THERMINOL®
from Eastman

THERMINOL® D-12

heat transfer fluid

Low-temperature coolant/heat transfer fluid that is NSF HT1 certified and outperforms FDA specifications for use in food contact applications

-94° to 230°C
(-137° to 450°F)

THERMINOL® D-12
heat transfer fluid

Physical and chemical characteristics

Therminol D-12 is especially suited to applications where a low order of acute toxicity and odor are desired. This product is registered to the NSF International Registration Guidelines for Nonfood Compounds. Therminol D-12 meets the technical requirements of 21 CFR 178.3570 for incidental food contact set forth by the FDA. Therminol D-12 is based on halogen-free chemistry, and it is considered nonhazardous and practically harmless for environmental purposes. For complete information regarding the safety of Therminol D-12, consult the Safety Data Sheet.

NSF

Nonfood Compounds
Program Listed (HT1)
(130383)

Therminol D-12 has a temperature range of –94° to 190°C (–137° to 374°F) without overpressure or up to 230°C (450°F) with appropriate level of system pressurization. In combined heating or cooling applications, Therminol D-12 can serve both needs, delivering excellent heat transfer rates even at –45°C (–50°F). Therminol D-12 remains liquid and is easily pumped at temperatures as low as –94°C (–137°F). Start-up problems often associated with batch processing systems are eliminated, and steam or electrical tracing is not required.

The recommended bulk and maximum film temperatures for Therminol D-12 are based on industry-standard thermal studies. Operation at or below these temperature maximums can provide long service life under most operating conditions.

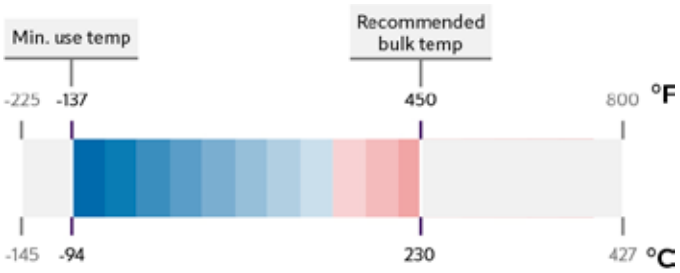
Actual fluid life is dependent on the total system design and operation and can vary by heat transfer fluid chemistry. As fluid ages, the formation of low- and high-boiling compounds may result. Low-boiling compounds should be vented from the system as necessary to a safe location away from personnel and sources of ignition and in compliance with applicable regulations and laws. The high-boiling compounds can be very soluble in the fluid. Significant overheating or fluid contamination will accelerate decomposition and may result in increased high-boiler and solids concentrations. Excess solids can typically be filtered for removal.

Eastman recommends that systems using Therminol D-12 fluid be blanketed with an atmosphere of inert gas to protect against the effects of fluid oxidation on its performance and life expectancy. Pressure relief device(s) should be installed where required.

Therminol D-12 is generally noncorrosive to metals commonly used in the construction of heat transfer systems.

Therminol D-12 is not classified as a fire-resistant heat transfer fluid. Consequently, the use of protective devices may be required to minimize fire risk, and users of Therminol D-12 should check with their safety and risk management experts for specific instructions.

Eastman Therminol® D-12 heat transfer fluid is a liquid phase heat transfer fluid specially developed for process cooling combined with moderate heating cycles using a single fluid in place of the traditional dual steam/brine or steam/glycol systems.

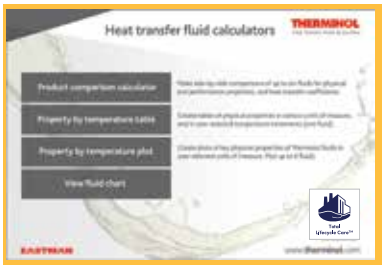


Therminol D-12 is available globally. Contact your local Eastman Therminol sales representative for more information.

Typical properties[a]

Appearance	Clear, water-white liquid
Composition	Synthetic hydrocarbons
Recommended bulk temperature	230°C (450°F)
Maximum film temperature	245°C (475°F)
Normal boiling point	192°C (378°F)
Pumpability, at 300 mm^2/s (cSt)	–82°C (–116°F)
Pumpability, at 2000 mm^2/s (cSt)	–94°C (–137°F)
Flash point, PMCC (ASTM D93)	62°C (144°F)
Autoignition temperature (DIN 51794)	277°C (531°F)
Autoignition temperature (ASTM E659)	247°C (477°F)
Minimum liquid temperatures for fully developed turbulent flow (N_{Re} > 10,000)	
10 ft/s, 1-in. tube (3.048 m/s, 2.54-cm tube)	–37°C (–35°F)
20 ft/s, 1-in. tube (6.096 m/s, 2.54-cm tube)	–51°C (–59°F)
Minimum liquid temperatures for transitional region flow (N_{Re} > 2000)	
10 ft/s, 1-in. tube (3.048 m/s, 2.54-cm tube)	–64°C (–82°F)
20 ft/s, 1-in. tube (6.096 m/s, 2.54-cm tube)	–71°C (–96°F)
Coefficient of thermal expansion at 100°C	0.00112/°C (0.00062/°F)
Heat of vaporization at maximum use temperature	198 kJ/kg (85.2 Btu/lb)
Total acidity (ASTM D664)	<0.2 mg KOH/g
Average molecular weight	162
Pseudocritical temperature	360°C (680°F)
Pseudocritical pressure	16.2 bar (235 psia)
Pseudocritical density	229 kg/m^3 (14.1 lb/ft^3)
Chlorine content, ppm (DIN 51577)	<10 ppm
Sulfur content, ppm (ASTM D7691)	<10 ppm
Copper corrosion (ASTM D130)	<<1a
Moisture content, maximum (ASTM E203)	80 ppm
Dielectric constant @ 23°C (ASTM D924)	2.02

aThese data are based on samples tested in the laboratory and are not guaranteed for all samples. Contact us for complete sales specifications for Therminol D-12 fluid. Does not constitute an express warranty. See disclaimer on the back page of this bulletin.



To create your own customized table
with preferred properties, units of measure,
and temperature intervals, visit
Therminol.com/resources
and download the Therminol heat transfer fluid calculator.

For technical service, visit the contact page of our website, **Therminol.com.**

Liquid properties of Therminol® D-12 heat transfer fluid by temperature[a] (SI units)

Temperature		Liquid density	Liquid heat capacity	Heat of vaporization	Liquid enthalpy[b]	Liquid thermal conductivity	Liquid viscosity[c]		Vapor pressure[d]
°C	°F	kg/m³	kJ/(kg·K)	kJ/kg	kJ/kg	W/(m·K)	cP (mPa·s)	cSt (mm²/s)	kPa
–94	–137	841	1.66	400.6	–137.4	0.1255	1750	2080	—
–90	–130	839	1.68	397.5	–130.7	0.1250	819	977	—
–80	–112	832	1.71	389.9	–113.8	0.1238	177	213	—
–70	–94	825	1.75	382.4	–96.5	0.1225	56.4	68.3	—
–60	–76	818	1.79	375.0	–78.8	0.1213	23.6	28.9	—
–50	–58	811	1.82	367.7	–60.8	0.1200	12.0	14.8	—
–40	–40	805	1.86	360.6	–42.3	0.1186	7.06	8.77	—
–30	–22	798	1.90	353.6	–23.5	0.1173	4.60	5.76	—
–20	–4	791	1.94	346.7	–4.3	0.1159	3.24	4.09	0.001
–10	14	784	1.98	340.0	15.3	0.1145	2.41	3.08	0.004
0	32	777	2.02	333.4	35.2	0.1130	1.88	2.43	0.011
10	50	770	2.05	326.9	55.6	0.1115	1.52	1.98	0.027
20	68	762	2.09	320.5	76.3	0.1100	1.26	1.65	0.062
30	86	755	2.13	314.3	97.4	0.1084	1.07	1.41	0.131
40	104	748	2.17	308.1	118.9	0.1068	0.918	1.23	0.259
50	122	741	2.21	302.1	140.9	0.1052	0.800	1.08	0.484
60	140	733	2.25	296.1	163.2	0.1035	0.705	0.961	0.859
70	158	726	2.29	290.3	185.9	0.1019	0.626	0.863	1.46
80	176	718	2.33	284.5	209.0	0.1001	0.561	0.781	2.39
90	194	710	2.37	278.8	232.5	0.0984	0.504	0.710	3.77
100	212	703	2.41	273.1	256.4	0.0966	0.456	0.649	5.76
110	230	695	2.45	267.5	280.8	0.0948	0.414	0.596	8.57
120	248	687	2.50	262.0	305.5	0.0929	0.378	0.550	12.4
130	266	678	2.54	256.4	330.7	0.0910	0.345	0.509	17.6
140	284	670	2.58	250.9	356.3	0.0891	0.316	0.472	24.4
150	302	661	2.62	245.3	382.3	0.0872	0.290	0.439	33.2
160	320	653	2.67	239.7	408.8	0.0852	0.267	0.409	44.3
170	338	644	2.71	234.1	435.6	0.0832	0.246	0.383	58.3
180	356	635	2.75	228.4	463.0	0.0812	0.227	0.358	75.5
190	374	625	2.80	222.6	490.7	0.0791	0.210	0.336	96.5
200	392	616	2.84	216.7	518.9	0.0770	0.195	0.316	122
210	410	606	2.89	210.7	547.6	0.0748	0.180	0.298	152
220	428	595	2.93	204.5	576.7	0.0727	0.167	0.281	188
230	446	584	2.98	198.1	606.3	0.0705	0.156	0.266	229
240	464	573	3.03	191.4	636.3	0.0682	0.145	0.252	278
250	482	562	3.08	184.5	666.9	0.0660	0.135	0.240	333

[a]Recommended bulk temperature 230°C (450°F). These data are based on samples tested in the laboratory and are not guaranteed for all samples. Contact us for complete sales specifications for Therminol D-12 fluid. [b]Liquid enthalpy basis is –17.8°C (0°F). [c]1 cSt = 1 mm²/s and 1 mPa•s = 1 cP. [d]100 kPa = 1 bar

Liquid properties of Therminol® D-12 heat transfer fluid by temperature[a] (English units)

Temperature		Liquid density		Liquid heat capacity	Heat of vaporization	Liquid enthalpy[b]	Liquid thermal conductivity	Liquid viscosity[c]		Vapor pressure[d]
°F	°C	lb/gal	lb/ft³	Btu/(lb·°F)	Btu/lb	Btu/lb	Btu/(ft·h·°F)	lb/(ft·h)	cSt (mm²/s)	psia
–137	–94	7.02	52.5	0.397	172.4	–59.1	0.0725	4230	2080	—
–120	–84	6.97	52.1	0.405	169.2	–52.2	0.0719	799	396	—
–100	–73	6.90	51.6	0.415	165.6	–44.0	0.0711	193	96.3	—
–80	–62	6.84	51.2	0.425	162.0	–35.6	0.0703	68.0	34.3	—
–60	–51	6.78	50.7	0.435	158.5	–27.0	0.0695	31.1	15.8	—
–40	–40	6.71	50.2	0.445	155.1	–18.2	0.0686	17.1	8.77	—
–20	–29	6.65	49.7	0.455	151.8	–9.2	0.0677	10.7	5.53	—
0	–18	6.59	49.3	0.465	148.5	0.0	0.0668	7.30	3.82	0.0002
20	–7	6.52	48.8	0.475	145.3	9.4	0.0659	5.35	2.83	0.0008
40	4	6.46	48.3	0.486	142.2	19.0	0.0649	4.13	2.21	0.0024
60	16	6.39	47.8	0.496	139.1	28.8	0.0640	3.30	1.78	0.0063
80	27	6.32	47.3	0.506	136.1	38.9	0.0630	2.72	1.49	0.0149
100	38	6.26	46.8	0.517	133.1	49.1	0.0620	2.29	1.26	0.0324
120	49	6.19	46.3	0.527	130.2	59.5	0.0609	1.96	1.10	0.0656
140	60	6.12	45.8	0.538	127.4	70.2	0.0599	1.71	0.961	0.125
160	71	6.05	45.3	0.549	124.6	81.1	0.0588	1.50	0.853	0.224
180	82	5.98	44.7	0.559	121.8	92.1	0.0577	1.32	0.764	0.384
200	93	5.91	44.2	0.570	119.1	103.4	0.0565	1.18	0.689	0.632
220	104	5.83	43.6	0.581	116.4	115.0	0.0554	1.06	0.625	1.00
240	116	5.76	43.1	0.592	113.8	126.7	0.0542	0.951	0.570	1.53
260	127	5.68	42.5	0.603	111.1	138.6	0.0530	0.860	0.522	2.28
280	138	5.61	41.9	0.614	108.5	150.8	0.0518	0.780	0.480	3.29
300	149	5.53	41.4	0.626	105.8	163.2	0.0505	0.709	0.443	4.65
320	160	5.45	40.7	0.637	103.1	175.9	0.0493	0.646	0.409	6.43
340	171	5.36	40.1	0.649	100.4	188.7	0.0480	0.591	0.380	8.70
360	182	5.28	39.5	0.660	97.7	201.8	0.0467	0.541	0.353	11.6
380	193	5.19	38.8	0.672	94.9	215.1	0.0453	0.496	0.329	15.1
400	204	5.10	38.2	0.684	92.1	228.7	0.0440	0.455	0.308	19.5
420	216	5.01	37.4	0.696	89.2	242.5	0.0426	0.419	0.289	24.8
440	227	4.91	36.7	0.709	86.1	256.6	0.0412	0.386	0.271	31.1
460	238	4.80	35.9	0.722	83.0	270.9	0.0397	0.356	0.255	38.6
480	249	4.70	35.1	0.735	79.7	285.4	0.0383	0.328	0.241	47.4

Single-fluid combined cycle heating and cooling systems

Cycling temperatures through a wide temperature range in batch reaction processes (for example, in small industrial or pilot-scale production units) requires a heat transfer fluid with unique characteristics.

In the past, the solution to these problems in combined heating and cooling systems operating over a wide temperature range has been to rely on twin-loop systems with two independent fluids—usually high-pressure steam for the heating and brine for the cooling loop.

Therminol D-12 offers design and production engineers an unrivaled choice, meeting their demands for efficiency and providing significant overall cost benefits when batch processing fine chemicals and pharmaceutical multipurpose plants.

Therminol D-12 has a number of practical advantages when used as a single fluid in dual-purpose heat transfer systems.

- **Closed-loop systems with wide temperature range**
  Therminol D-12 can be used in combined closed-loop systems, providing full heating and cooling capabilities with a single fluid. This is a major advantage when compared with the twin-fluid/twin-loop concept, such as steam/brine or steam/water-glycol.
- **Reliable low-temperature pumpability**
  Thermal degradation under operating conditions will not significantly alter the viscosity and pour point of the used fluid. The minimum use temperature of Therminol D-12 ensures that low-temperature pumpability should always remain satisfactory in a well-designed and maintained system.
- **Corrosion inhibitors not needed**
  Therminol D-12 heat transfer fluid is noncorrosive to carbon steel and common construction alloys. The need for the addition of costly and sometimes troublesome corrosion inhibitors and in-service monitoring of inhibitors concentration is therefore avoided.

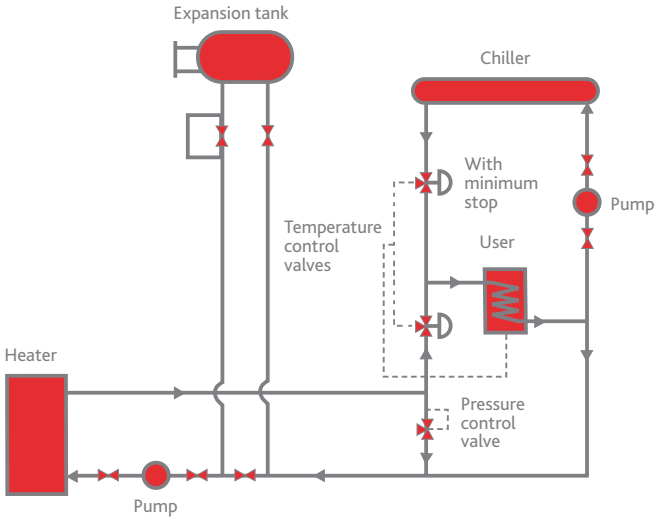
Typical design—heating and cooling of single user with one fluid

The following figure shows a dual system for heating and cooling, using two separate circulating systems for a common user.

The temperature controller output is connected in a split-range manner to the cold heat transfer fluid control valve. As the output increases from 0% to 55%, the cold-fluid valve closes (with a minimum stop to prevent deadheading the cooling zone pump).

As the output increases from 45% to 100%, the hot-fluid valve opens. The pressure control valve maintains a minimum flow through the heater in all conditions.

Even with the slight overlap in the cold- and hot-fluid valve ranges, this design operates with a minimum of interchange between the two circulating systems.



Total Lifecycle Care™

In-service heat transfer fluid sample analysis

When heat transfer fluids are used within suggested temperature limits, they can provide years of trouble-free service. To help maximize fluid life, Eastman offers testing of in-service heat transfer fluids to detect contamination, moisture, thermal degradation and other conditions that may impact system performance. This helps avoid unscheduled maintenance, saving time and money.

This comprehensive analysis measures acid number, kinematic viscosity, insoluble solids, low boilers, high boilers and moisture content. Additional special analysis may be available on request. Sample collection kits are easy to use and available at no cost. Most systems should be sampled annually or when a fluid-related problem is suspected.

FLUID GENIUS® from Eastman

Our patent-pending Fluid Genius digital service provides data from samples and other information to enable informed decision-making. Fluid Genius gives users access to data-driven insights to enhance maintenance, optimize performance and boost operational efficiency through monitoring.

Contact your account manager to get started on Fluid Genius — and keep your system up and running. To learn more, visit fluidgenius.net

Technical service hotline

Eastman customers get direct access to technical service specialists who can answer questions regarding heat transfer fluid selection, system start-ups, system design and operational issues. For questions in North America, call our hotline at 800-433-6997. For questions in other regions, contact your local technical support representative.

System design support

Eastman regularly assists the world's largest engineering, chemical and equipment manufacturing companies with system design and operation. Our liquid-phase and vapor-phase design guide information and system design data have been field tested in numerous installations.

Eastman also conducts engineering seminars for customers, engineering firms and equipment manufacturers to cover system design and operational issues. Help is available through local specialists or on-site assistance.

Operational training

Eastman believes sharing our experience with customers can help improve system design, promote safety and reduce overall costs. Customers can take advantage of Eastman's heat transfer system operation and product training programs. These programs for technicians and engineers enhance fluid selection knowledge and system operation skills. These programs are customized to suit frontline technicians, operations supervisors, maintenance technicians and design engineers.

Safety awareness training

Eastman provides safety training that focuses on system design, start-up, operation and maintenance. This training equips teams with the knowledge to maintain and operate systems as well as safely and effectively handle heat transfer fluid.

Start-up assistance

Eastman reviews start-up procedures and offers suggestions to reduce typical problems. Customers can also get help by calling their local Eastman technical specialist or through on-site assistance. This extends to regulatory compliance. Our industry expertise in safe fluid usage ensures companies stay in line with environmental and safety regulations.

Flush fluid and fluid refill

Liquid-phase heat transfer systems can be cleaned with Eastman's special cleaning fluids, including Therminol® FF flushing fluid. After the system is flushed, users can add the appropriate liquid-phase Therminol or Marlotherm® heat transfer fluid.

Compliance assurance

Our experts help customers come into regulatory compliance related to safety, health and environmental issues. Our proactive approach helps prevent potential problems from becoming substantive.

Environmental impact

Facilitate waste heat recovery to enhance resource use and minimize environmental impact. Using our services to achieve this saves money while promoting sustainability initiatives.

For more information, visit **Therminol.com.**

EASTMAN

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