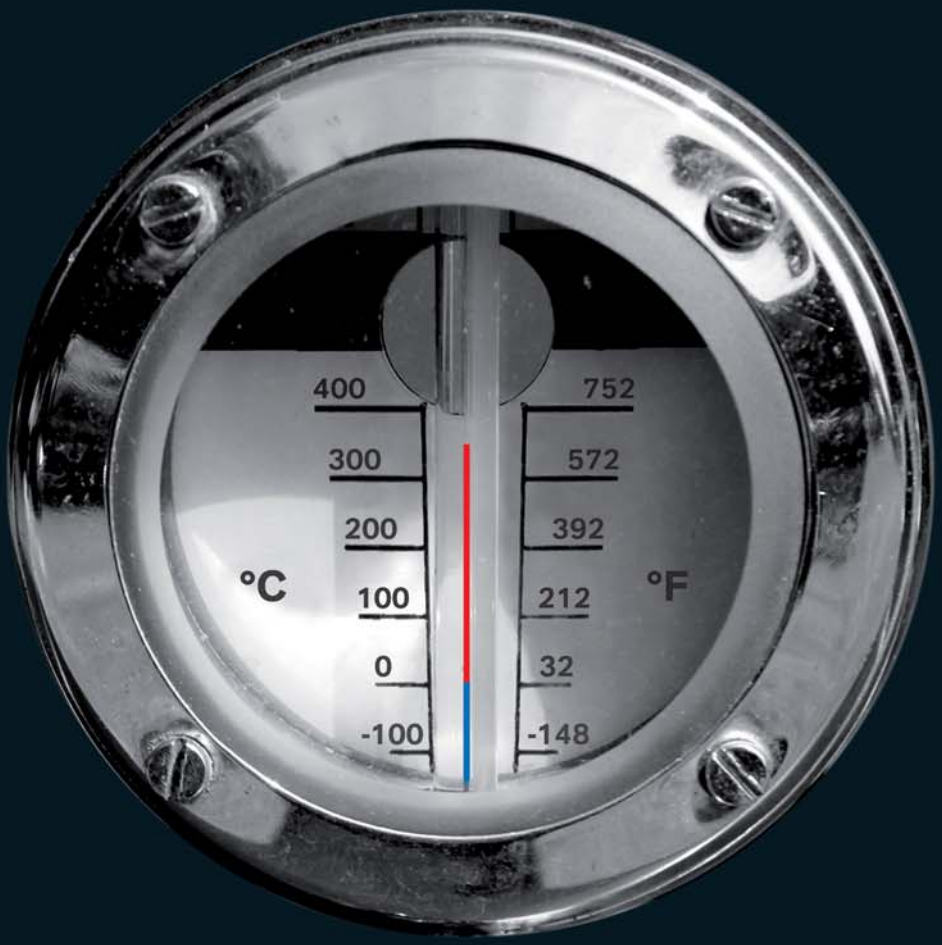
QUALITY HEATS.



Heat Transfer Fluids

Diphyl® Diphyl® DT Diphyl® KT Diphyl® THT

QUALITY WORKS.

LANXESS

LANXESS Distribution GmbH

WELCOME
TO LANXESS DISTRIBUTION

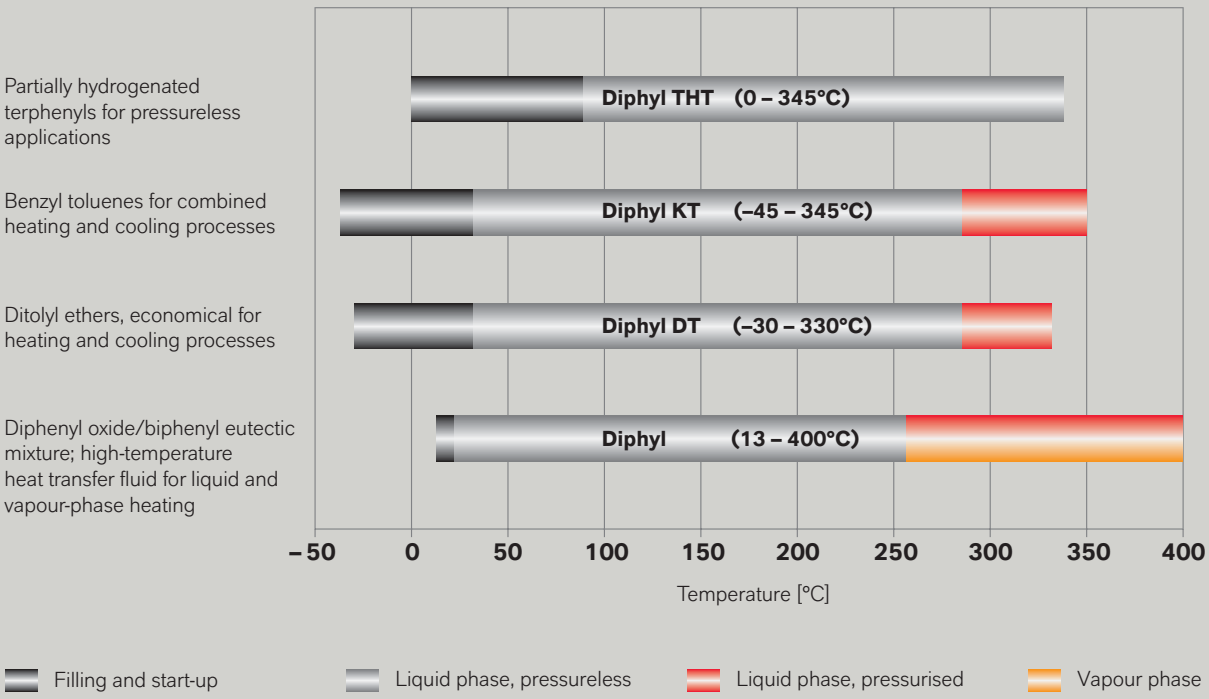
LANXESS is a leading specialty chemical company, currently represented with more then 50 production sites worldwide. The core business of LANXESS is the development, manufacture and marketing of plastics, rubber, intermediates and specialty chemicals.

As a 100% subsidiary, LANXESS Distribution GmbH is focused on the marketing and distribution of premium chemical products, providing expert solutions and specialist advice to our customers.

Combined with our technical expertise, international network, flexible lot sizes and outstanding service, this has made us a reliable, long-term partner for industry worldwide.

We offer products for the chemical industry, personal care, animal nutrition and selected plant protection products.

Diphyl® Heat Transfer Fluids from LANXESS and their application ranges



1.3. Heat Transfer Fluids

The LANXESS portfolio of HTF is based on synthetic products which are designed for use in the high temperature range. Four products which are based on very stable aromatic molecules allow for a wide range of application, from liquid at temperatures from -45 to 350°C to pressurized liquid/vapour up to 400°C. The unique products can be used in an almost unlimited number of applications in the wood, metal, oil refinery, chemical, polymer and many other industries.

Diphyl®	HTF for very high temperatures, pressure(less) application in liquid/vapour phase
Diphyl® DT	HTF for low to medium temperatures, pressure(less) application in liquid phase
Diphyl® KT	HTF for low to high temperatures, pressure(less) application in liquid phase
Diphyl® THT	HTF for high temperatures, application in liquid phase

4. DIPHYL® DT

4.1. General Properties

Diphyl® DT is a mixture of isomeric ditolyl ethers (dimethyl diphenyloxides). It boils in the temperature range between 284 and 294°C at 1.013 bar. Under pressure it can be operated in the liquid phase up to a temperature 330°C.

Special mention should be made of the low viscosity of Diphyl® DT even at low temperatures. With a pour point of -54°C, Diphyl® DT can be operated even at temperatures as low as -30°C.

It has a water content of maximum 0.02% by weight on delivery, is not hygroscopic and is virtually immiscible with water. Even at 30°C and 100% relative humidity, a maximum of only 0.07% by weight water dissolves in Diphyl® DT.

The autoignition temperature is 545°C, meaning Diphyl® DT is classified as temperature class T1. Unlike water, the conversion from a liquid to a solid state reduces the volume. Apparatus and pipelines are not damaged by solidification of the Diphyl® DT filling. The typical inherent odour of Diphyl® DT enables leaks to be identified quickly. The level of production-related impurities, such as chlorine and sulphur compounds, is so low that corrosive damage caused by the HTF is unlikely.

4.2. Characteristic Data

Parameter	Unit	Diphyl® DT
Appearance		clear, pale yellow liquid
Odour		inherent odour
Ditolyl ether content	weight-%	min. 97.5
Pour point	°C	-54
Boiling range	°C	284-294
Flash point	°C	135
Autoignition temperature	°C	545
Maximum film temperature	°C	340
Density (20°C)	kg/m³	1035
Kinematic viscosity (20°C)	mm²/s	6.3
Surface tension(20°C)	mN/m	37
Thermal conductivity (20°C)	W/m.K	0.134
Mean specific heat (20°C)	kJ/kg.K	1.58
Net caloric value HU	MJ/kg	37.6
Coeff. of therm. expansion (-20 to 300°C)	K^{-1}	$10.6 \cdot 10^{-4}$

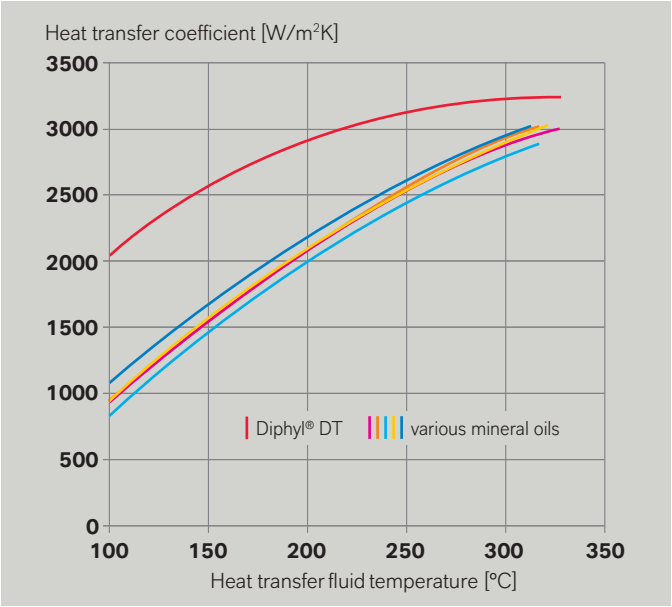
Physical Properties

Temperature	Vapour pressure	Dynamic viscosity	Density Liquid	Specific heat Liquid	Thermal conductivity	Surface tension
		Liquid			Liquid	
°C	mbar	mPa·s	kg/m³	kJ/kg·K	W/m·K	mN/m
-20		35.43	1056	1.475	0.140	
0		12.43	1044	1.530	0.137	38.7
20		5.88	1031	1.585	0.134	37.0
40		3.35	1017	1.640	0.131	35.3
60		2.17	1003	1.696	0.128	33.6
80		1.53	988	1.751	0.125	31.9
100		1.15	972	1.806	0.122	30.2
120		0.90	956	1.861	0.119	28.6
140	10.2	0.74	939	1.916	0.116	26.9
160	23.9	0.62	922	1.971	0.113	25.2
180	51.4	0.53	904	2.026	0.111	23.5
200	101.6	0.47	885	2.081	0.108	21.8
220	187.6	0.42	865	2.136	0.105	
240	326.3	0.38	845	2.192	0.102	
260	539.3	0.34	824	2.247	0.100	
280	853.0	0.32	803	2.302	0.097	
300	1299	0.29	781	2.357	0.094	
320	1914	0.27	758	2.412	0.092	
340	2742	0.26	735	2.467	0.089	

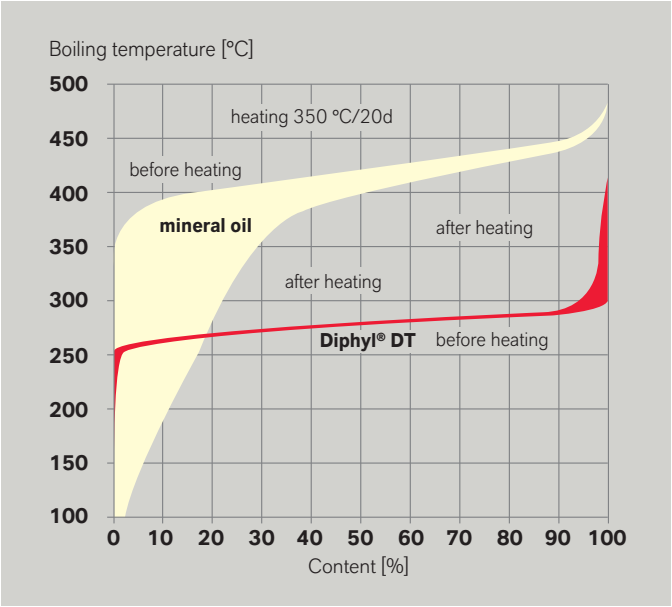
4.3. Diphyl® DT versus Mineral Oils

Whereas mineral oil-based HTF are isomeric mixtures of paraffin or naphthene-basic hydrocarbons, synthetic organic HTF like Diphyl® DT have well defined compositions and are much more stable due to the aromatic nature of the molecules. Diphyl® DT has appreciable advantages in application over mineral oil based types. Its high thermal stability increases life expectancy 2-3 times over that of mineral oil based HTF. Moreover, circuits filled with Diphyl® DT can be started up faster and more easily.

The heat transfer coefficients are also much better than those for mineral oils under identical conditions (see figure).



Heat transfer coefficient of Diphyl® DT compared with various mineral oils



Thermal stability acc. to DIN 51528, simulated distillation GC with Diphyl® DT and mineral oil

4.4. Applications

Many processes require uniform heating to high temperatures, precise temperature control, or removal and recovery of heat.

For the medium temperature range up to 330°C, Diphyl® DT is a cost-effective organic HTF of consistent composition. Its special properties are its low viscosity and low pour point. With this HTF – which should only be used in the liquid phase – all the advantages of the liquid phase process can be ex-ploited. For example, plants can be started up in winter time without any preheating and without a positive-displacement pump. No accompanying heating is needed. Another important feature is its low viscosity. This means greater safety against overloading in the heater, a smaller heating surface area of the consumer and/or faster heating.

Moreover, the low viscosity combined with the high thermal expansion coefficient offers the possibility of designing simple, cost effective plants with natural circulation of the HTF.

Diphyl® DT in Coating Resin Production

In the synthesis of various coating raw materials such as polyesters, polyamide and polypropylene, it is very important indeed to have accurate and reliable temperature control, for heating and cooling the individual stages of the process. Key properties of Diphyl® DT in the range from 30 – 300°C are its low vapour pressure, high auto-ignition temperature, good heat transfer properties and in particular accurate temperature control within narrow limits and high temperature stability.

Diphyl® DT in Phthalic Anhydride Production

In the production of phthalic anhydride, products are alternately precipitated and melted down in so-called switch condensers. Organic HTF have been used for many years for these cooling and heating processes.

Diphyl® DT in particular has proved itself for this application compared with mineral oils. Due to its low viscosity, higher thermal stability and consequently its low formation of solid substances, as well as its good heat transfer properties, Diphyl® DT is nowadays being used in a large number of phthalic anhydride production plants throughout the world.

Other Applications

Diphyl® DT can be used virtually anywhere where work is being carried out at high temperatures, typically between 200 and 300°C. Depending on the particular operating conditions, the HTF is used for heating or for dissipating the heat. Because of its outstanding versatility, a large number of applications have opened up for Diphyl® DT. The possibilities for using Diphyl® DT should be examined not only with reference to the examples shown here, but should be considered for any process which requires heating or cooling.

Health and Safety Information
Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling the LANXESS products mentioned in this publication. For materials mentioned which are not LANXESS products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be followed. Before working with any of these products, you must read and become familiar with the available information on their hazards, proper use and handling. This cannot be over-emphasized. Information is available in several forms, e.g., material safety data sheets, product information and product labels. Consult your LANXESS representative in Germany or contact the Health, Safety, Environment and Quality Department (HSEQ) of LANXESS Germany or – for business in the USA – the LANXESS Product Safety and Regulatory Affairs Department in Pittsburgh, PA, USA.

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