



DURATHERM

Heat Transfer Fluids

COMPARATIVE ANALYSIS

Duratherm, Therminol®, and Dowtherm™ Heat Transfer Fluids



The number of heat transfer fluids available on the market can make selecting the appropriate fluid an overwhelming process. Safety and chemical composition are two key factors that should be considered when choosing a fluid for your process. While worker and environmental safety should always be a priority, fluid compatibility between previously used and new fluids will also affect your choice. Duratherm, Therminol®, and Dowtherm™ all offer a variety of heat transfer products, but only one of the three offers a complete line of non-toxic and non-hazardous fluids – Duratherm.

www.durathermfluids.uk

WORKER SAFETY

Ensuring a safe workplace begins with utilizing safe process fluids. While some products on the market are composed of chemicals that are classified as health hazards, Duratherm heat transfer fluids are formulated from non-toxic and non-hazardous components. This negates the need for specialized training or handling procedures. Disposal costs can also be lowered since no special permits are required.



Therminol® SP, ADX-10 and 55, along with Dowtherm™ Q, are formulated using benzene-based chemicals. Benzene is a colorless, or light yellow, colored liquid with a high vapor pressure that makes it flammable. When used at elevated temperatures, benzene will also release noxious fumes due to the vapor pressure of the fluid. Therminol® SP, ADX-10, and 55 have relatively low flash points that can pose an increased risk of fire if there is, for example, an accidental leak of fluid. The same is true for Dowtherm™ Q, with an advertised flash point of approximately 121°C (250°F).

Another potential hazard is the phenol-based compounds that exist within the Dowtherm™ RP and G, as well as the Therminol® 62 and 59, products. These phenol-based compounds can pose a severe health hazard when utilized at elevated temperatures. The vapors that are produced are highly toxic in low concentrations and explosive at some concentrations as low as 3%. These aromatic heat transfer fluids can also release benzene compounds at elevated temperatures, the risks of which are discussed below.

Table 1: Comparison of Flammability Data (Higher Numbers = Less Volatile).

Test	Duratherm 630	Duratherm HF	Therminol® 66	Therminol® ADX-10	Therminol® 55	Therminol® 59	Therminol® 62	Dowtherm™ Q	Dowtherm™ RP	Dowtherm™ G
Flash Point (°C)	230	276	170	136	166	132	160	121	194	137
Auto Ignition Point (°C)	375	393	374	327	343	372	407	412	385	432

When benzene fumes are inhaled, they can cause long-term illnesses in humans. Exposure to benzene fumes has been shown to cause bone marrow cells to not produce enough red blood cells, which will eventually lead to anemia. Benzene exposure has also been linked to birth defects and low birth weights.

Alkanes are another category of potentially dangerous chemicals that are used in Therminol's® products. Alkanes are typically found in a wide variety of store-bought solvents that usually require extensive safety warnings and careful handling, such as mineral spirits (white spirit). Similar to benzene, alkanes are also highly flammable and can pose serious health concerns. Acute exposure to alkanes has been linked to central nervous system damage and can produce chemical burns on the skin.

WORKER SAFETY Continued

Phenol-based compounds, such as those found in Dowtherm™ heat transfer fluids, are aromatic organic molecules that are typically acidic and known for causing chemical burns. These compounds are also toxic to humans, even in low concentrations. Ingestion of as little as 1 gram can be fatal to adults, while smaller amounts are linked to reproductive toxicity. Inhalation of phenol-based compounds can also lead to severe respiratory issues, such as edema. The toxicity towards humans also carries over to the environment, with the ability to contaminate ecosystems in very small quantities.



The terphenyls found within Therminol® 66's formulation are a group of chemicals that can also pose serious health risks. These aromatic hydrocarbons are highly toxic, as indicated by their permissible exposure limits of approximately 0.5 ppm. Their toxicity to mammals is also heavily documented. The tables below illustrate the toxicity of these chemicals on common test animals.

Table 2: Mammalia Toxicity (Lower Value = More Toxic).

Mammalia Toxicity	Duratherm 630	Therminol® ADX-10	Therminol® SP	Therminol® 66	Therminol® 55	Therminol® 59	Therminol® 62
Oral Toxicity	>5,000mg/kg – Non-toxic	2,000 mg/kg	1,000 mg/kg	2,000 mg/kg	1,580 mg/kg	3,000 mg/kg	3,000 mg/kg
Dermal Toxicity	0 – Non-Irritant	2,000 mg/kg	3,600 mg/kg	2,000 mg/kg	7,940 mg/kg	5,000 mg/kg	5,000 mg/kg

Table 3: Mammalia Toxicity (Lower Value = More Toxic)

Mammalia Toxicity	Duratherm 450	Duratherm HF	Dowtherm™ Q	Dowtherm™ RP	Dowtherm™ G
Oral Toxicity	>5,000 mg/kg – Non-toxic	>5,000 mg/kg – Non-Toxic	5,000 mg/kg	2,000 mg/kg	2,322 mg/kg
Dermal Toxicity	0 – Non-Irritant	0 – Non-Irritant	5,000 mg/kg	2,000 mg/kg	2,000 mg/kg

In comparison, Duratherm's heat transfer fluids do not contain any of the dangerous chemicals that were previously described. They are formulated with 100% non-toxic and non-hazardous componentry, and do not require any special handling or disposal procedures. The fluids can be disposed of in the same manner as standard used oils. The exceedingly low vapor pressure of our fluids greatly minimizes the production of vapors, even under high process temperatures. The high flash points improve safety by helping eliminate the fire hazard that is typically associated with other heat transfer fluids.

ENVIRONMENTAL SAFETY

While employee safety is always a major concern, environmental safety must also be considered during fluid transitions. Reducing the amount of toxic by-products that are released by industrial processes ensures minimal impact on the earth. Choosing environmentally-friendly fluids is an ideal way to reduce this impact.

The chemicals commonly utilized in Therminol® and Dowtherm™ products – benzene, alkanes, phenols and terphenyls – are just as toxic to the environment as they are to humans. Eco-friendly fluid choices, such as Duratherm's heat transfer fluids, reduce potential liability from accidental spills and are also inherently biodegradable.

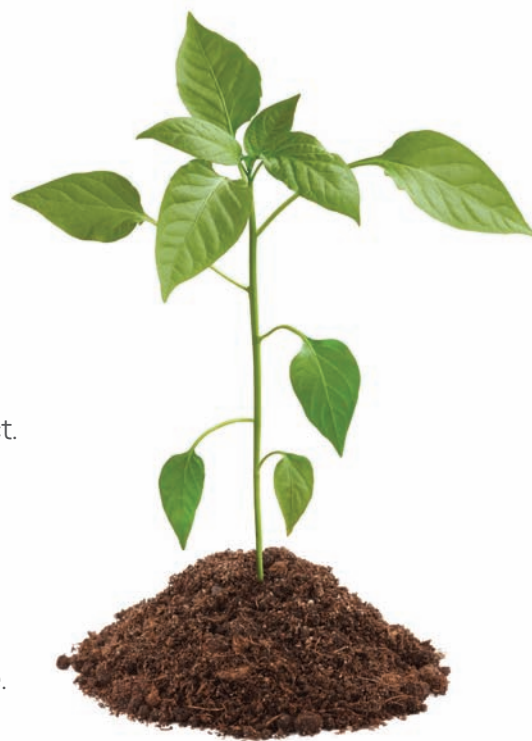


Table 4: Eco-toxicity Comparison (Higher Number = Lower Toxicity).

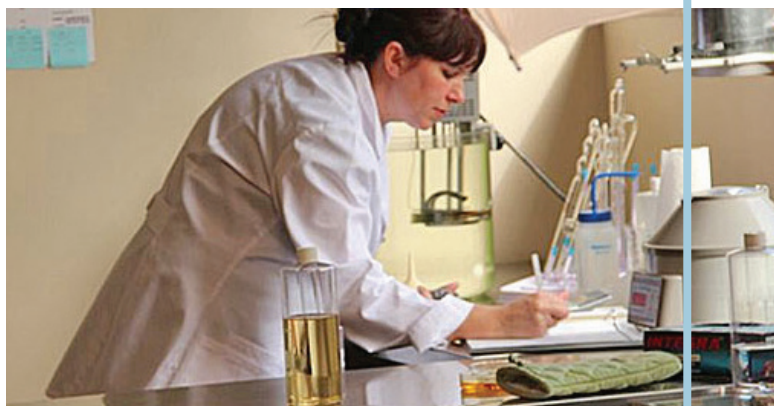
Eco-Toxicity	Duratherm 630	Therminol® SP	Therminol® 66	Therminol® ADX-10	Therminol®55	Therminol®59	Therminol® 62
Algae Toxicity	>100,000 mg/L	2.08 mg/L	0.103 mg/L	1,000 mg/L	1,000 mg/L	0.67 mg/L	10.1 µg/L
Fish Toxicity	>100,000 mg/L	100 mg/L	27 mg/L	1,000 mg/L	1,000 mg/L	0.97 mg/L	8.24 µg/L
Other Aquatic Invertebrates Toxicity	>100,000 mg/L	1.4 mg/L	22 µg/L	1.0 mg/L	600 mg/L	0.3 mg/L	4.52 µg/L
Biodegradability	Inherently Biodegradable	Not Readily Biodegradable	Not Readily Biodegradable	Not Readily Biodegradable	Not Readily Biodegradable	Not Readily Biodegradable	Not Readily Biodegradable

Table 5: Eco-toxicity Comparison (Higher Number = Lower Toxicity)

Eco-Toxicity	Duratherm 450	Duratherm HF	Dowtherm™ Q	Dowtherm™ RP	Dowtherm™ G
Algae Toxicity	>100,000 mg/L	>100,000 mg/L	<1 mg/L	0.07 mg/L	<1mg/L
Fish Toxicity	>100,000 mg/L	>100,000 mg/L	<1 mg/L	0.0225 mg/L	5.7 mg/L
Other Aquatic Invertebrates Toxicity	>100,000 mg/L	>100,000 mg/L	0.17 mg/L	0.062 mg/L	0.1 mg/L
Biodegradability	Inherently Biodegradable	Inherently Biodegradable	Not Readily Biodegradable	Not Readily Biodegradable	Not Readily Biodegradable

The data presented on the Therminol® and Dowtherm™ products' chemical compositions indicates that they can pose a risk to the health of aquatic life, even in very low or minimal concentrations. Some of the Therminol® and Dowtherm™ products that are listed are not readily biodegradable as well. This could lead to an increased liability for the plant in the event of an accidental discharge. **Duratherm 630's** formulation is non-toxic, inherently biodegradable and safe for aquatic life, even in high concentrations.

FLUID PROPERTIES COMPARISON



Fluid	Duratherm 630	Duratherm HF	Therminol® 66	Therminol® 55	Therminol® SP	Therminol® 62	Dowtherm Q	Dowtherm G	Dowtherm RP
Max Bulk Temp. (°C)	332	338	345	305**	315	325	330	360	350
Min Use Temp - Vis @300°C cSt*	5	24	13	-8	-7	-9	n/a	n/a	n/a
Flash Point (°C)	229	276	184	193	177	171	120	137	194
Vis @40°C	42.31	103.21	29.6	36.8	18.99	10.7	2.37	6.35	14.92
Vis @ Max Temp	0.73	0.71	0.43	0.45	0.53	10.7	0.17	0.21	0.31
Heat Capacity @ Max Temp (kJ/kg-K)	2.971	2.392	2.889	2.950	2.860	2.580	2.587	2.735	2.602
Thermal Conductivity @ Max Temp (W/m-K)	0.127	0.144	0.084	0.094	0.097	0.090	0.077	0.087	0.089
Vapor Pressure @ Max Temp (kPa)	15.03	23.06	148.1	48.70	27.20	86.07	495	437	142

Fluid	Duratherm 450	Therminol® ADX-10	Duratherm LT	Therminol® 59	Duratherm XLT-120	Duratherm XLT-50	Therminol® D12
Max Bulk Temp. (°C)	232	250	315	315	65	121	230
Min Use Temp - Vis @300°C cSt*	-53	-43	-31	-38	-93	-65	-80
Flash Point (°C)	150	136	165	132	49	85	59
Vis @40°C	4.61	4.03	7.98	4.04	0.98	5.57	1.239
Vis @ Max Temp	0.68	0.39	0.53	0.32	0.77	0.86	0.277
Heat Capacity @ Max Temp (kJ/kg-K)	2.725	2.720	3.102	2.680	2.158	2.361	2.971
Thermal Conductivity @ Max Temp (W/m-K)	0.129	0.090	0.123	0.089	0.133	0.135	0.070
Vapor Pressure @ Max Temp (kPa)	19.82	37.00	64.75	162.00	2764	21.51	228.7

*Subject to user system/pump capabilities

**Bulk temp, not extended use temp