

CALFLO™ AF HEAT TRANSFER FLUID

Introduction

Petro-Canada CALFLO™ AF is a highly efficient heat transfer fluid formulated to lower operating costs in systems where fluid resistance to oxidative breakdown is critical.

CALFLO AF's unique chemistry starts with a blend of 99.9% pure base fluids, produced using the HT purity process. These crystal clear fluids are free of impurities that can hinder performance. Utilizing more than 25 years of formulating experience, Petro-Canada fortifies these thermally stable fluids with specially selected additives to provide stronger resistance to oxidative breakdown than leading competitive fluids.

The result is CALFLO AF, a heat transfer fluid that provides high thermal efficiency in systems operating up to 316°C (600°F). CALFLO AF's breakthrough chemistry can extend fluid life longer than leading competitive fluids, lowering operating costs by reducing the frequency of fluid change-outs.

Applications

Petro-Canada CALFLO AF is recommended for use in non pressurized, liquid phase, closed heat transfer systems operating at bulk temperatures up to 316°C (600°F). CALFLO AF's outstanding resistance to oxidative breakdown can result in longer fluid life and lower operating costs in systems where exposure to air cannot be avoided, and oxidation is the most likely form of fluid degradation. Typical applications include temperature control units used in plastic extrusion, plastic moulding, and metal die-casting operations.

Features and Benefits

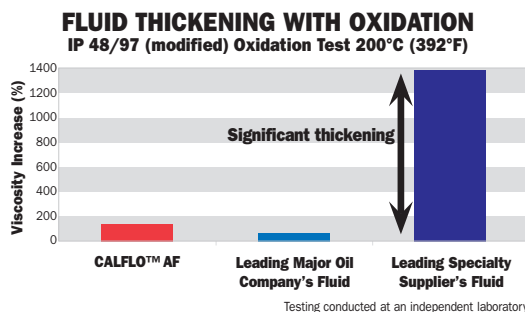
- **Better oxidative resistance than leading competitors can extend fluid life and lower operating costs.**

- Higher resistance to oxidative breakdown versus leading competitive fluids.

As a fluid oxidizes, it becomes more viscous. This increase in viscosity can:

- significantly reduce a fluid's thermal efficiency
- make the fluid more difficult to circulate through the heat transfer system
- result in overheating of the fluid
- necessitate a costly, premature fluid change-out

CALFLO AF demonstrates significantly better resistance to viscosity increase versus a leading specialty fluid in a severe oxidation test conducted at an independent industry laboratory:



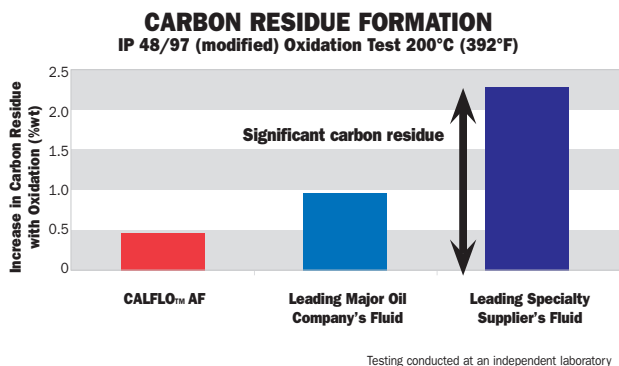
- Less prone to carbon residue and sludge formation versus leading competitive fluids. CALFLO AF's resistance to oxidative breakdown also minimizes the formation of carbonaceous deposits and sludge within heat transfer systems. These deposits can dramatically reduce heat transfer efficiency and increase operating costs.

What is the HT difference?

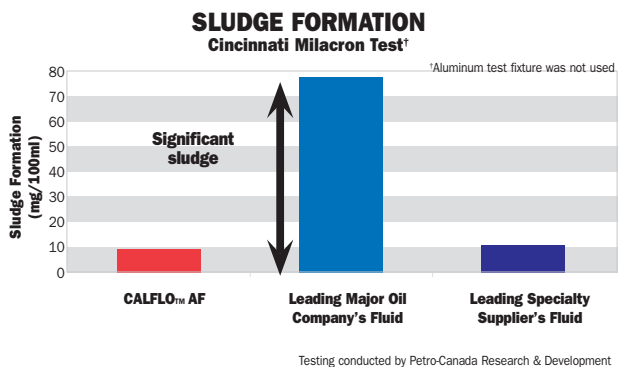
Petro-Canada Lubricants starts with the HT purity process to produce water-white, 99.9% pure base oils. The result is a range of lubricants, specialty fluids and greases that deliver maximum performance for our customers.



CALFLO AF demonstrates significantly better resistance to carbon residue formation versus a leading major oil company's fluid and a leading specialty supplier's fluid in a severe oxidation test conducted at an independent industry laboratory:



Even at mild 135°C (275°F) temperature conditions, a second laboratory study conducted by Petro-Canada Research and Development demonstrates CALFLO AF's stronger resistance to sludge formation versus a leading major oil company's fluid:



- **Low vapour pressure can save on top-up costs while improving workplace safety.**
 - CALFLO AF's low vapour pressure can reduce or eliminate fluid leakage from control valves and pipe flanges.
 - Reduction or elimination of leaks provides a cleaner and safer operating environment, and results in operational savings by reducing the need for cleaning, maintenance and fluid top-up.
- **Natural lubricity extends operational savings.**
 - CALFLO AF's natural lubricating properties can also reduce maintenance costs by extending the service life of circulating pumps and other rotating parts.

- **No compromise to environmental and workplace health and safety.**
 - Unlike some alternative fluid chemistries, CALFLO AF is virtually odourless and is not considered a toxic* substance according to OSHA (United States), WHMIS (Canada) and EUDPD (Europe) criteria.
 - Because CALFLO AF produces no objectionable odours and is not a respiratory or skin irritant, workplace conditions remain pleasant and safe for continuous operations.
 - CALFLO AF does not require special handling. Shipments and storage of CALFLO AF do not normally require special safety permits. Empty drums used to transport CALFLO AF are readily accepted by drum re-conditioners. In addition, used CALFLO AF may be responsibly disposed in the following ways **:
 - through re-sale to used oil recycling companies
 - in some jurisdictions, combined with BTU recovery systems

Operational Considerations

CALFLO AF's high thermal stability provides long service life under normal operating conditions up to its maximum recommended temperature. However, actual fluid life is dependent upon system design and operating practice.

Special precautions should be taken to avoid operating conditions that can shorten fluid life. These include:

- thermal shocking resulting from accelerated system temperature increases
- thermal shocking from hot spots on a system's heating coils
- continuously running above the maximum recommended operating temperature

Although CALFLO AF is highly resistant to oxidative breakdown, excessive air and water contamination can reduce thermal efficiency and shorten fluid life. Where practical, Petro-Canada recommends inert gas blanketing of a system's expansion tank to guard against exposure to air and water and the need to change-out the fluid prematurely.

While CALFLO AF has been formulated to resist breakdown when exposed to air and water, contamination with process chemicals or deteriorated residual fluids can shorten fluid life. To maximize system efficiency and fluid life, Petro-Canada highly recommends system cleaning and flushing to remove all contaminants, sludge and varnish prior to recharging a system with CALFLO AF.

Thermal Data

PROPERTY	TEMPERATURE			
	15°C (59°F)	38°C (100°F)	260°C (500°F)	316°C (600°F)
Density, kg/L (lb/ft ³)	0.867 (54.1)	0.852 (53.2)	0.715 (44.7)	0.681 (42.5)
Thermal Conductivity, W/m K (BTU/hr.°F.ft)	0.142 (0.082)	0.141 (0.082)	0.130 (0.075)	0.127 (0.073)
Heat Capacity, kJ/kg K (BTU/lb. °F)	1.89 (0.45)	1.96 (0.47)	2.69 (0.64)	2.88 (0.69)
Vapour Pressure, kPa (psia)	0.00 (0.00)	0.00 (0.00)	3.78 (0.55)	15.32 (2.20)

For detailed heat transfer calculations please refer to our Engineering Assistant software which is available at no cost from your Petro-Canada representative.

Typical Performance Data

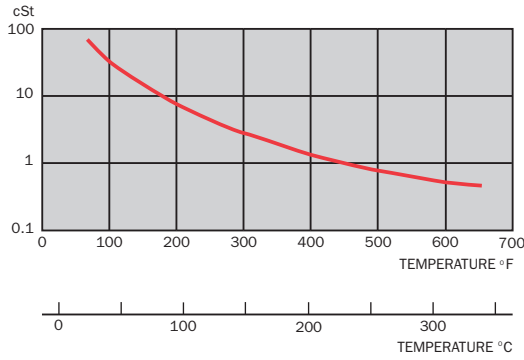
PROPERTY	TEST METHOD	RESULTS
Colour	ASTM D1500	<0.5
Pour Point, °C (°F)	ASTM D5950	-42 (-44)
Flash Point, COC, °C (°F)	ASTM D92	217 (423)
Fire Point, °C (°F)	ASTM D92	240 (464)
Autoignition Temperature, °C (°F)	ASTM E659	343 (649)
Viscosity, cSt at 40°C (104°F)	ASTM D445	32.1
cSt at 100°C (212°F)		5.4
cSt at 316°C (600°F)		0.7
Average Molecular Weight		371
Neutralization Value, TAN, mg KOH/g	ASTM D664	< 0.1
Sulfur by XRF, wt%	ASTM D4294	< 0.0001
Conradson Carbon Residue, wt %	ASTM D189	0.01
Coefficient of Thermal Expansion, %/°C (%/°F)		0.0907 (0.0504)
Distillation Range, °C (°F)	ASTM D2887	
10%		365 (689)
50%		417 (783)
90%	475 (887)	

The values quoted above are typical of normal production. They do not constitute a specification.

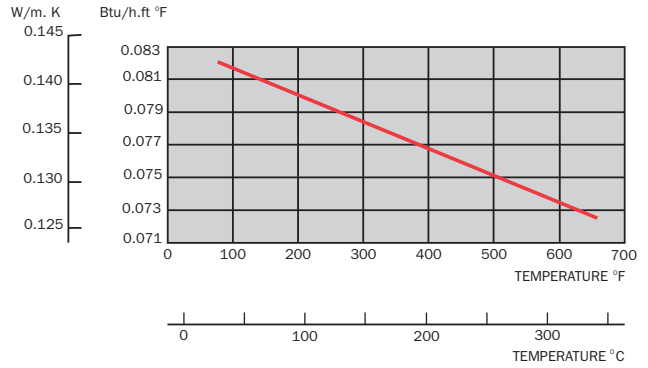
*non-toxic defined as non-controlled under WHIMIS, non-hazardous under OSHA and non-dangerous under EUDPD.

** Any transport and disposal practice must be in compliance with federal, state, and provincial and/or local laws and regulations.

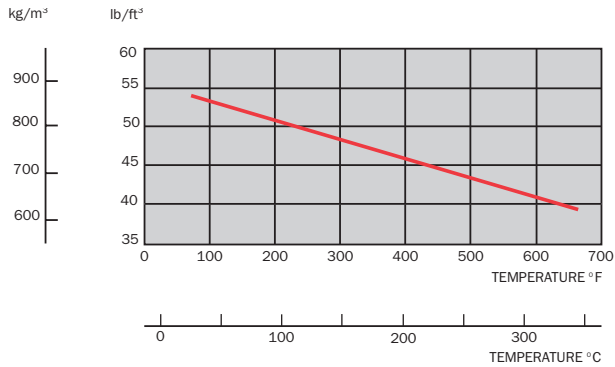
CALFLO AF VISCOSITY



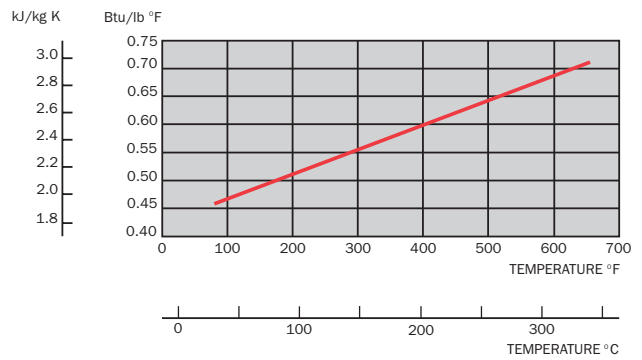
CALFLO AF THERMAL CONDUCTIVITY



CALFLO AF DENSITY



CALFLO AF HEAT CAPACITY



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