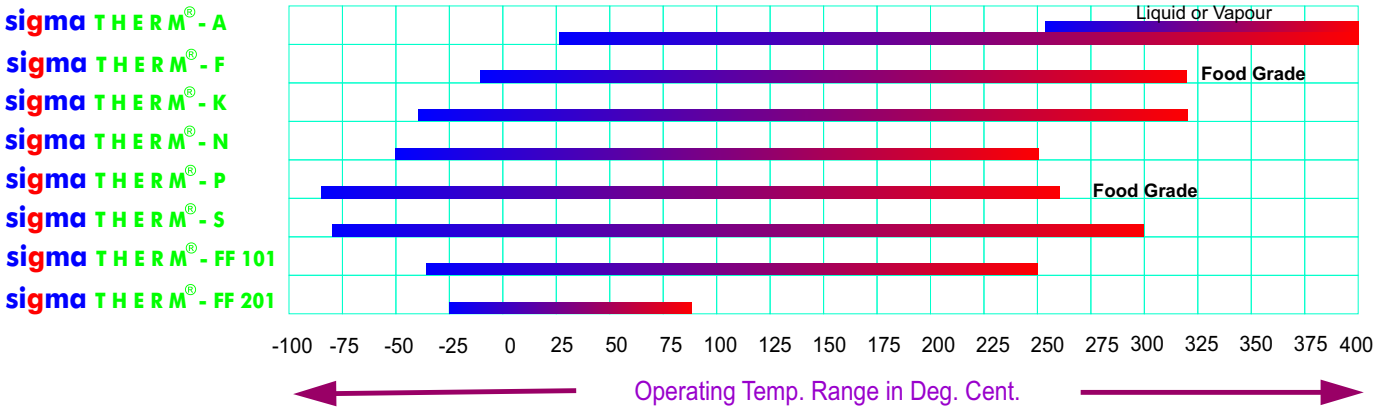
Shreyas Petroleum Additives Limited

High Temperature Synthetic Thermic Fluid

sigma THERM® - K

Extended Life Thermic Fluid

Thermic Fluid and other Speciality Range



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ISO 9001

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High Temperature Synthetic Heat Transfer Fluid

sigma THERM® - K

Extended Life Thermic Fluid

Description :

sigma THERM® – K is a synthetic heat transfer fluid.

Application :

Indirect closed heat transfer systems up to 320°C.
For best life it should be used at or below 300°C.

Benefits :

As compared to other mineral based thermic fluid, it has…….

- ✓ High thermal stability.
- ✓ High oxidation stability
- ✓ Very low carbon deposits.
- ✓ Long Life.
- ✓ Reduced " Low Boilers " and " High Boilers"

sigma THERM® – K has lower Viscosity as compared to other thermic fluids - lower power consumption of circulating pump and high co-efficient of heat transfer.

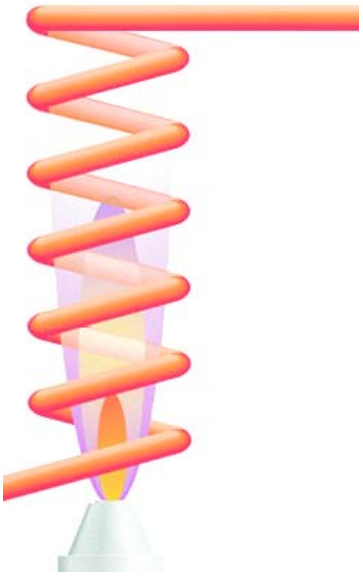
sigma THERM® – K has been thoroughly tested in the laboratory with different proportionate of mineral oil at various high temperatures for stability and other related parameters.

Based on results it is proved that **sigma THERM® – K** could be used for top-up purpose in the systems already containing mineral oil based thermic fluids or similar chemistry synthetic fluid.

Thermic Fluids after some time of usage

sigma THERM® – K Mineral oil Based

Packing : 210 Liters Barrel



High and Low Boilers :

High and low boilers are formed when heat transfer fluids are heated to a high temperature and certain molecular bonds begin to break or thermally degrade. Some of the new materials that form have a lower molecular weight and typically a lower boiling point than the original fluid: these are low boilers.

Other compounds resulting from thermal degradation will polymerize into higher molecular weight and higher boiling point molecules than the original fluid : These are high boilers.

High and low boilers seen in components may not have the heat transfer efficiency and thermal stability of the original heat transfer fluid molecules.

Typical Properties :

Base Oil	100 % Synthetic
Appearance	Bright Yellow liquid
Max. Temperature	320° C / 608° F
Kin. Vis. @ 40°C	19 - 23 cSt
Specific Gravity @ 15° C	0.86 ± 0.005
Flash Point (COC)	200 - 240° C
Pour point	(- 60) - (- 40) °C
Moisture content	50 - 100 ppm
Total Acid No.	0.005- 0.01 mg KOH/g
Auto Ignition Temperature	Above 375° C

SYNTHETIC

Mineral Oil Based Thermic Fluid.

In the Petroleum refinery crude oil goes through various refining processes like Distillation, Cracking, Isomerisation, Hydrogenation etc.

In the distillation process crude oil is heated and at different temperatures different petroleum products are available like – LPG, Aviation Fuel, Petrol, SKO, Diesel, Lubricant Base Oil, LDO, FO, Asphaltene etc.

This separation is purely on the basis of their boiling ranges. It means whatever may be the chemical structure (Paraffinic, Naphthenic, etc) and if it boils within certain temperature range it will be classified as a certain petroleum product.

This fundamental is also applicable for the lubrication base oil. It contains different class of chemistry with different structures like linear and branched chain with saturated and unsaturated carbons.

A particular boiling range petroleum refinery cut is being used as base oil for mineral based thermic fluid. Since source of raw material is mineral oil (Petroleum Crude) it is called mineral based thermic fluid.

Note :

All mineral oil based thermic fluid and sigma THERM® – K are compatible with each other. So if any system is filled with either of the fluid alternative fluids can be used for top up purpose.

sigma THERM® – K

- Synthetic Heat Transfer Fluid.

Since molecule of sigma THERM® – K is made by "Synthesis" process, it is called as synthetic oil.

A particular short length of Straight and Saturated Chain of Alkyl group is been reacted with particular Aromatic to produce Alkyl Substituted Aromatic.

Alkyl Substituted Aromatics are a base oil of sigma THERM® – K

It has a definite chemical structure and very narrow range of boiling.

Due to presence of Aromatic group and particular arrangement of short and saturated alkyl group in the molecule, it has far better properties like Oxidation resistance, Thermal stability, low carbon depositions, low viscosity, low rate of evaporation loss at operating temperature etc.

Thus due to its properties its deterioration rate is reduced by approx. half. In other words it has got double the life as compared to mineral base thermic fluids.

Aromatics are well known for their solvency effect. Presence of aromatic group in sigma THERM® – K provides self cleaning property.

Kin. Vis. at 40 °C of sigma THERM® – K is 19-23 cSt as compared to 32-36 of Mineral base thermic fluids. Lower viscosity will increase heat transfer rate.

In summery as compared to mineral based oil, it has.....

High thermal efficiency.	Better oxidation stability
Reduced "Low Boilers" and "High Boilers"	Lower carbon deposits.
Lower Power consumption of Pump	Long Life.

SYNTHETIC

Thermal Stability Test Report

sigma THERM® - K
Extended Life Thermic Fluid

The Cincinnati Milacron test (Procedure A * modified) consisted of heating 200 ml of thermal fluid in a beaker at 135 ± 3°C in a convection oven for 168 hours. Prior to heating, polished copper and steel rods were placed in the beaker with the rods touching each other. After 168 hours, the rods were inspected for deposits and lacquer and then rated against heat test standards on a scale from 1 to 10 where 10 indicates highly fouled rods (see Figure). The quantity of sludge produced in the fluid was also determined.
* Aluminum Fixture is not used

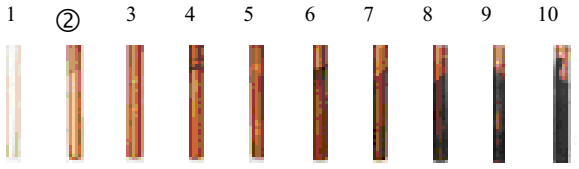
This test has been accepted worldwide as well as in ASTM standard by the Designation: D 2070 – 91 (Re-approved 2006)

Sr. No.	Test Description	Test Method	Result
1.	Rating of copper rod	As per Cincinnati Milacron scale	2
2.	Weight of sludge deposit on copper rod, mg	Weighing	- -
3.	Metal loss on copper rod, mg	Weighing	- 0.8
4.	Rating of steel rod	As per Cincinnati Milacron scale	2
5.	Weight of lacquer deposit on steel rod, mg	Weighing	+ 0.2
6.	Metal loss on steel rod, mg	Weighing	- -
7.	**Total sludge, mg/100ml**	**IS 1448 (P:41)**	**NIL**

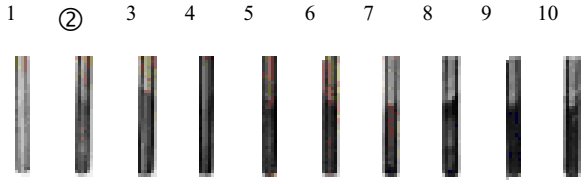
SYNTHETIC

Cincinnati Milacron Scale

Heat Test Standard



Copper Rod Corrosion Standard



Steel Rod Corrosion Standard

Test carried out at Independent Research laboratory – The Automotive Research Association of India, Research Institute of the Automotive Industry with the Ministry of Heavy Industries and Public Enterprises, Govt. Of India.

sigma THERM® - K

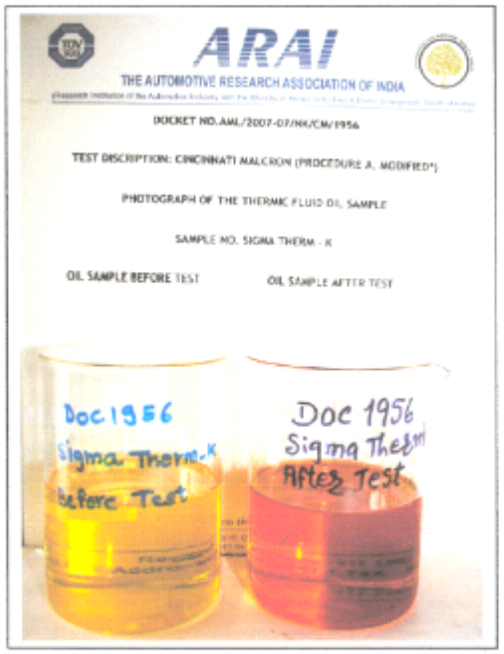
ARAI
Progress through Research

AML/2007-08/NK/CM/2391/329
OC No. 2391

TEST REPORT

Service requirements : Photograph of the samples before & after the Cincinnati Milacron (Procedure A, Modified*) test.

Sample Description : Sigma THERM – K



TEST COMPILED BY
MRS M.S.VARTAK
LABORATORY ASSISTANT

TEST REPORT VERIFIED BY
S. V. SHETE
ASSISTANT DIRECTOR
A. R. ARANKALLE
SR. ASSISTANT DIRECTOR

AML/2007-08/NK/CM/2391/329
OC No. 2391

TEST REPORT

Service requirements : Photograph of the samples before & after the Cincinnati Milacron (Procedure A, Modified*) test.

Sample Description : Market Leader Mineral based thermic fluid.

TEST COMPILED BY
MRS M.S.VARTAK
LABORATORY ASSISTANT

TEST REPORT VERIFIED BY
S. V. SHETE
ASSISTANT DIRECTOR
A. R. ARANKALLE
SR. ASSISTANT DIRECTOR

Shreyas Petroleum Additives Limited

Thermal Stability Test Photos
sigma THERM® - K
Extended Life Thermic Fluid

	sigma THERM® - K	All Other Thermic Fluids
Kin. Vis. @ 40 °C, cSt	19-23	32 - 38

High Co efficient of Heat Transfer :

Heat transfer of co-efficient (h) is calculated by below given formula.

$$h = \frac{k_w \,.\, Nu}{D_H}$$

Where

k_w = thermal conductivity

Nu = Nusselt number

$= 0.024.Re^{0.8} \,.\, Pr^{0.4}$

Dittus-Boelter correlation for pipe flow with fluid heated by wall

Pr = Prandtl number = $\frac{Cp \,.\, V}{K_w}$

Re = Reynolds number = $\frac{m.D_H}{V \,.\, A}$

D_H = Hydraulic diameter

m = mass flow rate

V = viscosity

Cp = heat capacity at constant pressure

A = cross-sectional area of flow

By solving above formula it is proved that heat transfer co-efficient is inversely proportionate to the viscosity of the fluid.

$$h \propto \frac{1}{V}$$

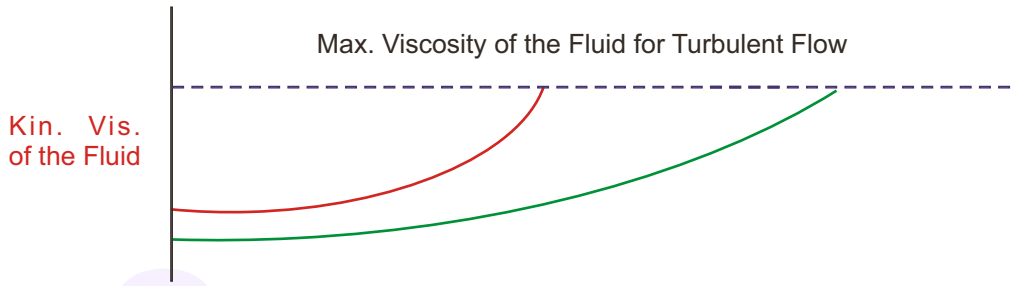
At 40 °C Kin. Vis. of sigma THERM® - K is just 19 - 23 cSt as compared to 32 - 38 of all other mineral based or synthetic thermic fluids. Lower viscosity of sigma THERM® - K provides very high co-efficient of heat transfer as compared to any other thermic fluid.

Viscosity Index of sigma THERM® - K is very low as compared to 95 of mineral oil based thermic fluid. It means as the temperature increases sigma THERM® - K will be thinner as compared to mineral oil. At operating temperature difference between Kinematic Viscosity will be further increased. This in tern increases heat transfer co-efficient at operating temperature.

In thermopack system heat transfer oil gets below 1 minute to get heat from both the coils. Same way this much short time is available on machine side. In this circumstances speed at which it gets and releases heat is very important. Speed of heat transfer is Co efficient of heat transfer. So lower the viscosity of oil - faster heat transfer.

- Reduced load on circulating pump
- High Flow Rate of thermic fluid with the same power usage.
- High co efficient of heat transfer gives higher thermal efficiency and thus reduces fuel consumption.

To maintain turbulent flow inside the tube is very important for any thermic fluid based heat transfer system. Now to maintain turbulent flow Viscosity of oil should not exceed certain limit. Turbulent flow is important for better heat transfer and long life of thermic fluid.



Mineral Based Thermic Fluid

sigma THERM® – K

Since thermal stability of mineral based thermic fluid is lower as compared to synthetic thermic fluid normal life of synthetic thermic fluid is 2 to 3 times.

Viscosity and Viscosity Index of sigma THERM® – K is very low as compared to all other mineral and synthetic fluids. So it takes longer duration to reach viscosity where turbulent flow is not possible.

SYNTHETIC

Temp °C	Density	Specific Heat	Thermal Conductivity	Kinematic Viscosity	Vapour Pressure	Volumetric Expansion
	kg/m^3	KJ/Kg K	W/m K	cSt	psia	%
-25	902	1.74	0.1336	1450	0	-
0	885	1.83	0.1306	172	0	0
25	869	1.92	0.1278	40	0	1.8
50	851	2.01	0.125	13	0	3.8
75	835	2.1	0.122	6.21	0	5.6
100	818	2.2	0.119	3.52	0.00495	7.6
125	801	2.28	0.1162	2.32	0.0157	9.5
150	783	2.36	0.1133	1.65	0.0484	11.5
175	766	2.45	0.1103	1.2	0.117	13.4
200	748	2.55	0.1074	0.97	0.319	15.5
225	730	2.64	0.1045	0.823	0.686	17.5
250	711	2.72	0.1016	0.686	1.41	19.7
275	692	2.81	0.0985	0.581	2.76	21.6
300	671	2.9	0.0954	0.496	5.06	23.6
325	650	3	0.0925	0.425	9	25.5

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sigma THERM® - K