMAL COND. Btu/hr ft²(°F/ft)	DENSITY lb/ft³
53.6	0.000	5.52	0.370	0.0809	66.54	440	7.19	0.33	0.515	0.0610	55.06
60	0.000	4.91	0.373	0.0805	66.37	450	8.25	0.32	0.518	0.0605	54.72
70	0.000	4.15	0.377	0.0800	66.10	460	9.45	0.30	0.522	0.0600	54.38
80	0.001	3.55	0.380	0.0795	65.82	470	10.78	0.29	0.526	0.0595	54.04
90	0.001	3.07	0.384	0.0790	65.55	480	12.25	0.28	0.529	0.0590	53.70
100	0.001	2.69	0.388	0.0785	65.28	490	13.87	0.27	0.533	0.0585	53.35
110	0.002	2.38	0.392	0.0780	65.00	494.8	14.71	0.27	0.535	0.0582	53.18
120	0.003	2.12	0.396	0.0775	64.72	500	15.66	0.27	0.537	0.0579	53.00
130	0.005	1.90	0.399	0.0769	64.44	510	17.63	0.26	0.540	0.0574	52.65
140	0.007	1.72	0.403	0.0764	64.16	520	19.79	0.25	0.544	0.0569	52.29
150	0.010	1.57	0.407	0.0759	63.88	530	22.15	0.24	0.548	0.0564	51.93
160	0.014	1.43	0.411	0.0754	63.60	540	24.72	0.23	0.552	0.0559	51.57
170	0.020	1.32	0.414	0.0749	63.32	550	27.51	0.23	0.555	0.0554	51.20
180	0.028	1.22	0.418	0.0744	63.03	560	30.54	0.22	0.559	0.0549	50.82
190	0.038	1.13	0.422	0.0739	62.75	570	33.83	0.21	0.563	0.0543	50.45
200	0.051	1.05	0.426	0.0733	62.46	580	37.37	0.21	0.567	0.0538	50.07
210	0.069	0.98	0.429	0.0728	62.17	590	41.20	0.20	0.571	0.0533	49.68
220	0.091	0.92	0.433	0.0723	61.88	600	45.31	0.19	0.575	0.0528	49.29
230	0.120	0.86	0.437	0.0718	61.59	610	49.73	0.19	0.579	0.0523	48.89
240	0.16	0.81	0.441	0.0713	61.30	620	54.47	0.18	0.583	0.0518	48.49
250	0.20	0.76	0.444	0.0708	61.00	630	59.53	0.18	0.587	0.0513	48.08
260	0.26	0.72	0.448	0.0703	60.71	640	64.95	0.17	0.591	0.0508	47.67
270	0.33	0.68	0.452	0.0698	60.41	650	70.73	0.17	0.595	0.0502	47.25
280	0.41	0.65	0.456	0.0692	60.11	660	76.89	0.16	0.599	0.0497	46.82
290	0.51	0.62	0.459	0.0687	59.81	670	83.44	0.16	0.604	0.0492	46.39
300	0.64	0.59	0.463	0.0682	59.51	680	90.40	0.15	0.608	0.0487	45.94
310	0.78	0.56	0.467	0.0677	59.20	690	97.79	0.15	0.613	0.0482	45.49
320	0.96	0.53	0.470	0.0672	58.90	700	105.6	0.14	0.617	0.0477	45.03
330	1.17	0.51	0.474	0.0667	58.59	710	113.9	0.14	0.622	0.0472	44.56
340	1.41	0.49	0.478	0.0662	58.28	720	122.7	0.14	0.627	0.0466	44.08
350	1.70	0.47	0.481	0.0656	57.97	730	131.9	0.13	0.633	0.0461	43.59
360	2.03	0.45	0.485	0.0651	57.65	740	141.7	0.13	0.638	0.0456	43.09
370	2.42	0.43	0.489	0.0646	57.34	750	152.0	0.13	0.644	0.0451	42.57
380	2.87	0.41	0.492	0.0641	57.02	760	162.9	0.12	0.651	0.0446	42.04
390	3.38	0.40	0.496	0.0636	56.70	770	174.4	0.12	0.658	0.0441	41.49
400	3.96	0.38	0.500	0.0631	56.37	780	186.4	0.12	0.665	0.0436	40.93
410	4.63	0.37	0.503	0.0626	56.05	790	199.1	0.11	0.673	0.0430	40.34
420	5.38	0.35	0.507	0.0620	55.72	800	212.5	0.11	0.682	0.0425	39.74
430	6.23	0.34	0.511	0.0615	55.39						

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

TEMP °C	VAPOR PRESS. bar	VISCOSITY mPa sec	SPECIFIC HEAT kJ/kg K	THERMAL COND. W/mK	DENSITY kg/m³	TEMP °C	VAPOR PRESS. bar	VISCOSITY mPa sec	SPECIFIC HEAT kJ/kg K	THERMAL COND. W/mK	DENSITY kg/m³
12	0.00	5.52	1.550	0.1400	1065.9	225	0.48	0.33	2.148	0.1059	883.5
15	0.00	5.00	1.558	0.1395	1063.5	230	0.54	0.32	2.162	0.1051	878.7
20	0.00	4.29	1.573	0.1387	1059.6	235	0.61	0.31	2.176	0.1043	873.8
25	0.00	3.71	1.587	0.1379	1055.7	240	0.69	0.30	2.190	0.1035	868.9
30	0.00	3.25	1.601	0.1371	1051.7	245	0.77	0.29	2.204	0.1027	864.0
35	0.00	2.87	1.616	0.1363	1047.8	250	0.87	0.28	2.218	0.1019	859.0
40	0.00	2.56	1.630	0.1355	1043.8	255	0.97	0.27	2.231	0.1011	854.0
45	0.00	2.30	1.644	0.1347	1039.8	257.1	1.01	0.27	2.237	0.1008	851.9
50	0.00	2.07	1.658	0.1339	1035.8	260	1.08	0.27	2.245	0.1003	849.0
55	0.00	1.88	1.673	0.1331	1031.8	265	1.20	0.26	2.259	0.0995	843.9
60	0.00	1.72	1.687	0.1323	1027.8	270	1.33	0.25	2.273	0.0987	838.7
65	0.00	1.58	1.701	0.1315	1023.7	275	1.48	0.24	2.288	0.0979	833.6
70	0.00	1.46	1.715	0.1307	1019.7	280	1.63	0.24	2.302	0.0971	828.3
75	0.00	1.35	1.729	0.1299	1015.6	285	1.80	0.23	2.316	0.0963	823.0
80	0.00	1.25	1.744	0.1291	1011.5	290	1.98	0.22	2.330	0.0955	817.7
85	0.00	1.17	1.758	0.1283	1007.4	295	2.17	0.22	2.344	0.0947	812.3
90	0.00	1.09	1.772	0.1275	1003.2	300	2.38	0.21	2.359	0.0939	806.8
95	0.00	1.03	1.786	0.1267	999.1	305	2.60	0.20	2.373	0.0931	801.3
100	0.01	0.97	1.800	0.1259	994.9	310	2.84	0.20	2.388	0.0923	795.8
105	0.01	0.91	1.814	0.1251	990.7	315	3.10	0.19	2.403	0.0915	790.1
110	0.01	0.86	1.828	0.1243	986.5	320	3.37	0.19	2.417	0.0907	784.4
115	0.01	0.82	1.842	0.1235	982.3	325	3.66	0.18	2.432	0.0899	778.6
120	0.01	0.77	1.856	0.1227	978.1	330	3.96	0.18	2.448	0.0891	772.8
125	0.02	0.73	1.870	0.1219	973.8	335	4.29	0.17	2.463	0.0883	766.9
130	0.02	0.70	1.884	0.1211	969.5	340	4.64	0.17	2.479	0.0875	760.9
135	0.03	0.67	1.898	0.1203	965.2	345	5.00	0.17	2.494	0.0867	754.8
140	0.03	0.64	1.912	0.1195	960.9	350	5.39	0.16	2.511	0.0859	748.6
145	0.04	0.61	1.926	0.1187	956.6	355	5.80	0.16	2.527	0.0851	742.3
150	0.05	0.58	1.940	0.1179	952.2	360	6.24	0.15	2.544	0.0843	735.9
155	0.06	0.56	1.954	0.1171	947.8	365	6.69	0.15	2.561	0.0835	729.4
160	0.07	0.53	1.968	0.1163	943.4	370	7.18	0.15	2.579	0.0827	722.8
165	0.08	0.51	1.982	0.1155	938.9	375	7.68	0.14	2.597	0.0819	716.1
170	0.09	0.49	1.996	0.1147	934.5	380	8.22	0.14	2.616	0.0811	709.2
175	0.11	0.47	2.010	0.1139	930.0	385	8.78	0.14	2.636	0.0803	702.2
180	0.13	0.46	2.023	0.1131	925.5	390	9.37	0.13	2.657	0.0795	695.0
185	0.15	0.44	2.037	0.1123	920.9	395	9.99	0.13	2.678	0.0787	687.7
190	0.18	0.42	2.051	0.1115	916.4	400	10.64	0.13	2.701	0.0779	680.2
195	0.21	0.41	2.065	0.1107	911.8	405	11.32	0.12	2.725	0.0771	672.5
200	0.24	0.39	2.079	0.1099	907.1	410	12.03	0.12	2.751	0.0763	664.6
205	0.28	0.38	2.093	0.1091	902.5	415	12.78	0.12	2.779	0.0755	656.5
210	0.32	0.37	2.107	0.1083	897.8	420	13.56	0.11	2.809	0.0747	648.1
215	0.37	0.35	2.120	0.1075	893.1	425	14.38	0.11	2.842	0.0739	639.4
220	0.42	0.34	2.134	0.1067	888.3						

Table 4—Saturated Vapor Properties of DOWTHERM A Fluid (English Units)

TEMP °F	VAPOR PRESSURE psia	LIQUID ENTHALPY Btu/lb	LATENT HEAT Btu/lb	VAPOR ENTHALPY Btu/lb	VAPOR DENSITY lb/ft³	VAPOR VISCOSITY cP	VAPOR THERMAL COND. Btu/hr ft²(°F/ft)	Z_{VAPOR}	SPECIFIC HEAT (c_p) Btu/lb °F	RATIO OF SPECIFIC HEATS c_p/c_v
53.6	0.000	0.0	176.0	176.0		0.0053	0.0043	1.000	0.247	1.051
60	0.000	2.5	175.1	177.6		0.0054	0.0044	1.000	0.250	1.050
70	0.000	6.4	173.7	180.1		0.0055	0.0046	1.000	0.255	1.049
80	0.001	10.3	172.3	182.7		0.0056	0.0047	1.000	0.260	1.048
90	0.001	14.3	171.0	185.3		0.0057	0.0049	1.000	0.265	1.047
100	0.001	18.2	169.8	188.0		0.0058	0.0051	1.000	0.270	1.047
110	0.002	22.2	168.5	190.7		0.0059	0.0053	1.000	0.275	1.046
120	0.003	26.2	167.3	193.5		0.0060	0.0055	1.000	0.279	1.045
130	0.005	30.2	166.1	196.3	0.0001	0.0061	0.0056	1.000	0.284	1.044
140	0.007	34.3	164.9	199.2	0.0002	0.0062	0.0058	1.000	0.289	1.043
150	0.010	38.3	163.8	202.1	0.0003	0.0064	0.0060	1.000	0.294	1.043
160	0.014	42.4	162.6	205.1	0.0004	0.0065	0.0062	1.000	0.298	1.042
170	0.020	46.5	161.5	208.1	0.0005	0.0066	0.0064	1.000	0.303	1.041
180	0.028	50.7	160.4	211.1	0.0007	0.0067	0.0066	1.000	0.308	1.041
190	0.038	54.9	159.3	214.2	0.0009	0.0068	0.0068	1.000	0.312	1.040
200	0.051	59.1	158.3	217.3	0.0012	0.0069	0.0070	0.999	0.317	1.039
210	0.069	63.3	157.2	220.5	0.0016	0.0070	0.0072	0.999	0.321	1.039
220	0.091	67.6	156.2	223.8	0.0021	0.0071	0.0075	0.999	0.326	1.038
230	0.120	71.9	155.1	227.0	0.0027	0.0072	0.0077	0.999	0.330	1.038
240	0.16	76.2	154.1	230.3	0.0034	0.0073	0.0079	0.999	0.335	1.037
250	0.20	80.6	153.1	233.7	0.0044	0.0074	0.0081	0.998	0.339	1.037
260	0.26	85.0	152.0	237.1	0.0055	0.0075	0.0083	0.998	0.344	1.037
270	0.33	89.5	151.0	240.5	0.0069	0.0076	0.0085	0.997	0.348	1.036
280	0.41	94.0	150.0	244.0	0.0086	0.0077	0.0087	0.997	0.352	1.036
290	0.51	98.5	149.0	247.5	0.0106	0.0078	0.0090	0.996	0.356	1.036
300	0.64	103.0	148.0	251.1	0.0130	0.0079	0.0092	0.996	0.361	1.035
310	0.78	107.6	147.0	254.6	0.0158	0.0080	0.0094	0.995	0.365	1.035
320	0.96	112.2	146.0	258.3	0.0191	0.0081	0.0097	0.994	0.369	1.035
330	1.17	116.9	145.0	261.9	0.0230	0.0082	0.0099	0.993	0.373	1.035
340	1.41	121.6	144.0	265.6	0.0275	0.0083	0.0101	0.992	0.377	1.034
350	1.70	126.4	143.0	269.3	0.0328	0.0084	0.0103	0.990	0.381	1.034
360	2.03	131.1	142.0	273.1	0.0388	0.0086	0.0106	0.989	0.385	1.034
370	2.42	135.9	141.0	276.9	0.0457	0.0087	0.0108	0.988	0.389	1.034
380	2.87	140.8	139.9	280.7	0.0535	0.0088	0.0111	0.986	0.393	1.034
390	3.38	145.7	138.9	284.6	0.0624	0.0089	0.0113	0.984	0.397	1.034
400	3.96	150.6	137.9	288.5	0.0725	0.0090	0.0115	0.982	0.401	1.034
410	4.63	155.6	136.8	292.4	0.0839	0.0091	0.0118	0.980	0.405	1.034
420	5.38	160.6	135.8	296.3	0.0967	0.0092	0.0120	0.977	0.409	1.034
430	6.23	165.6	134.7	300.3	0.1110	0.0093	0.0123	0.975	0.413	1.034
440	7.19	170.7	133.6	304.3	0.1270	0.0094	0.0125	0.972	0.417	1.034
450	8.25	175.8	132.5	308.3	0.1447	0.0095	0.0128	0.969	0.421	1.035
460	9.45	180.9	131.4	312.4	0.1644	0.0096	0.0130	0.966	0.425	1.035
470	10.78	186.1	130.3	316.4	0.1861	0.0097	0.0133	0.962	0.429	1.035
480	12.25	191.4	129.2	320.5	0.2100	0.0098	0.0135	0.959	0.433	1.035
490	13.87	196.6	128.0	324.7	0.2364	0.0100	0.0138	0.955	0.437	1.036
494.8	14.71	199.1	127.5	326.6	0.2499	0.0100	0.0139	0.953	0.438	1.036
500	15.66	201.9	126.9	328.8	0.2653	0.0101	0.0140	0.951	0.441	1.036
510	17.63	207.2	125.7	332.9	0.2969	0.0102	0.0143	0.946	0.444	1.037
520	19.79	212.6	124.5	337.1	0.3315	0.0103	0.0145	0.942	0.448	1.037
530	22.15	218.0	123.3	341.3	0.3692	0.0104	0.0148	0.937	0.452	1.038
540	24.72	223.5	122.1	345.5	0.4102	0.0105	0.0150	0.932	0.456	1.039
550	27.51	228.9	120.8	349.7	0.4547	0.0107	0.0153	0.926	0.460	1.040
560	30.54	234.5	119.5	354.0	0.5030	0.0108	0.0156	0.920	0.464	1.040
570	33.83	240.0	118.2	358.2	0.5554	0.0109	0.0158	0.914	0.468	1.041
580	37.37	245.6	116.9	362.5	0.6119	0.0110	0.0161	0.908	0.472	1.042
590	41.20	251.2	115.6	366.8	0.6730	0.0111	0.0164	0.902	0.476	1.044
600	45.31	256.9	114.2	371.1	0.7389	0.0113	0.0166	0.895	0.480	1.045
610	49.73	262.6	112.8	375.4	0.8099	0.0114	0.0169	0.888	0.484	1.046
620	54.47	268.3	111.4	379.7	0.8864	0.0115	0.0172	0.880	0.488	1.048
630	59.53	274.1	109.9	384.0	0.9686	0.0117	0.0175	0.873	0.492	1.049
640	64.95	279.9	108.4	388.3	1.057	0.0118	0.0177	0.865	0.496	1.051
650	70.73	285.8	106.9	392.6	1.152	0.0119	0.0180	0.857	0.501	1.053
660	76.89	291.7	105.3	397.0	1.254	0.0121	0.0183	0.848	0.505	1.055
670	83.44	297.6	103.7	401.3	1.364	0.0122	0.0186	0.839	0.509	1.057
680	90.40	303.6	102.0	405.6	1.481	0.0124	0.0189	0.830	0.514	1.060
690	97.79	309.6	100.3	409.9	1.608	0.0125	0.0191	0.820	0.519	1.062
700	105.6	315.7	98.6	414.3	1.743	0.0127	0.0194	0.810	0.523	1.066
710	113.9	321.8	96.8	418.6	1.888	0.0128	0.0197	0.799	0.528	1.069
720	122.7	327.9	95.0	422.9	2.045	0.0130	0.0200	0.789	0.534	1.073
730	131.9	334.1	93.1	427.2	2.213	0.0132	0.0203	0.777	0.539	1.077
740	141.7	340.4	91.1	431.5	2.394	0.0134	0.0206	0.766	0.545	1.082
750	152.0	346.7	89.1	435.7	2.588	0.0135	0.0209	0.754	0.551	1.087
760	162.9	353.0	87.0	440.0	2.798	0.0137	0.0212	0.741	0.557	1.093
770	174.4	359.4	84.8	444.2	3.025	0.0139	0.0215	0.728	0.564	1.100
780	186.4	365.9	82.5	448.4	3.270	0.0142	0.0219	0.714	0.571	1.108
790	199.1	372.4	80.2	452.5	3.537	0.0144	0.0222	0.700	0.579	1.117
800	212.5	379.0	77.7	456.7	3.827	0.0146	0.0225	0.685	0.588	1.128

Table 5 — Saturated Vapor Properties of DOWTHERM A Fluid (SI Units)

TEMP °C	VAPOR PRESSURE bar	LIQUID ENTHALPY kJ/kg	LATENT HEAT kJ/kg	VAPOR ENTHALPY kJ/kg	VAPOR DENSITY kg/m^3	VAPOR VISCOSITY mPa sec	VAPOR THERMAL COND. W/mK	Z_{VAPOR}	SPECIFIC HEAT (c_p) kJ/kg K	RATIO OF SPECIFIC HEATS c_p/c_v
12	0.00	0.0	409.0	409.0		0.0053	0.0074	1.000	1.032	1.050
15	0.00	4.9	407.2	412.1		0.0054	0.0075	1.000	1.044	1.050
20	0.00	13.1	404.4	417.4		0.0055	0.0078	1.000	1.062	1.050
25	0.00	21.3	401.5	422.8		0.0056	0.0081	1.000	1.081	1.049
30	0.00	29.5	398.8	428.3		0.0057	0.0084	1.000	1.100	1.048
35	0.00	37.7	396.1	433.8		0.0058	0.0086	1.000	1.118	1.047
40	0.00	46.0	393.4	439.5		0.0059	0.0089	1.000	1.137	1.046
45	0.00	54.4	390.9	445.2	0.0011	0.0060	0.0092	1.000	1.155	1.045
50	0.00	62.7	388.3	451.0	0.0015	0.0061	0.0095	1.000	1.173	1.045
55	0.00	71.2	385.8	457.0	0.0021	0.0062	0.0098	1.000	1.191	1.044
60	0.00	79.6	383.4	463.0	0.0029	0.0062	0.0101	1.000	1.209	1.043
65	0.00	88.1	380.9	469.1	0.0040	0.0063	0.0104	1.000	1.227	1.043
70	0.00	96.7	378.6	475.2	0.0053	0.0064	0.0107	1.000	1.245	1.042
75	0.00	105.3	376.2	481.5	0.0072	0.0065	0.0110	1.000	1.262	1.041
80	0.00	114.0	373.9	487.9	0.0095	0.0066	0.0113	1.000	1.280	1.041
85	0.00	122.7	371.6	494.3	0.0125	0.0067	0.0116	1.000	1.297	1.040
90	0.00	131.5	369.4	500.8	0.0162	0.0068	0.0120	0.999	1.315	1.040
95	0.00	140.3	367.1	507.4	0.0210	0.0069	0.0123	0.999	1.332	1.039
100	0.01	149.2	364.9	514.1	0.0268	0.0070	0.0126	0.999	1.349	1.039
105	0.01	158.1	362.7	520.9	0.0341	0.0071	0.0129	0.999	1.366	1.038
110	0.01	167.1	360.6	527.7	0.0430	0.0072	0.0133	0.999	1.382	1.038
115	0.01	176.2	358.4	534.6	0.0538	0.0073	0.0136	0.999	1.399	1.037
120	0.01	185.4	356.3	541.6	0.0669	0.0074	0.0139	0.998	1.416	1.037
125	0.02	194.6	354.1	548.7	0.0826	0.0075	0.0143	0.998	1.432	1.037
130	0.02	203.8	352.0	555.9	0.1013	0.0076	0.0146	0.998	1.448	1.036
135	0.03	213.2	349.9	563.1	0.1235	0.0077	0.0149	0.997	1.464	1.036
140	0.03	222.6	347.8	570.4	0.1498	0.0078	0.0153	0.997	1.481	1.036
145	0.04	232.1	345.7	577.8	0.1806	0.0078	0.0156	0.996	1.497	1.035
150	0.05	241.6	343.6	585.2	0.2165	0.0079	0.0160	0.995	1.512	1.035
155	0.06	251.2	341.5	592.7	0.2583	0.0080	0.0163	0.995	1.528	1.035
160	0.07	260.9	339.4	600.3	0.3065	0.0081	0.0167	0.994	1.544	1.035
165	0.08	270.7	337.3	608.0	0.3621	0.0082	0.0170	0.993	1.560	1.035
170	0.09	280.5	335.2	615.7	0.4257	0.0083	0.0174	0.992	1.575	1.034
175	0.11	290.4	333.1	623.5	0.4984	0.0084	0.0178	0.991	1.590	1.034
180	0.13	300.4	331.0	631.3	0.5809	0.0085	0.0181	0.990	1.606	1.034
185	0.15	310.4	328.8	639.2	0.6744	0.0086	0.0185	0.988	1.621	1.034
190	0.18	320.5	326.7	647.2	0.7798	0.0087	0.0189	0.987	1.636	1.034
195	0.21	330.7	324.6	655.2	0.8984	0.0088	0.0192	0.985	1.651	1.034
200	0.24	340.9	322.4	663.3	1.031	0.0089	0.0196	0.984	1.666	1.034
205	0.28	351.2	320.2	671.5	1.179	0.0090	0.0200	0.982	1.681	1.034
210	0.32	361.6	318.0	679.7	1.344	0.0091	0.0204	0.980	1.696	1.034
215	0.37	372.1	315.8	687.9	1.528	0.0092	0.0207	0.978	1.711	1.034
220	0.42	382.6	313.6	696.2	1.730	0.0093	0.0211	0.975	1.726	1.034
225	0.48	393.2	311.4	704.6	1.954	0.0094	0.0215	0.973	1.741	1.034
230	0.54	403.9	309.1	713.0	2.201	0.0095	0.0219	0.970	1.755	1.034
235	0.61	414.6	306.8	721.4	2.471	0.0096	0.0223	0.967	1.770	1.035
240	0.69	425.4	304.5	729.9	2.768	0.0097	0.0227	0.964	1.785	1.035
245	0.77	436.3	302.1	738.4	3.092	0.0098	0.0231	0.961	1.799	1.035
250	0.87	447.2	299.8	747.0	3.446	0.0099	0.0234	0.958	1.814	1.036
255	0.97	458.2	297.4	755.6	3.831	0.0100	0.0238	0.954	1.829	1.036
257.1	1.01	462.9	296.4	759.2	4.003	0.0100	0.0240	0.953	1.835	1.036
260	1.08	469.3	294.9	764.3	4.250	0.0101	0.0242	0.951	1.843	1.036
265	1.20	480.5	292.5	773.0	4.704	0.0102	0.0246	0.947	1.858	1.037
270	1.33	491.7	290.0	781.7	5.196	0.0103	0.0250	0.942	1.872	1.037
275	1.48	503.0	287.5	790.4	5.727	0.0104	0.0254	0.938	1.887	1.038
280	1.63	514.3	284.9	799.2	6.301	0.0105	0.0258	0.934	1.902	1.038
285	1.80	525.8	282.3	808.1	6.920	0.0106	0.0263	0.929	1.916	1.039
290	1.98	537.3	279.6	816.9	7.586	0.0107	0.0267	0.924	1.931	1.040
295	2.17	548.8	277.0	825.8	8.302	0.0108	0.0271	0.919	1.946	1.041
300	2.38	560.5	274.2	834.7	9.071	0.0109	0.0275	0.913	1.961	1.042
305	2.60	572.2	271.5	843.6	9.896	0.0110	0.0279	0.908	1.976	1.042
310	2.84	583.9	268.6	852.6	10.78	0.0111	0.0283	0.902	1.991	1.044
315	3.10	595.8	265.8	861.5	11.73	0.0113	0.0287	0.896	2.006	1.045
320	3.37	607.7	262.8	870.5	12.74	0.0114	0.0292	0.889	2.021	1.046
325	3.66	619.7	259.8	879.5	13.82	0.0115	0.0296	0.883	2.036	1.047
330	3.96	631.7	256.8	888.6	14.98	0.0116	0.0300	0.876	2.052	1.048
335	4.29	643.9	253.7	897.6	16.21	0.0117	0.0304	0.869	2.068	1.050
340	4.64	656.1	250.5	906.6	17.53	0.0119	0.0309	0.862	2.084	1.052
345	5.00	668.4	247.3	915.7	18.93	0.0120	0.0313	0.854	2.100	1.053
350	5.39	680.7	244.0	924.7	20.43	0.0121	0.0317	0.846	2.116	1.055
355	5.80	693.1	240.6	933.8	22.03	0.0122	0.0322	0.838	2.133	1.057
360	6.24	705.7	237.2	942.8	23.73	0.0124	0.0326	0.830	2.150	1.060
365	6.69	718.2	233.6	951.9	25.54	0.0125	0.0331	0.821	2.168	1.062
370	7.18	730.9	230.0	960.9	27.47	0.0126	0.0335	0.812	2.186	1.065
375	7.68	743.7	226.3	970.0	29.53	0.0128	0.0340	0.803	2.204	1.068
380	8.22	756.5	222.5	979.0	31.73	0.0129	0.0344	0.793	2.224	1.071
385	8.78	769.4	218.6	988.0	34.07	0.0131	0.0349	0.783	2.244	1.075
390	9.37	782.4	214.5	997.0	36.58	0.0132	0.0354	0.773	2.264	1.079
395	9.99	795.5	210.4	1005.9	39.25	0.0134	0.0358	0.762	2.286	1.083
400	10.64	808.7	206.1	1014.8	42.11	0.0136	0.0363	0.751	2.309	1.088
405	11.32	822.0	201.7	1023.7	45.17	0.0138	0.0368	0.740	2.333	1.094
410	12.03	835.4	197.1	1032.5	48.45	0.0139	0.0373	0.728	2.359	1.100
415	12.78	848.9	192.4	1041.3	51.98	0.0141	0.0378	0.715	2.387	1.107
420	13.56	862.5	187.5	1050.0	55.77	0.0143	0.0383	0.703	2.417	1.115
425	14.38	876.3	182.3	1058.6	59.86	0.0145	0.0388	0.689	2.450	1.125

Figure 6—Expansion of DOWTHERM A Liquid
(Basis: 100 Gallons at 60°F)

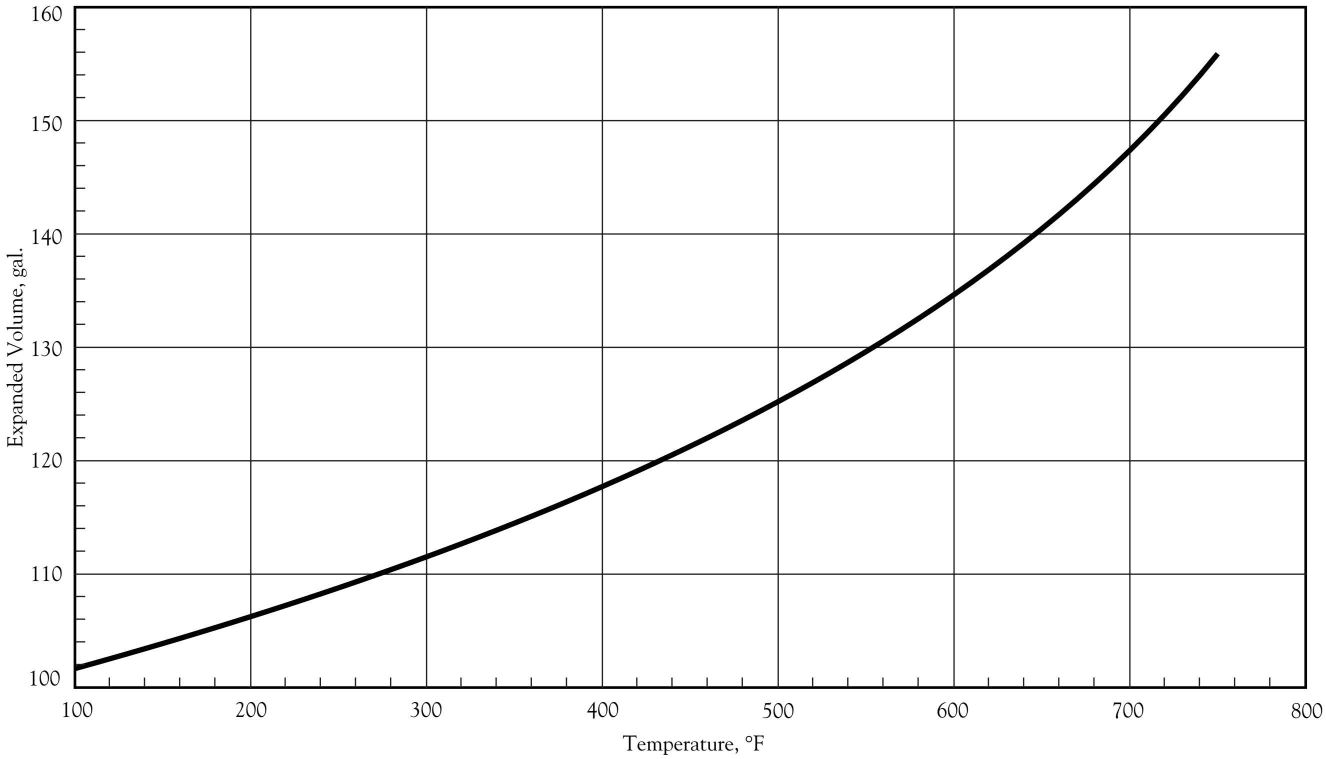


Figure 7—Expansion of DOWTHERM A Liquid
(Basis: 1 m^3 at 25°C)

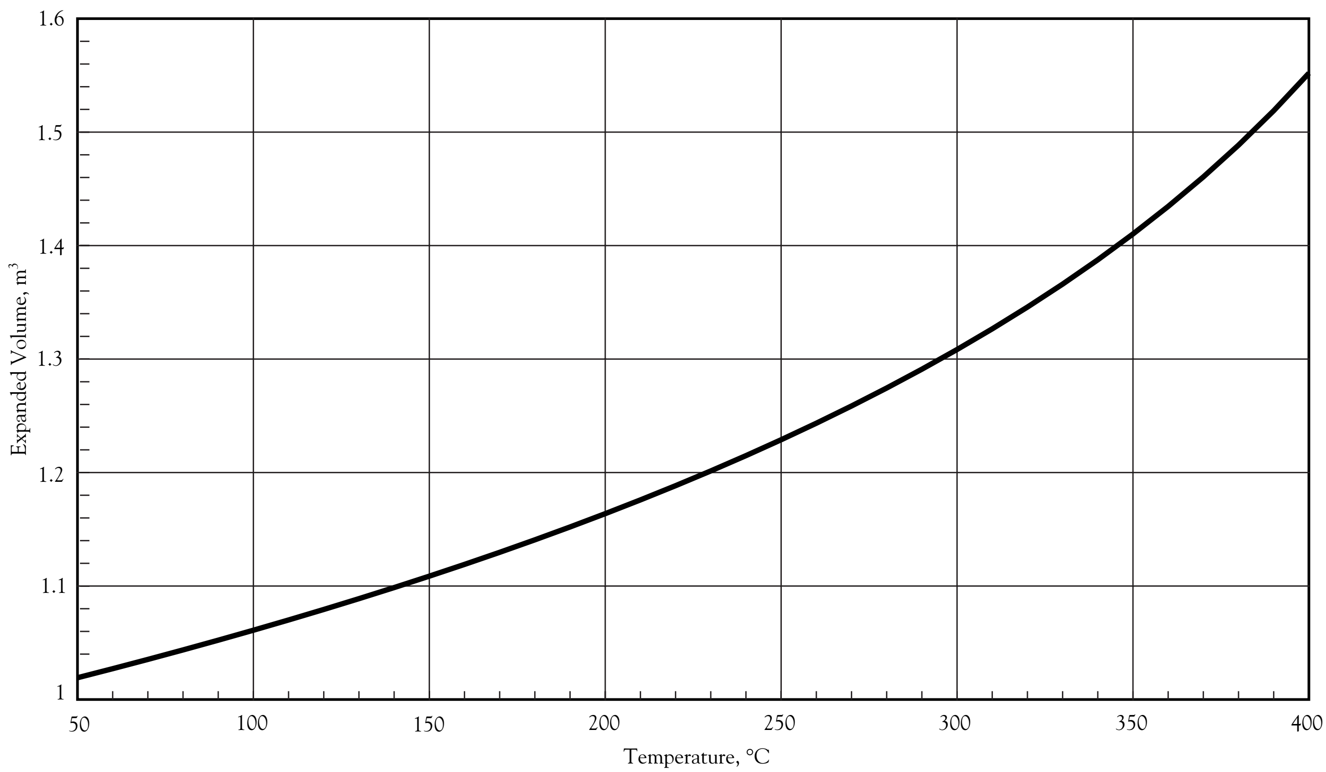


Figure 8—Liquid Properties of DOWTHERM A Liquid (English Units)

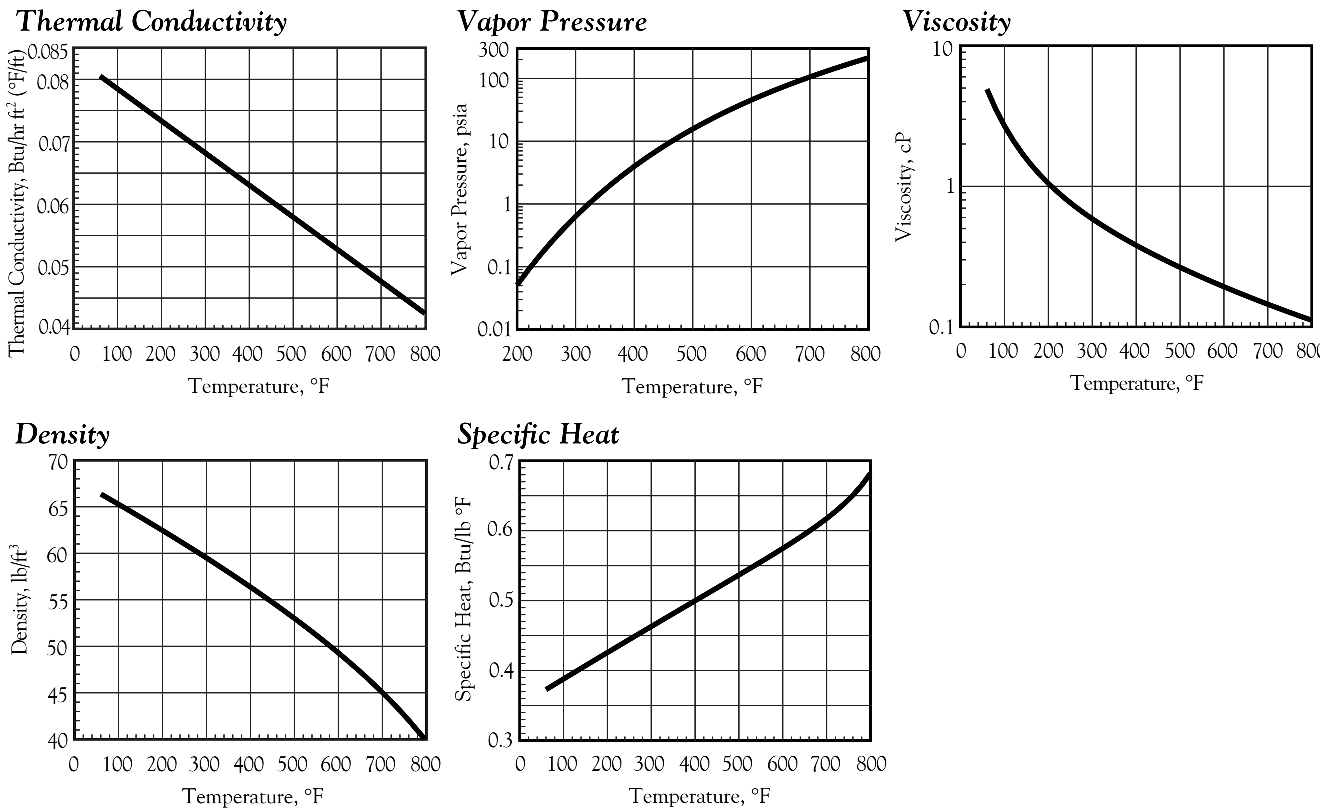


Figure 9—Liquid Properties of DOWTHERM A Liquid (SI Units)

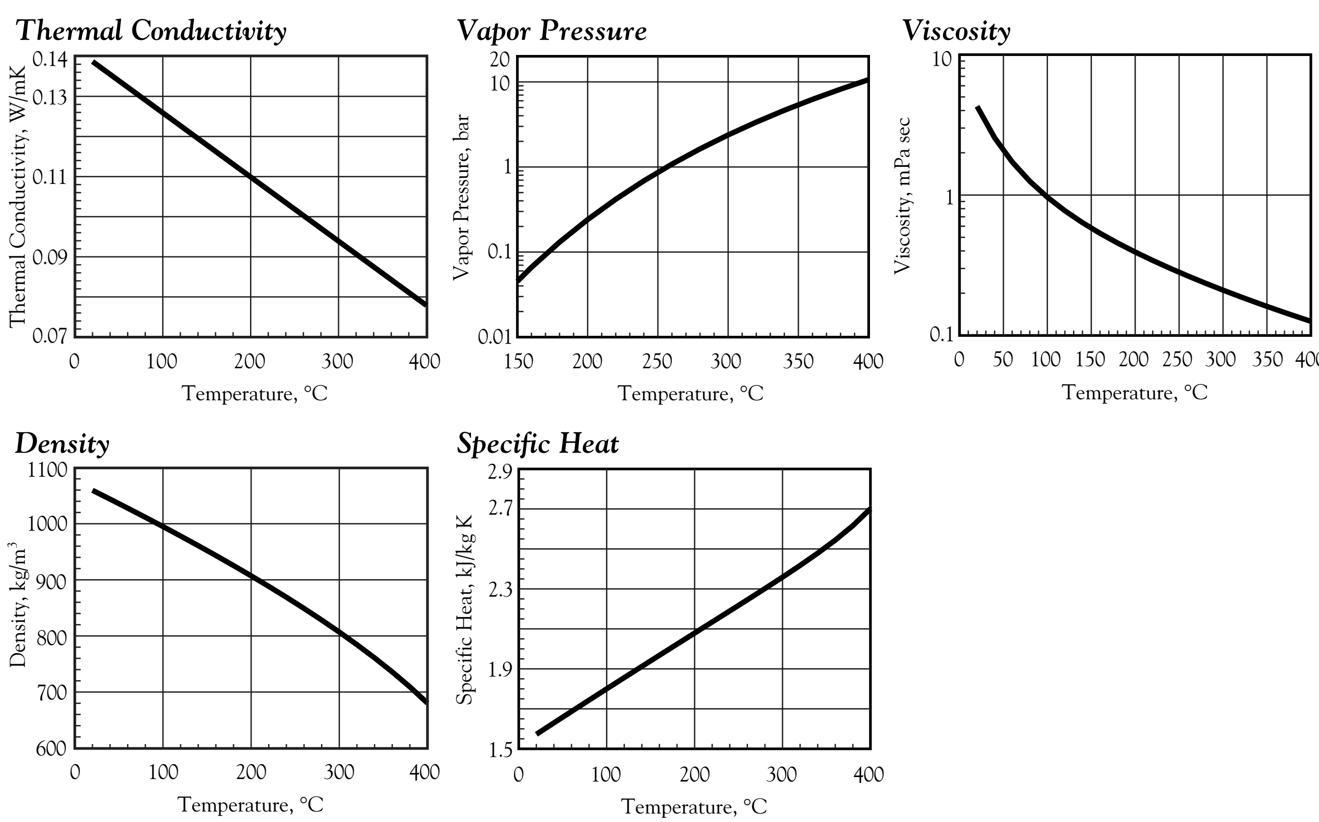


Figure 10—Water Saturation of DOWTHERM A Liquid (English Units)

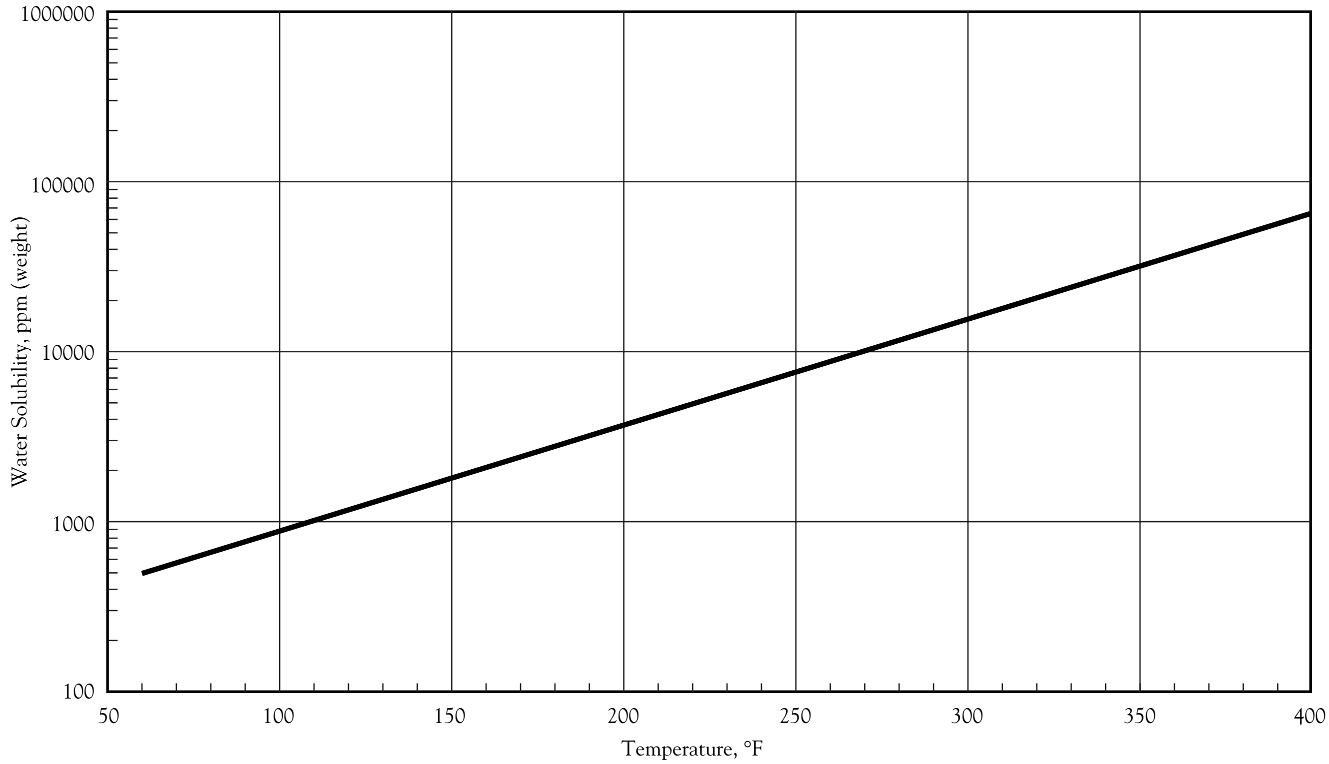


Figure 11—Water Saturation of DOWTHERM A Liquid (SI Units)

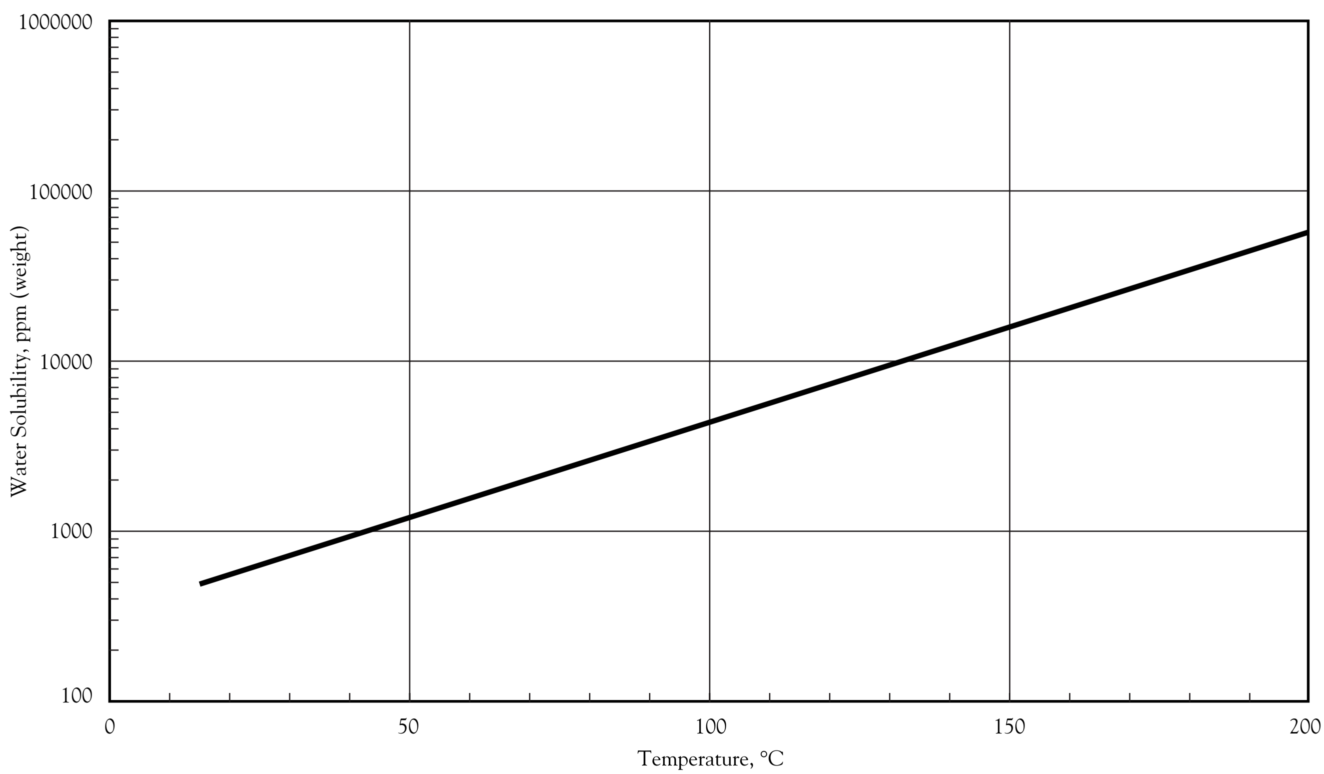


Figure 12 — Calculated Pressure vs. Enthalpy for DOWTHERM A Fluid (English Units)

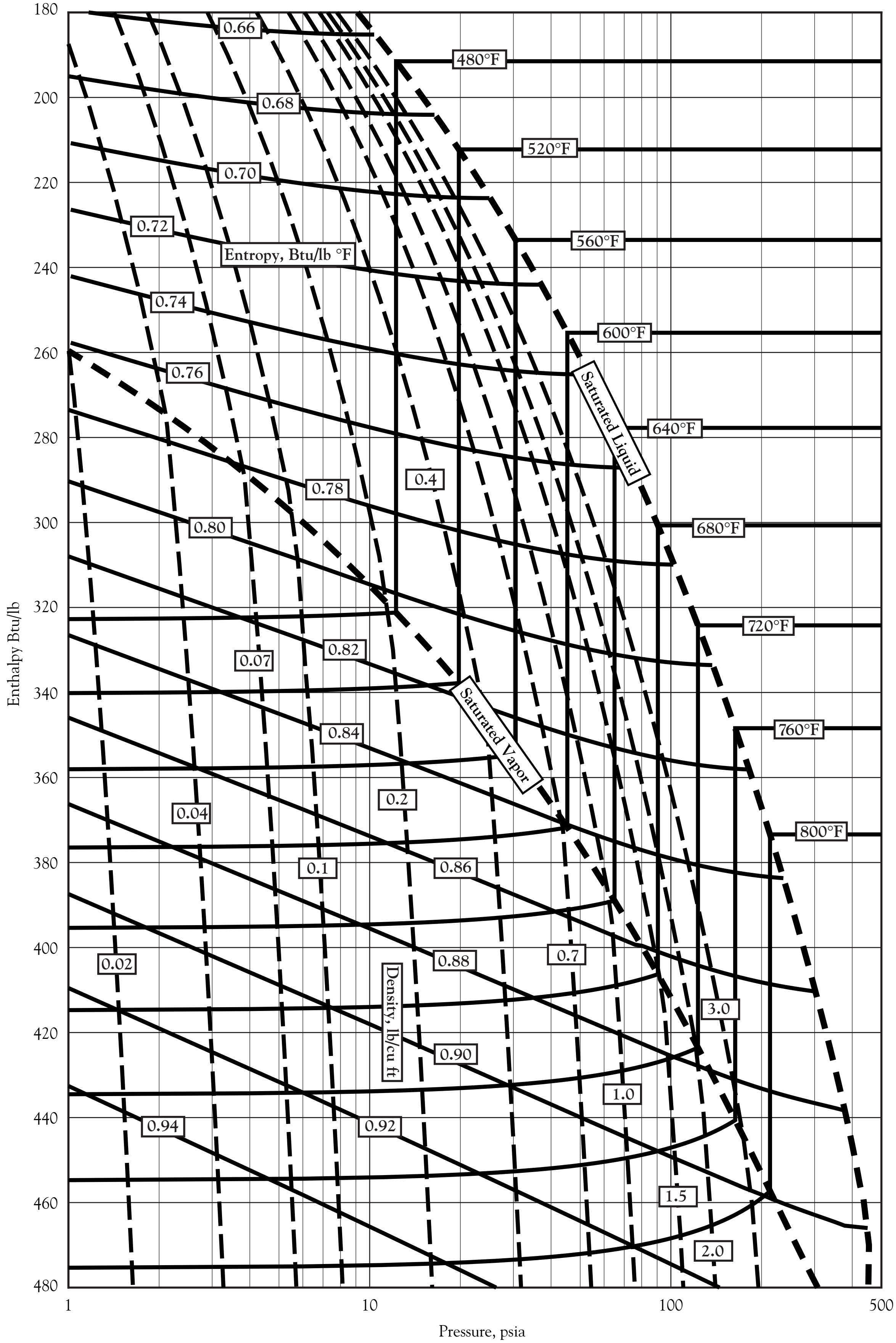


Figure 13—Calculated Pressure vs. Enthalpy for DOWTHERM A Fluid (SI Units)

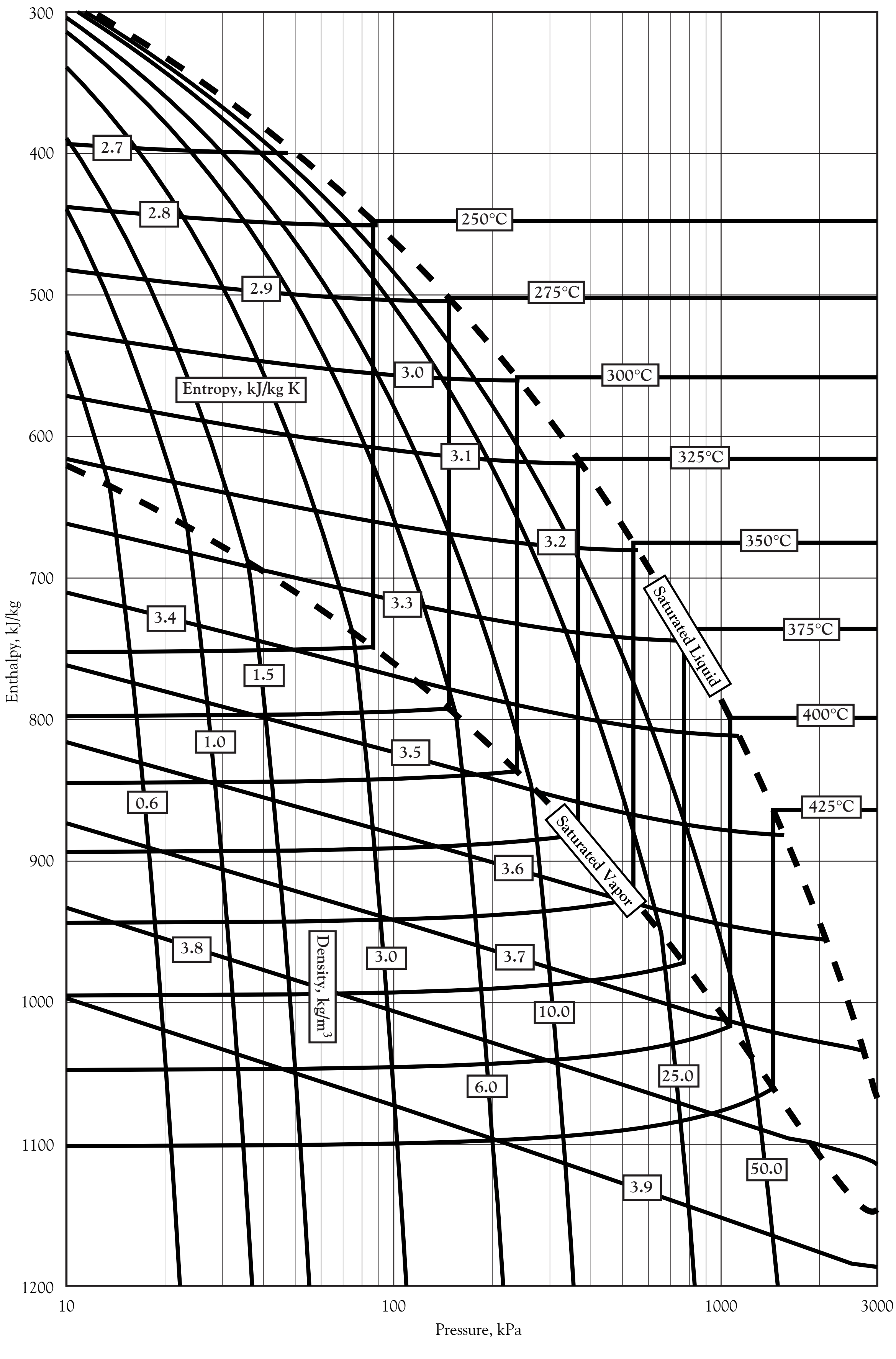
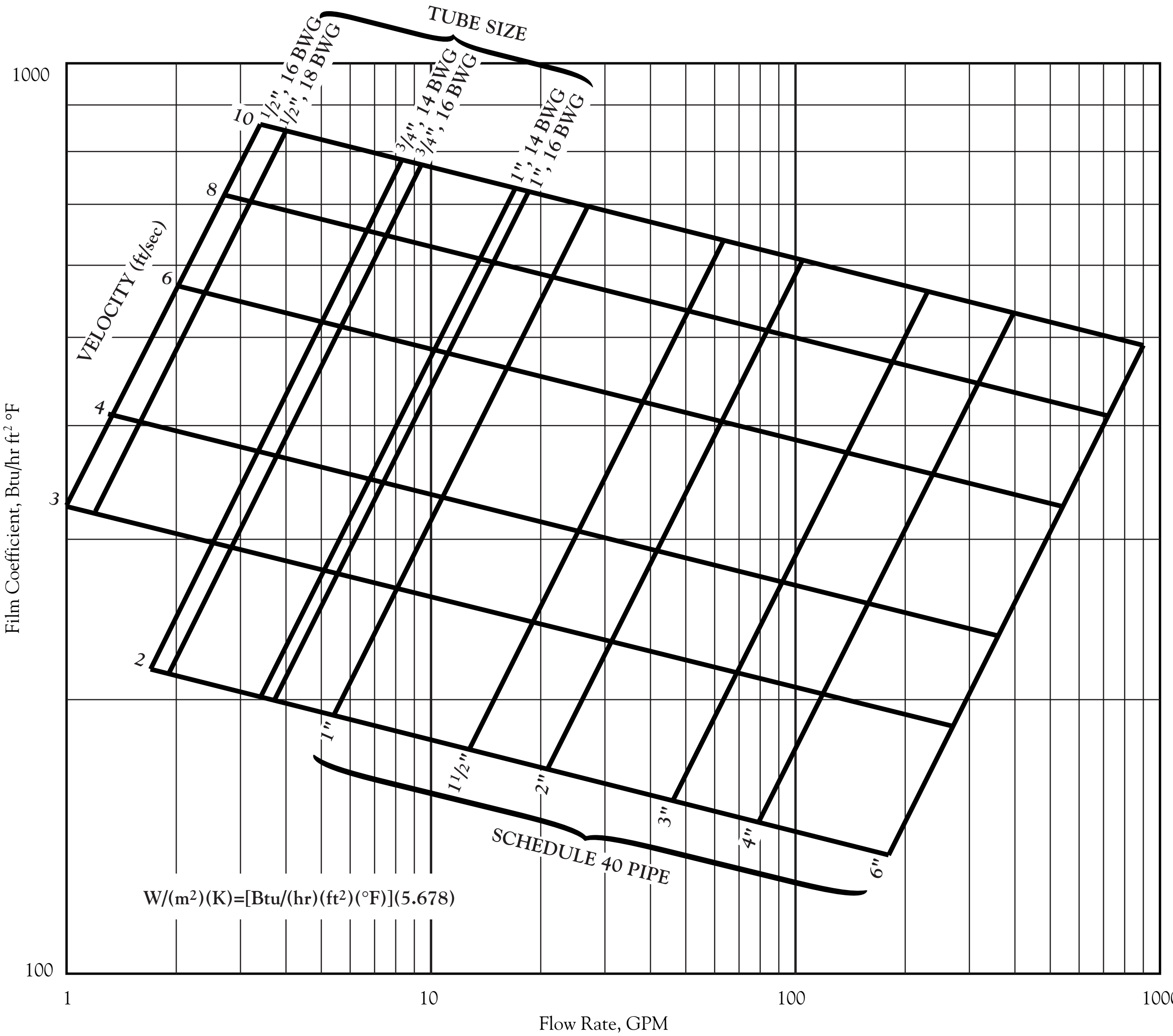
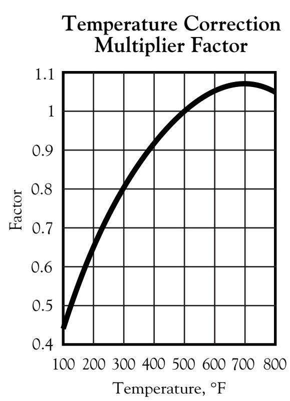


Figure 14—Liquid Film Coefficient for DOWTHERM A Fluid Inside Pipes and Tubes (English Units)



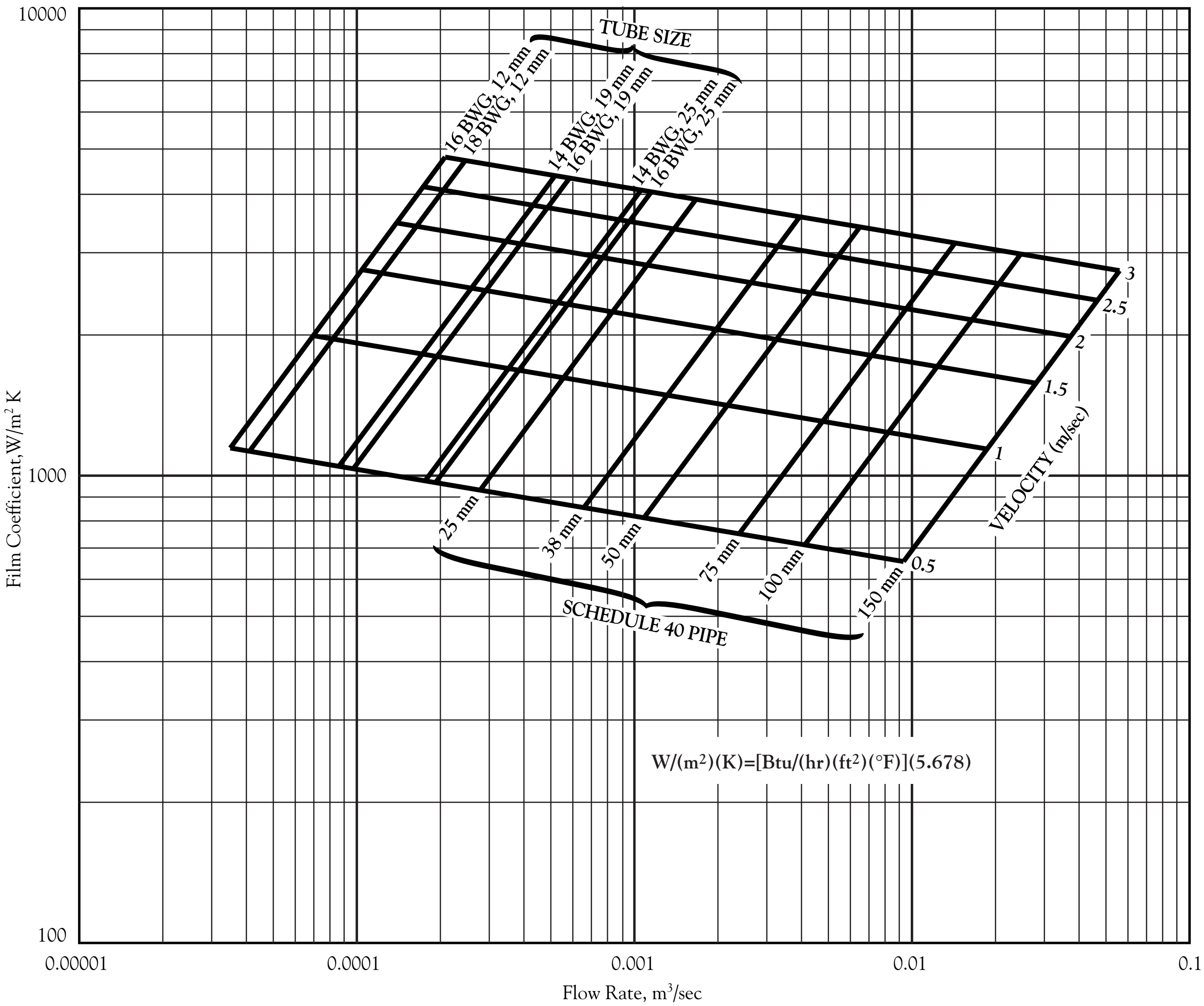


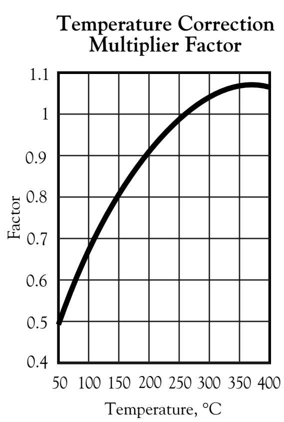
Sieder and Tate Equation Process Heat Transfer,
D.Q. Kern (1950) p. 103

$$Nu = 0.027\, Re^{0.8} P_R^{1/3} \left(\frac{\mu}{\mu_w}\right)^{0.14} \qquad \text{Chart based on} \left(\frac{\mu}{\mu_w}\right)^{0.14} = 1$$

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

Figure 15—Liquid Film Coefficient for DOWTHERM A Fluid Inside Pipes and Tubes (SI Units)



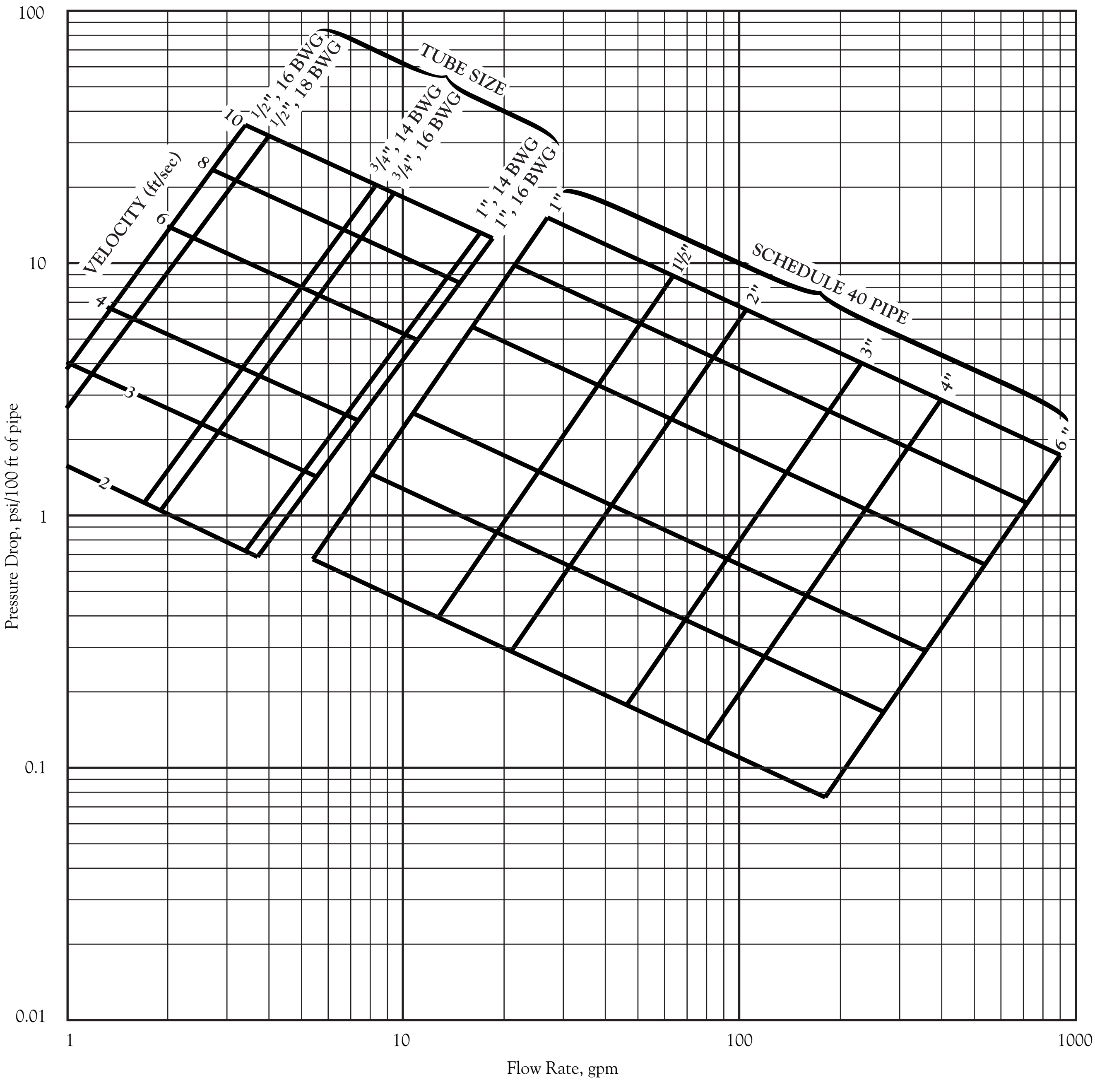


Sieder and Tate Equation Process Heat Transfer, D.Q. Kern (1950) p. 103

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

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

Figure 16—Pressure Drop vs. Flow Rate of DOWTHERM A Fluid Inside Pipes and Tubes (English Units)



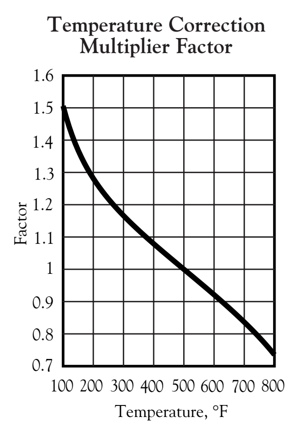
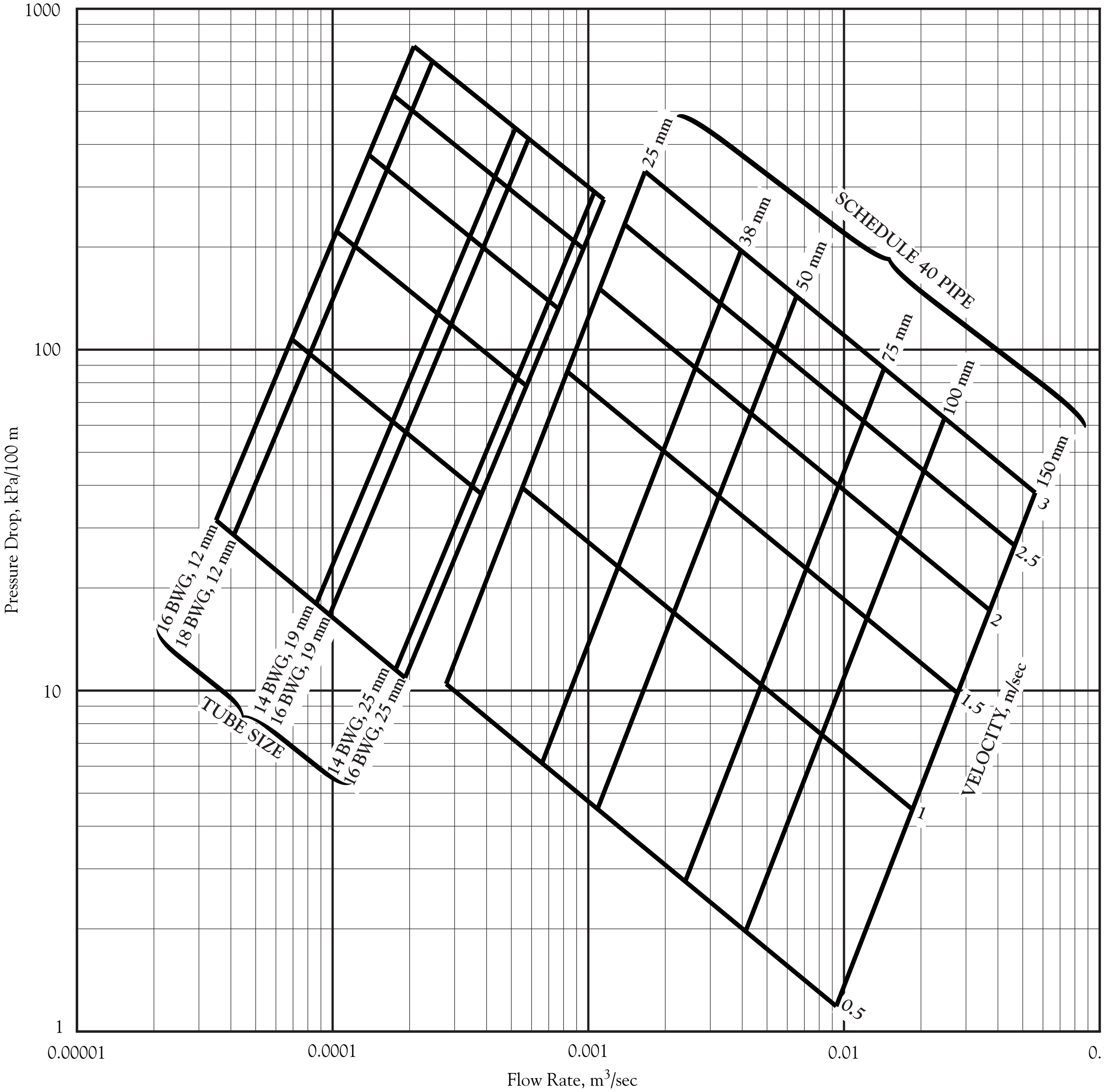


Figure 17—Pressure Drop vs. Flow Rate of DOWTHERM A Fluid Inside Pipes and Tubes (SI Units)



Temperature Correction Multiplier Factor

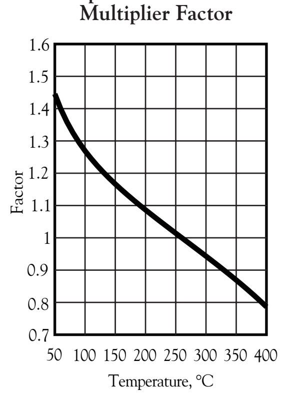
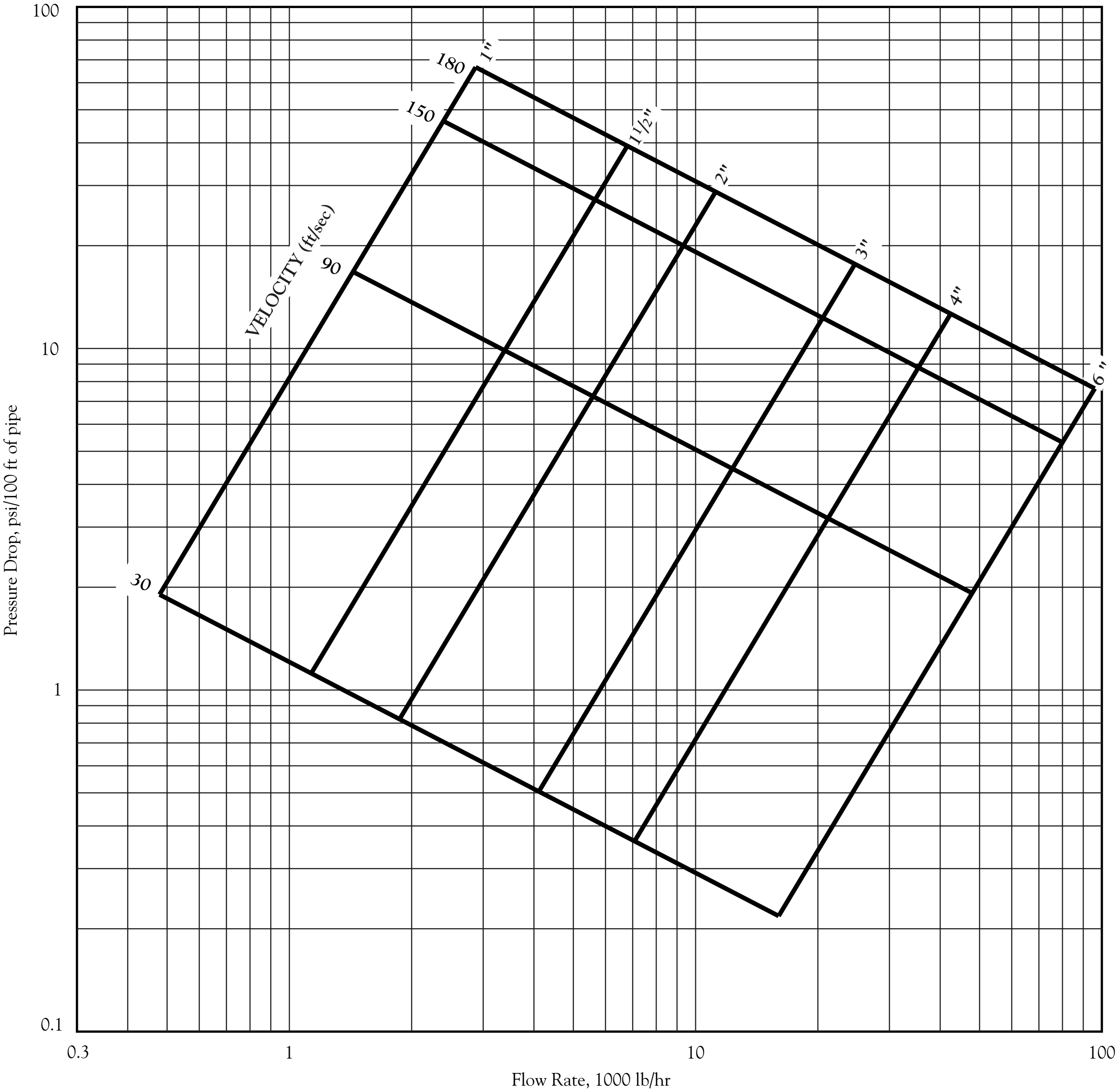


Figure 18 — Pressure Drop vs. Flow Rate of DOWTHERM A Vapor Inside Schedule 40 Pipe (English Units)



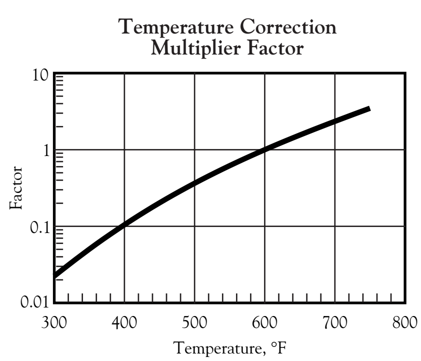
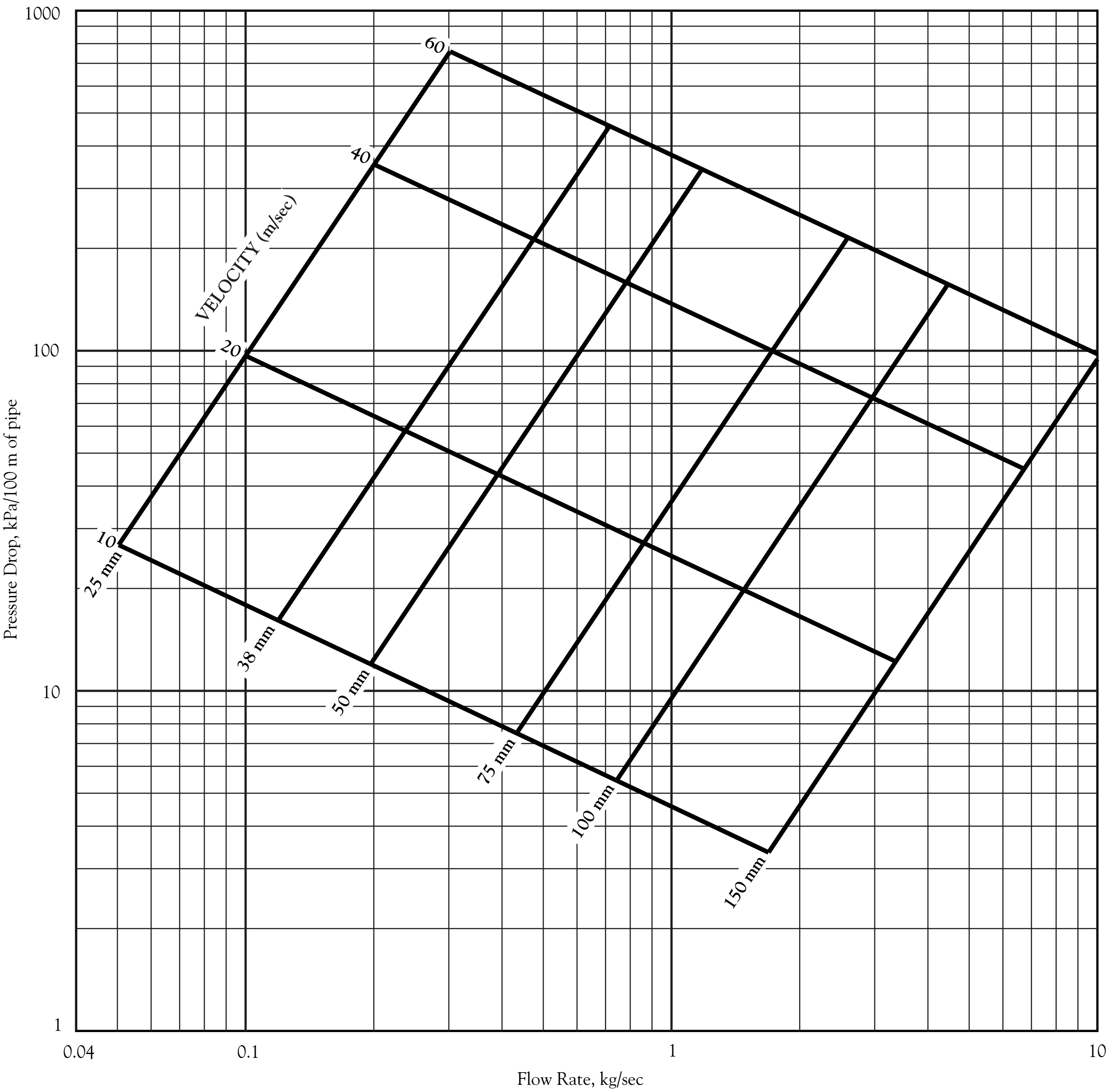
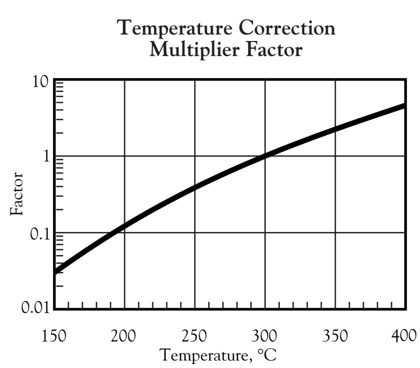


Figure 19 — Pressure Drop vs. Flow Rate of DOWTHERM A Vapor Inside Schedule 40 Pipe (SI Units)





DOWTHERM* A
Heat Transfer Fluid

Product Technical Data

For further information, call...

In The United States And Canada: 1-800-447-4369 • FAX: 1-517-832-1465

In Europe: +31 20691 6268 • FAX: +31 20691 6418

In The Pacific: +886 2 715 3388 • FAX: +886 2 717 4115

In Other Global Areas: 1-517-832-1556 • FAX: 1-517-832-1465

http://www.dow.com/heattrans

Published March 1997

NOTE: SYLTHERM heat transfer fluids are manufactured by Dow Corning Corporation and distributed by The Dow Chemical Company.

Printed in U.S.A.

NA/LA/Pacific: Form No. 176-1337-397 AMS
Europe: CH 153-039-E-397