

Lubrizol Fluid Engineering

Paratherm Heat Transfer Fluids: Asphalt Industry

July 9, 2025

Lubrizol

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Key Discussion Topics

- Review Asphalt Industry Thermal Focus
- Major Hot Mix Asphalt Plant OEMs
- Product Focus & Competitive Advantages
- Sales Tools & Value Proposition
- Fluid Changeout/Cleaning Options
- Open Discussion

HTF in the Asphalt Industry

Thermal Fluids

- Also known as:
 - Heat Transfer Fluids (HTF)
 - Heating/Cooling Fluids
 - Hot Oils ***
- Able to generate high temperatures at low system pressures
- Offer safety, low maintenance & extended operating lifetimes
- Highly efficient, non-corrosive & allow for accurate temperature regulation and uniformity



Asphalt Products

- Thermal Fluid Applications in Asphalt Industry
 - Hot Mix (Road Surface)
 - Roofing Shingles
 - Liquid Asphalt Storage
 - Patch/Tar
- Seasonal Industry (Hot Mix)
 - Difficult to manufacture in cold weather
 - Maintenance Planning
- Paratherm HE is Fluid of Choice



Hot Mix Asphalt Market Profile

- Reported >4,000 hot mix asphalt plants in North America¹
 - Average 2-5 MT per plant based on current customer profiles
- Industry features 3-5 major corporations
 - Remaining highly fragmented by regional players
 - If there are paved roads, there is an asphalt plant close by
- Average Temperature Profile: Moderate (~350°F)
- Premature degradation is VERY HIGH relative to other industries
 - Oxidation is highest mode of degradation

¹National Asphalt Paving Association 2022

Main Thermal Fluid Asphalt OEMs

Two Largest Hot Mix Asphalt Thermal Fluid Heater/Plant OEMs:

- **Astec**
 - FKA Heatec & CEI heaters
- **Gencor**
 - Hy-Way Heaters
 - General Combustion

Additional Players:

- **Meeker** (Longstanding key hot mix asphalt plant OEM/service provider)
- **Fulton** (Not as present in hot mix, more roofing & terminal tank heating, general industry)
- **Volcanic** (Asphalt barge and tank heating more than hot mix or roofing)
- **VaporPower** (Not as present in hot mix, more roofing & terminal tank heating)

Recognizing Hot Oil/Thermal Fluid Heaters



Image Credit: <https://www.gencor.com/home>

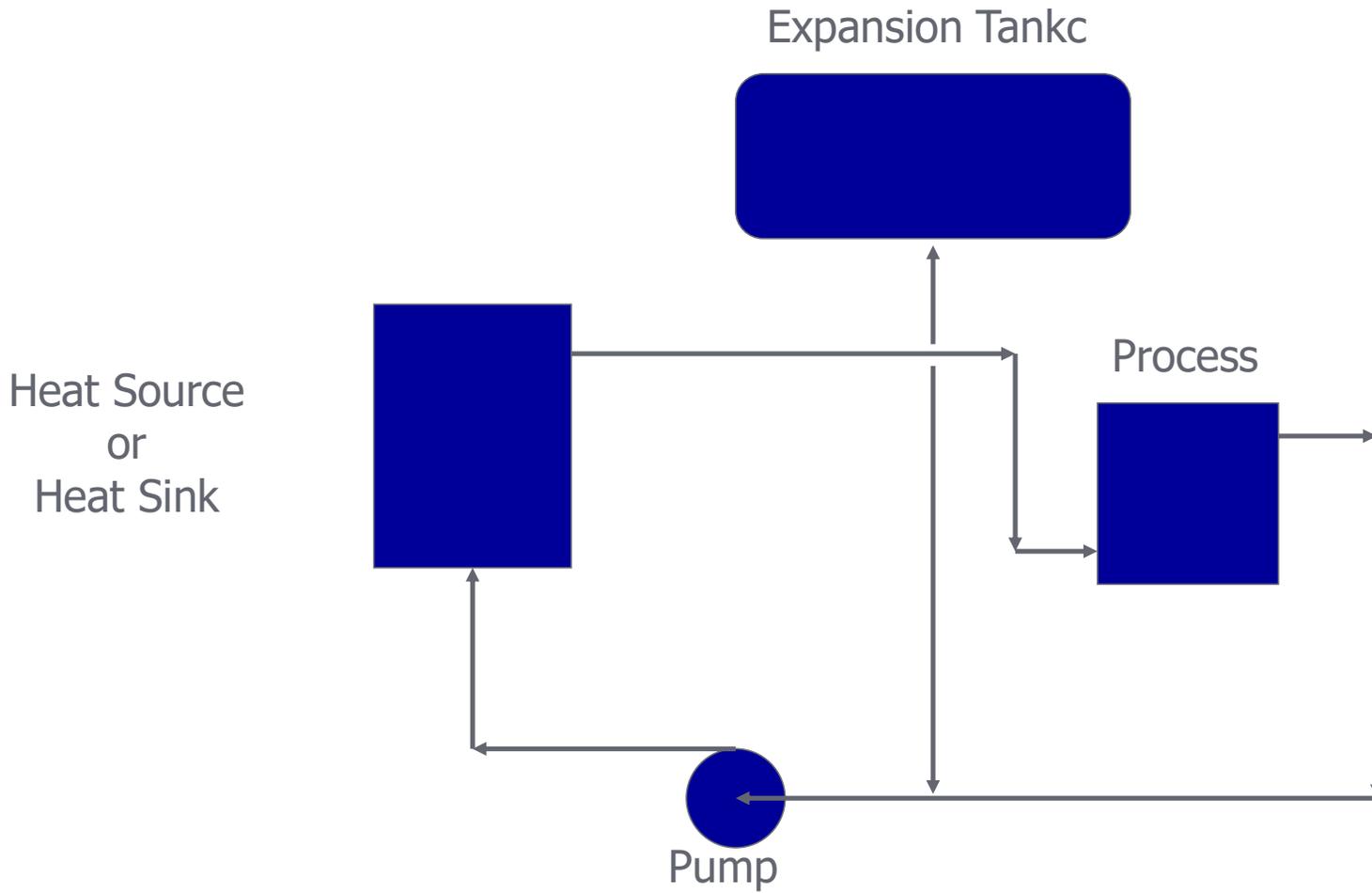


Image Credit: <https://www.gencor.com/equipment/heat-thermal-fluid-systems/>



Image Credit: <https://www.astecindustries.com/products/details/heatec-hc-hcs-heaters>

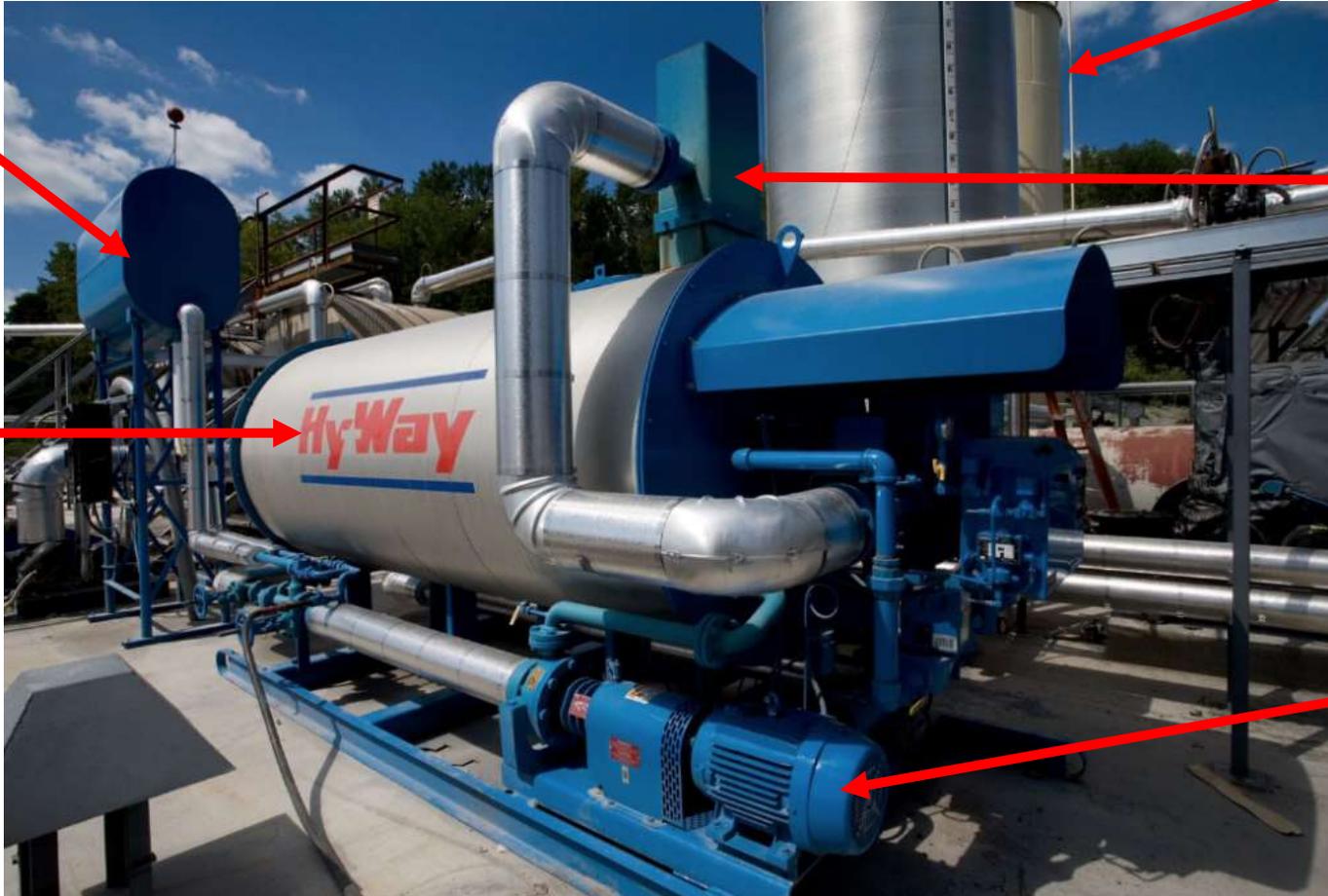
Basic System Elements



Basic System Elements

Expansion Tank

Thermal Fluid
Heater



Heated Tank
(Process)

Heater Stack

Centrifugal
Pump

Image Credit: <https://www.gencor.com/equipment/heat-thermal-fluid-systems/>

High Level Paratherm Value

Technical & Commercial Team Features

- Highly technical team made up of chemical engineers, chemists, food scientists, process control experts, etc.
 - >60 years of combined experience dedicated specifically to Heat Transfer Fluids & Systems
- Highly Specialized in HTF products & applications
 - Focus 100% on engineering & supporting the highest quality HTFs & system cleaners
 - High-level expertise in system design, equipment specifications, operation & maintenance
- State-of-the-art facilities/capabilities
 - On-site, fully functional Fluid Analysis/R&D Lab with fulltime fluid monitoring technicians
 - Full access to Lubrizol's global network of industry leading research & testing facilities
- Customer Relationships
 - Users value the Paratherm brand for dedicated focus on operation-critical delivery requirements

Paratherm Asphalt Product Line

Products of Interest

Paratherm HE **HOT MIX Asphalt**

- Highly Purified Paraffinic Based Fluid, Available at Competitive Price Points
- High Flash Point & Stability Characteristics
- Priced to Sell against Majority of Competitors

Paratherm NF **Roofing Shingles/Patch**

- Premier High Temperature HTF in Specialty Industrial Processing
- Outstanding Thermal Stability & Non-fouling characteristics (ideal for electric heating)
- BEST VALUE: Durability, Efficiency, Purity are all best in the industry

Products of Interest

- *Paratherm GLT*

- Direct Alternative to Popular Competitive Alkylbenzene Based Products
- Lower Start-up Temperatures, High Thermal Stability

- *Paratherm GP*

- Premium Enhanced Thermal Stability & Extended Service to 600°F
- Unique Chemical Formulation for Reliable Non Fouling Use in O&G Industries

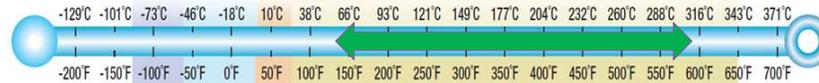
- *Paratherm LC/AC Cleaner*

- “On The Fly” Additive System Cleaner Allows Continued Operation While Cleaning

Paratherm HE – Competitive High Temp Performance



125°F (52°C) – 600°F (316°C)

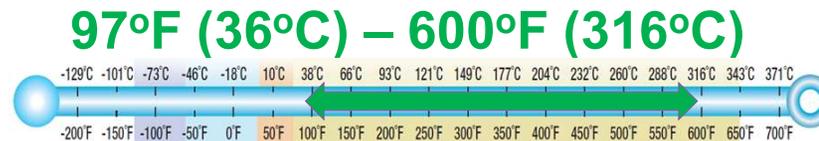


Advantages

- Quality Economical Alternative: Highly Refined & more thermally stable than group I, NSF HT 1 rating. Efficient in continuous, fuel fired systems. High flash point
- Competitive pricing: Pricing is more competitive with major oil competitors on high-volume opportunities. Superior service becomes competitive advantage

Common Competitors: Mobiltherm 43, Chevron 46, Shell S2x, PetroTherm

Paratherm NF – Flagship Product



Advantages

- Premium Quality: Pure hydrocarbon, NSF HT 1 food grade product that inherently resists fouling. Low maintenance & highly dependable
- Performance & Stability: Significantly more thermally stable than paraffinic based products, higher heat transfer coefficients

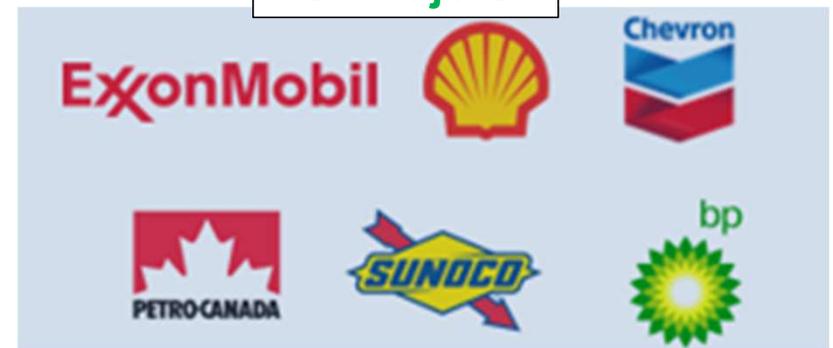
Common Competitors: Calflo Purity FG, Multitherm PG1, Mobiltherm 603

Competitive Overview

HTF Specialty



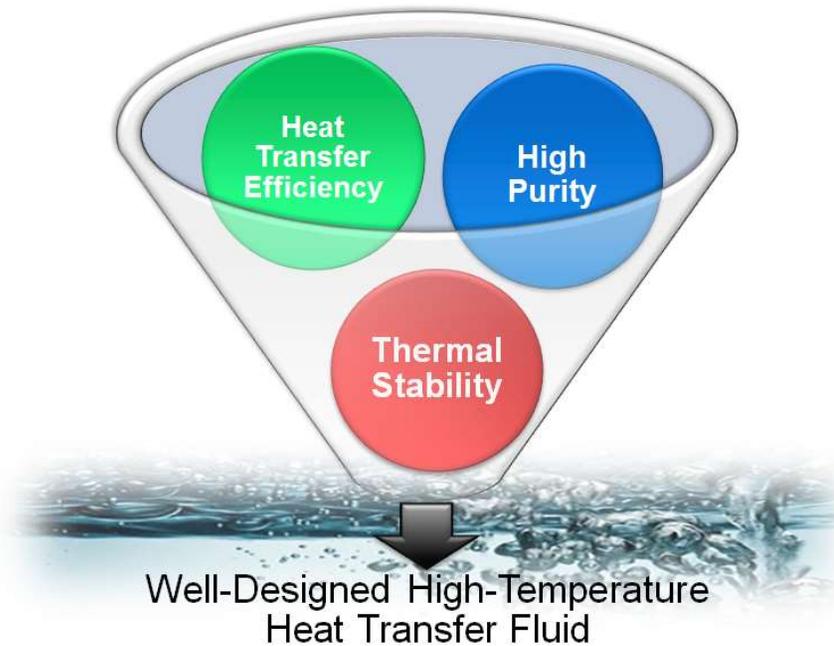
Oil Majors



VARIOUS Regional Oil Blenders / Resellers

Advantages by the Numbers

- Paratherm has done extensive product comparison evaluations and can provide evidence of superior benchmarking against any of the major competitive fluids
 - Purity/Quality
 - Heat Transfer Efficiency
 - Thermal Stability
 - Certifications



Engineering Superior HTFs

Fundamental Product Specifications

- Operating Temperature Range
 - Maximum Operating Temperature
 - Minimum Operating Temperature
- Minimum Start-up Temperature
 - Climate/Environment
- Other Considerations:
 - Level of impurities (fouling @ high temps)
 - Specialized additive packages (typically narrow the operating range)
 - Preference to Synthetic vs. Mineral Oil base?

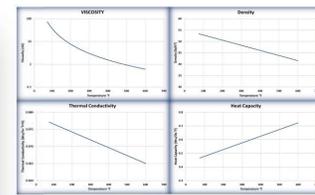
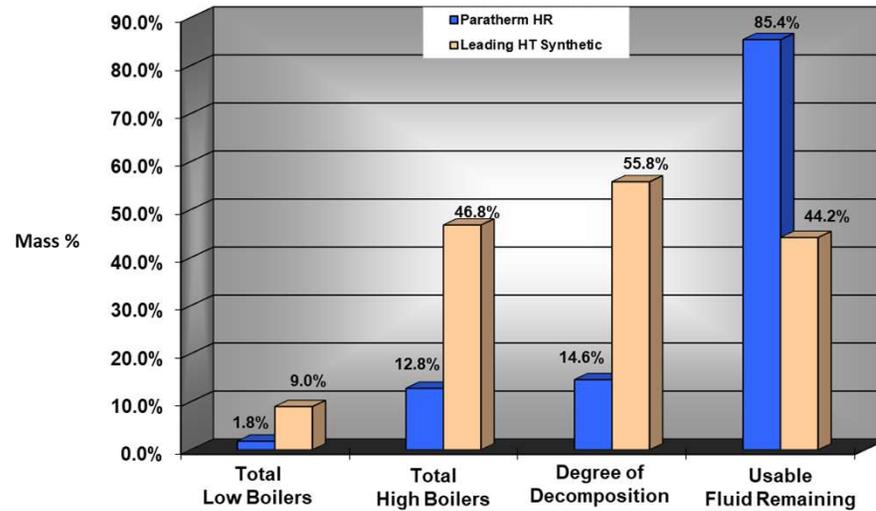
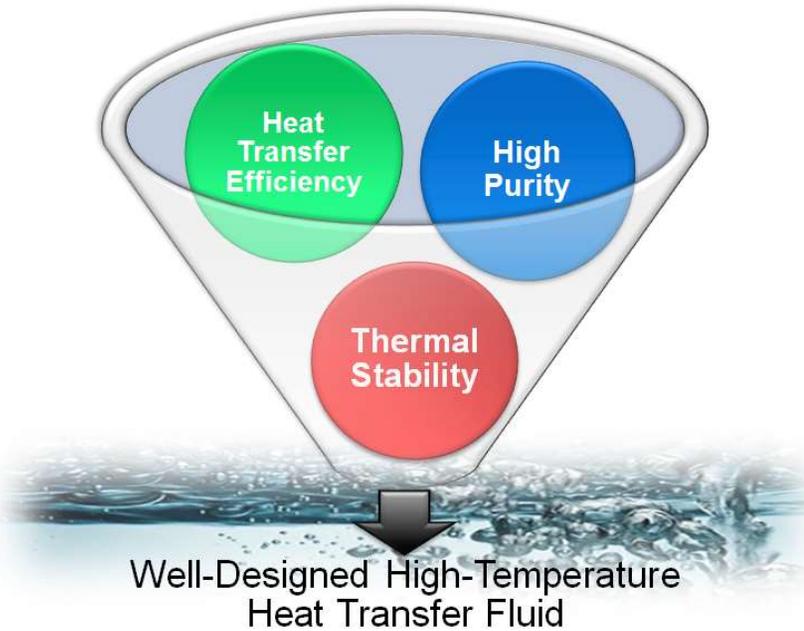


Process Considerations

- Existing system?
 - Compatibility issues with existing fluid?
- Continuous process?
 - Continuous exposure to high temps, accelerated breakdown
- Local Climate
 - Cold weather areas, low startup considerations
- Open to atmosphere?
 - Oxidation is an issue
 - Irritating vapor odor?
- Heat/Cool cycle necessary?
- Food Processing Application?
 - NSF HT-1 Incidental Food Contact rating needed
 - Typical temperatures $>270^{\circ}\text{C}$



Paratherm Engineered Products: 3 Key Factors



$$Re = \frac{d_i v \rho}{\mu}, \quad Pr = \frac{c_p \mu}{k}, \quad Nu = \frac{h_i d_i}{k}$$



Paratherm product specialists take great care in engineering fluids that balance the most effective ratio of these key characteristics

High Purification

- The level of thermal fluid purification goes beyond toxicity considerations, removing the impurities that catalyze fluid degradation & foul equipment surfaces when continuously exposed to high operating temperatures.



Benefits of Higher Purification:

- Extended fluid service life
- Reduction in maintenance activities
- Lower risk of equipment failure
- Greater consistency in performance

Heat Transfer Efficiency

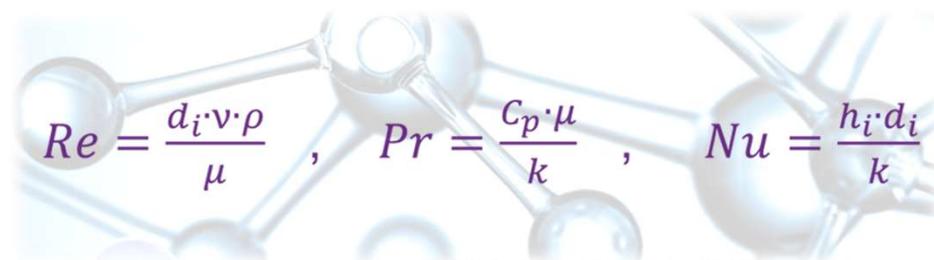
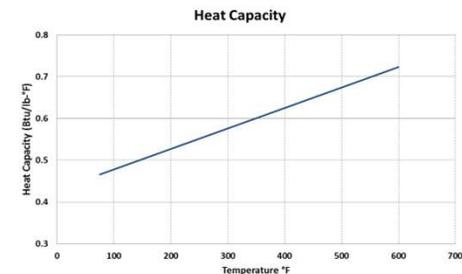
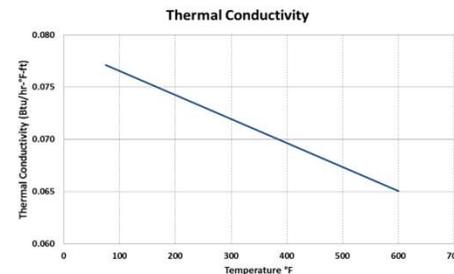
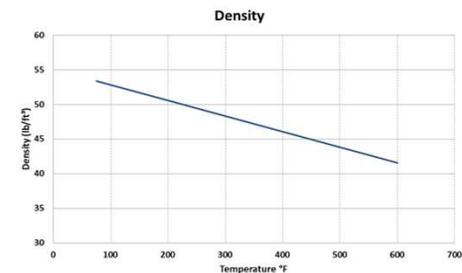
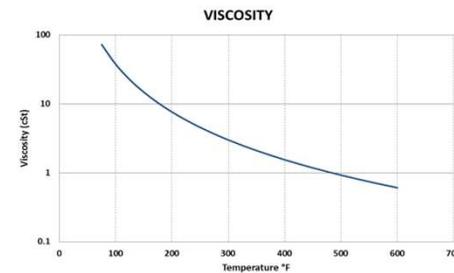
Inside Film Coefficient (h_i)

- Fluid Inside Film Coefficient (h_i) is used to represent the heat transfer efficiencies of each fluid at a given set of operating conditions (fluid temp, flow dynamics, etc).
- Considering all other operating conditions to be equal, the heat transfer efficiency of each fluid can be directly related to any other product at any given temperature by comparing calculated Inside Film Coefficients.
- The higher the Inside Film Coefficient, the more efficient the Heat Transfer Fluid at the given set of operating parameters.
- Calculated using established correlations between thermophysical properties and process-specific flow dynamics (pipe size, fluid velocity, etc)

Heat Transfer Efficiency

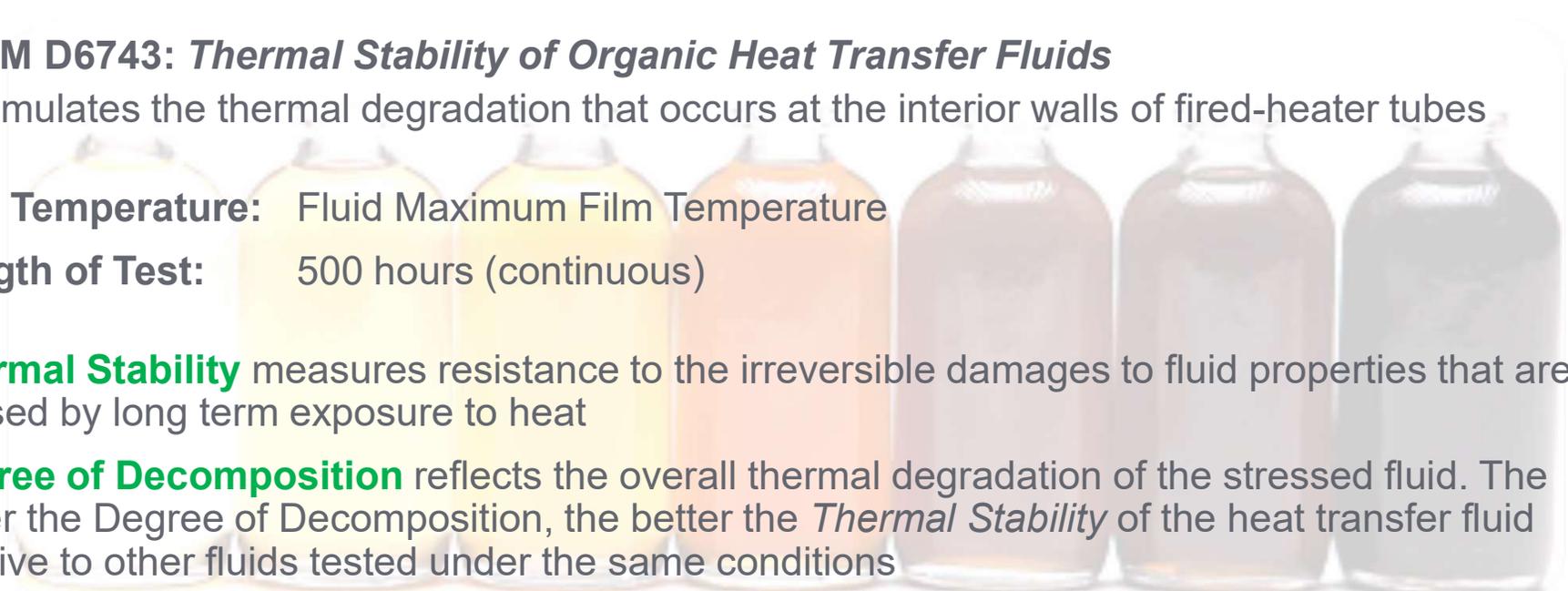
Engineering Fluid Performance

- Efficiency (h_i) determined by ideal combination of:
 - Low Viscosity (μ)
 - High Density (ρ)
 - High Thermal Conductivity (κ)
 - High Specific Heat Capacity (C_p)
- Considerable advantages in Viscosity, Density, Thermal Conductivity & Specific Heat Capacity will result in better Heat Transfer Efficiency characteristics at any proposed operating temperatures & flow conditions.
- Paratherm takes great care in engineering fluids that balance the most effective ratio of these key characteristics



Thermal Stability

- **ASTM D6743: *Thermal Stability of Organic Heat Transfer Fluids***
 - Simulates the thermal degradation that occurs at the interior walls of fired-heater tubes
- **Test Temperature:** Fluid Maximum Film Temperature
- **Length of Test:** 500 hours (continuous)
- **Thermal Stability** measures resistance to the irreversible damages to fluid properties that are caused by long term exposure to heat
- **Degree of Decomposition** reflects the overall thermal degradation of the stressed fluid. The lower the Degree of Decomposition, the better the *Thermal Stability* of the heat transfer fluid relative to other fluids tested under the same conditions



Thermal Stability

- When tested under identical conditions, superior heat transfer fluids display lower the Degree of Decomposition values
- More thermally stable fluids have significantly higher percentages of usable fluid remaining at the conclusion of the testing period
- When compared to competitive fluids, greater Thermal Stability will result in higher heat transfer efficiency over time, longer fluid life and lower potential for system damage and safety hazards when proper operating conditions are followed



Selling Advantages & Tools

Competitive Benchmarking

- Focus on the 3 key features of engineered thermal fluids
 - Thermal stability
 - Heat transfer efficiency
 - Product purity
- Ability to engineer fluids to balance primary factors such as
 - Hydrocarbon stock ratios
 - physical property consideration (density, viscosity, etc)
 - Level of processing refinement, ie hydrogenation
 - purity consideration
 - Addition of additive packages
 - design/functionality consideration

Legitimate Thermal Fluid Quick Checks

- Does the fluid supplier provide detailed thermo-physical data points?
 - Viscosity, Density, Specific Heat Capacity, Thermal Conductivity across full temperature range
 - Necessary for actual design of legitimate heat transfer fluid performance/efficiency
 - High expense & time commitment to obtain – supports legitimacy
- Supplier Fluid Safety Data Sheets (SDS)

RED FLAGS

*Don't be misled by product branding/names! Check the application/intended use!

*Color can be a key indicator of impurities! Look for “Colorless/Near Colorless”, “Clear”, “Water White”, etc

SAFETY DATA SHEET
HEAT TRANSFER OIL LIGHT
According to Appendix D, OSHA Hazard Communication Standard 29 CFR §1910.1200

1. Identification

Product Identifier	
Product name	HEAT TRANSFER OIL LIGHT
Product number	L0751-060, L0751-062, L0751-072
Recommended use of the chemical and restrictions on use	
Application	Petroleum lubricating oil
Uses advised against	No specific uses advised against are identified.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

GENERAL INFORMATION

Physical State:	Liquid
Colour:	Amber
Odour:	Characteristic
Odour Threshold:	N/D

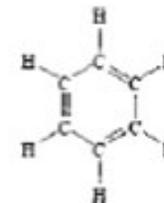
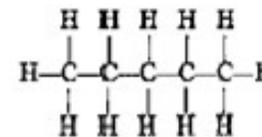
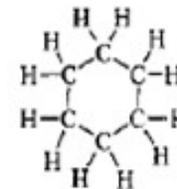
Features & Benefits: *Paratherm NF*

- Formulated to meet  HT1 approvals for incidental contact in food processing operations
- Paratherm NF is the fluid of choice for over 90% of the food processing industry in North America and continues to be recognized globally as the premier high temperature heat transfer fluid for further processed food applications.
- When compared to established thermal fluids sold by major oil companies & specialty suppliers alike, the NF consistently offers the following advantages:
 - Highest levels of purification***
 - Exceptional heat transfer efficiency***
 - Superior thermal stability***

Superior Chemistry

Hydrocarbons are the basis of all petroleum products. They are made of chains of carbon atoms bonded to hydrogen atoms & are classified by size & arrangement. Paratherm fluids are designed to have an ideal balance of these characteristics.

- Naphthenes, (Cycloalkanes)
 - Ring-like structure provides exceptional heat transfer properties, thermal stability & resistance to fluid fouling
- Paraffins, (Alkanes)
 - High flash point & resistance to oxidation, low volatility
- Aromatics – Trace/Zero content
 - Double-bonded ring structure provides great thermal stability, but this chemistry is typically toxic/carcinogenic



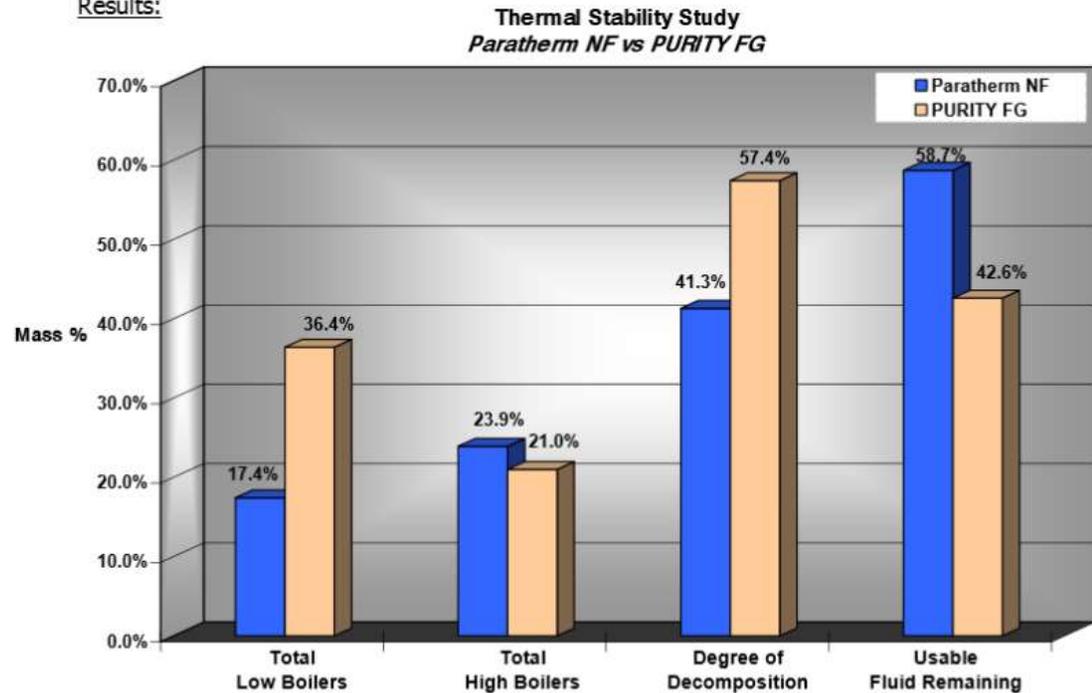
Thermal Stability Reports – Paratherm NF



Thermal Stability Study ASTM D6743

Fluids Tested: -Paratherm NF
-Petro-Canada Purity FG
Date Reported: 02/09/2012

Results:



*Note: Value for *Total Low Boilers* includes gaseous decomposition products
Value for *Total High Boilers* includes residual materials not vaporized

Heat Transfer Efficiency Calculations

Example: Paratherm NF vs. Cassida FM HTF 32

Heat Transfer Correlation

$$Nu = 0.023 \cdot Re^{0.8} \cdot Pr^{0.4}$$

$$Re = \frac{d_i \cdot v \cdot \rho}{\mu}, \quad Pr = \frac{C_p \cdot \mu}{k}, \quad Nu = \frac{h_i \cdot d_i}{k}$$

(Reynolds Number) (Prandtl Number) (Nusselt Number)

where:

C_p = Specific Heat (Btu/lb · °F)

d_i = Inside Pipe Diameter (ft)

h_i = Inside Film Coefficient (Btu/hr·ft²·°F)

k = Thermal Conductivity (Btu/hr·ft·°F)

v = Fluid Velocity (ft/sec)

ρ = Density (lb/ft³)

μ = Viscosity (lb/hr · ft)

Heat Transfer Results (calculated)

- Assumed System/Operating Values
 - Fluid Velocity (v) = 10.0 ft/sec
 - Pipe Diameter = 2" Sch 40 pipe
 - All Calculations at 100°C (published data availability)

Product	Prandtl Number <i>Pr</i>	Reynolds Number <i>Re</i>	Nusselt Number <i>Nu</i>	<i>h_i</i> BTU/(hr·ft ² ·°F)	<i>h_i</i> Watt/(m ² ·K)
PARATHERM NF	66.980	43247.700	632.24	<u>220.23</u>	<u>1,249.69</u>
Cassida FM HTF 32	95.560	27591.950	508.71	<u>171.29</u>	<u>971.98</u>

Common Concern : Compatibility (BLEND ANALYSIS)



HTF Blend Analysis Compatibility & Performance Evaluation

Paratherm HR / Competitor A*

*An Industry Leading Hydrogenated Terphenyl Heat Transfer Fluid

Fluids Tested: -Paratherm HR
-Competitor A

Date Reported: 4/09/2018

Prepared By: Ryan Ritz
Global Director of Technology
Paratherm Heat Transfer Fluids

HTF Blend Analysis Paratherm HR/ Competitor A

*Paratherm HR & Competitor A have relatively similar molecular structures and have industry-proven compatibility criteria. Tier 1 analysis sufficiently verifies full fluid compatibility; however, we will proceed with Tier 2 analysis to build additional confidence.

Tier 2 Analysis:

All fluid samples were run concurrently during the same testing intervals in the same testing apparatus, and under identical conditions.

Test: Kinematic Viscosity @ 40°C (ASTM D445)

Viscosity (mm ² /s)	High Limit	✓	✓	✓	Low Limit
	100% COMP A	90% COMP A	50/50	90% PARA HR	100% PARA HR
	31.00	27.44	17.44	11.71	11.00

Table 2 – Kinematic Viscosity @40C, Values for Tier 2 Compatibility by Physical Property Evaluation

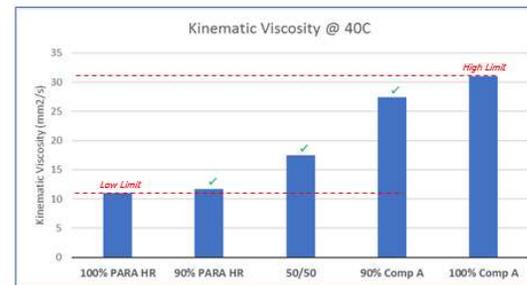


Chart 1 – Kinematic Viscosity @40C, Values for Tier 2 Compatibility by Physical Property Evaluation

Tier 2 Property Analysis - Viscosity Compatibility Rating: **PASS ✓**

HTF Blend Analysis Paratherm HR/ Competitor A

Test: Boiling Range Distribution (Sim Distillation) by Gas Chromatography (ASTM D2887)

	Boiling Point Distribution (°C)				
	High Limit	✓	✓	✓	Low Limit
	100% COMP A	90% COMP A	50/50	90% PARA HR	100% PARA HR
Initial BP	309.2	305.0	291.7	282.6	281.4
5%	313.1	312.4	308.0	306.7	306.0
10%	326.0	314.2	311.7	308.3	308.2
20%	329.7	328.3	314.2	312.7	312.0
30%	331.8	330.6	319.1	314.2	313.8
40%	334.0	332.7	321.0	317.3	315.1
50%	336.3	335.7	324.9	320.2	319.6
60%	340.4	339.8	331.0	321.4	321.0
70%	343.7	341.6	334.9	322.3	322.1
80%	345.9	345.7	340.2	324.4	322.8
90%	408.3	404.0	345.7	330.3	324.9
95%	422.8	422.3	411.8	338.1	326.0
Final BP	455.3	451.2	443.8	426.2	337.4

Table 3 – Boiling Range Distribution by GC, Values for Tier 2 Compatibility by Physical Property Evaluation

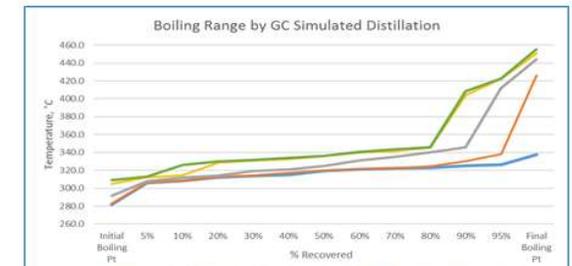


Chart 3 – Boiling Range Distribution by GC, Values for Tier 2 Compatibility by Physical Property Evaluation

Tier 2 Property Analysis - Boiling Range Distribution Compatibility Rating: **PASS ✓**

Common Concern : Compatibility (Certificate of Compatibility)



Paratherm™
HEAT TRANSFER FLUIDS

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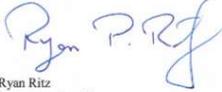
April 24, 2017

Certificate of Compatibility

Paratherm HR is a highly purified Synthetic Aromatic based heat transfer fluid. It can be added to any closed-loop, liquid phase heat transfer system containing Therminol 66 or any other similarly formulated high temperature modified terphenyl synthetic aromatic fluid. Existing gaskets and pump seals should not be affected as a result of mixing the two products in any ratio. Likewise, there will be no chemical reactions due to the direct mixing of the Paratherm HR with Therminol 66; temperature dependent or otherwise. We strongly recommend continued use of a nitrogen blanket on the expansion tank.

Please feel free to contact me directly if you have any questions or concerns.

Best Regards,



Ryan Ritz
Global Product Manager
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Precise, Uniform Temperature Control™





Paratherm™
HEAT TRANSFER FLUIDS

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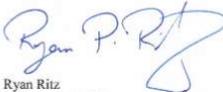
March 31, 2016

Certificate of Compatibility

Paratherm LR is a highly purified synthetic hydrocarbon based heat transfer fluid. It can be added to any closed-loop, liquid phase heat transfer system containing Therminol® D-12 or any other similarly formulated synthetic fluid covering the recommended operating temperature range. The condition of the existing fluid vs. the volume ratio of new product to be added should be professionally evaluated to ensure effective life/performance of new Paratherm LR introduced into the system. Existing gaskets and pump seals should not be affected as a result of mixing the two products in any ratio. Likewise, there will be no chemical reactions due to the direct mixing of the Paratherm LR with Therminol® D-12; temperature dependent or otherwise. We strongly recommend continued use of a nitrogen blanket on the expansion tank.

Please feel free to contact me directly if you have any questions or concerns.

Best Regards,



Ryan Ritz
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Industry Leading Technical Support

Technical Support

“Fluid degradation either reduces the safety margin or increases the amount of maintenance required. Fluid degradation over time is inevitable, the goal is to minimize the rate at which it happens.”



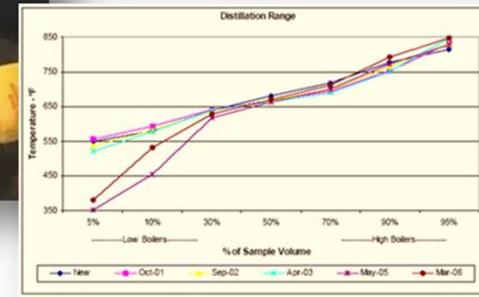
Fluid Selection Support

- Heat Transfer Fluids play an integral part in most industrial processes; be sure to emphasize the importance of making the correct fluid selection up front to maximize value
- Selecting the proper fluid for each operation is crucial
 - Choose the right fluid to optimize...
 - Operating specifications
 - Equipment design
 - Budget, etc
 - Superior fluids will feature the most effective combination of
 - High purification
 - Heat transfer efficiency
 - Thermal stability
 - Supplier Partnership



System Troubleshooting Support

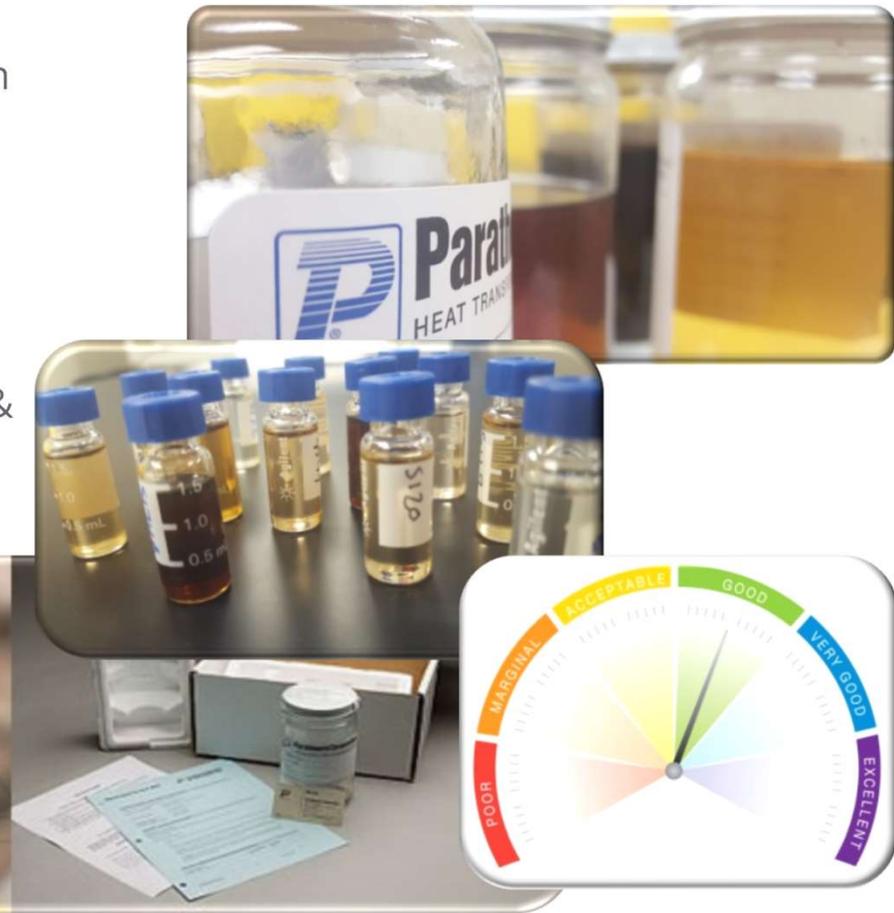
- Issues that Impact the Fluid/System
 - Oxidation
 - Thermal Cracking (Overheating)
 - Contamination
 - Proper Start-up and Shut-down
- Key Maintenance Practice:
 - **Fluid Analysis Program**



Fluid Analysis Program

Initiated & Managed by Lubrizol

- Most reliable tool for keeping your system running at an optimum level & avoiding unexpected problems
- Recommended annually as a minimum preventative maintenance practice
- Tests should be specific to HTF, not lube oil analysis
- Full report of fluid condition, expert recommendations & verbal review on results & best practices for controlling degradation – plan of action



PROPER FLUID ANALYSIS

*Show Lube Oil Analysis Report

Physical Inspection

Qualitative Evaluation - Paratherm fluid experts perform hands-on evaluation of key physical characteristics, assessing subtle variations in color, odor, consistency, clarity, sediment, etc.



Total Acid Number

Total Acid Number (ASTM D664) shows current oxidation level of the fluid

- Acid Numbers above 0.4 will show faster rate of carbon formation
- Acid Numbers as low as 0.2 can cause significant problems
- Total Acid Number (TAN) starts reaching between 0.4 to 1.0 action on fluid should be taken

AutoSample Potentiometric Titrator



Kinematic Viscosity

Kinematic Viscosity @40°C (ASTM D445) determines whether fluid has become too viscous (resistant to flow) for efficient heat transfer

- Significant change in viscosity (+ or -) action on fluid should be taken

Fully Automated Kinematic Viscometer



Water Content

Water by Karl Fischer Titration (ASTM E1064) analyzes water contamination present in the fluid sample at PPM levels

Coulometric Karl Fischer Titrator



Distillation Range

Simulated Distillation Range by GC (ASTM D2887) analyzes fluid composition for alteration caused by overheating

Gas Chromatograph



Reviewing Key Points

Key Point: Seasonal Shutdowns

- **PLAN AHEAD!!**
- Schedule a Fluid Analysis at least 2 months prior to shutdown
- If needed, introduce an additive cleaner (3 weeks to 2 months before shutdown)
- Taking care of degraded fluid issues in advance will allow for easier/on-schedule start-up in the spring

Key Point: Expansion Tank

- Allows for Thermal Expansion of HTF
- Main Location for Oxidation to Occur
- Location is Important (high point)
- Fluid Level Switch (functional??)
- Vented to Atmosphere
- Nitrogen Blanket Optional
- Boilout Valve! Closed after moisture removal

Key Point: Stack Temperature

- Quick indication of Efficiency between Heater/Fluid
- Monitor Stack Temp Regularly and Note Significant Changes
- Increased Heat Escaping from Stack Indicates Decreased Heat Into Tanks
- Typical Causes for Decreased Efficiency:
 - Soot build-up on outside of heater tubes
 - Severe fluid degradation carbonized on inside of tubes

Enhanced Thermal Fluid Service

In Summary

- Heat Transfer Fluids play an integral part in the production of many of the essential elements that we rely on in our daily lives in addition to the fundamental processes that our industry depends on
- Selecting the proper fluid for an operation is crucial
 - Choose the right fluid to optimize...
 - Operating specifications
 - Equipment design
 - Budget, etc
 - Superior fluids will feature the most effective combination of
 - High purification
 - Heat transfer efficiency
 - Thermal stability
- Enhanced Service Experience
 - Maintain a close working relationship between Customers, HTF supplier/distributor, & OEMs
 - Know system & operation inside & out: monitor, react, report
 - Properly maintain the system & fluid. **FLUID ANALYSIS IS KEY**

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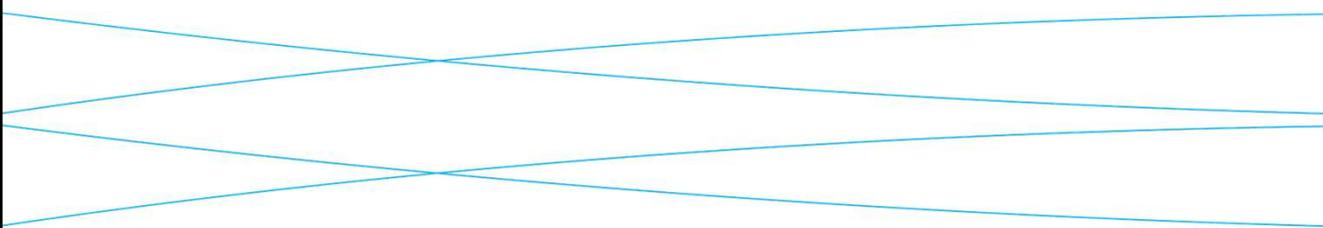


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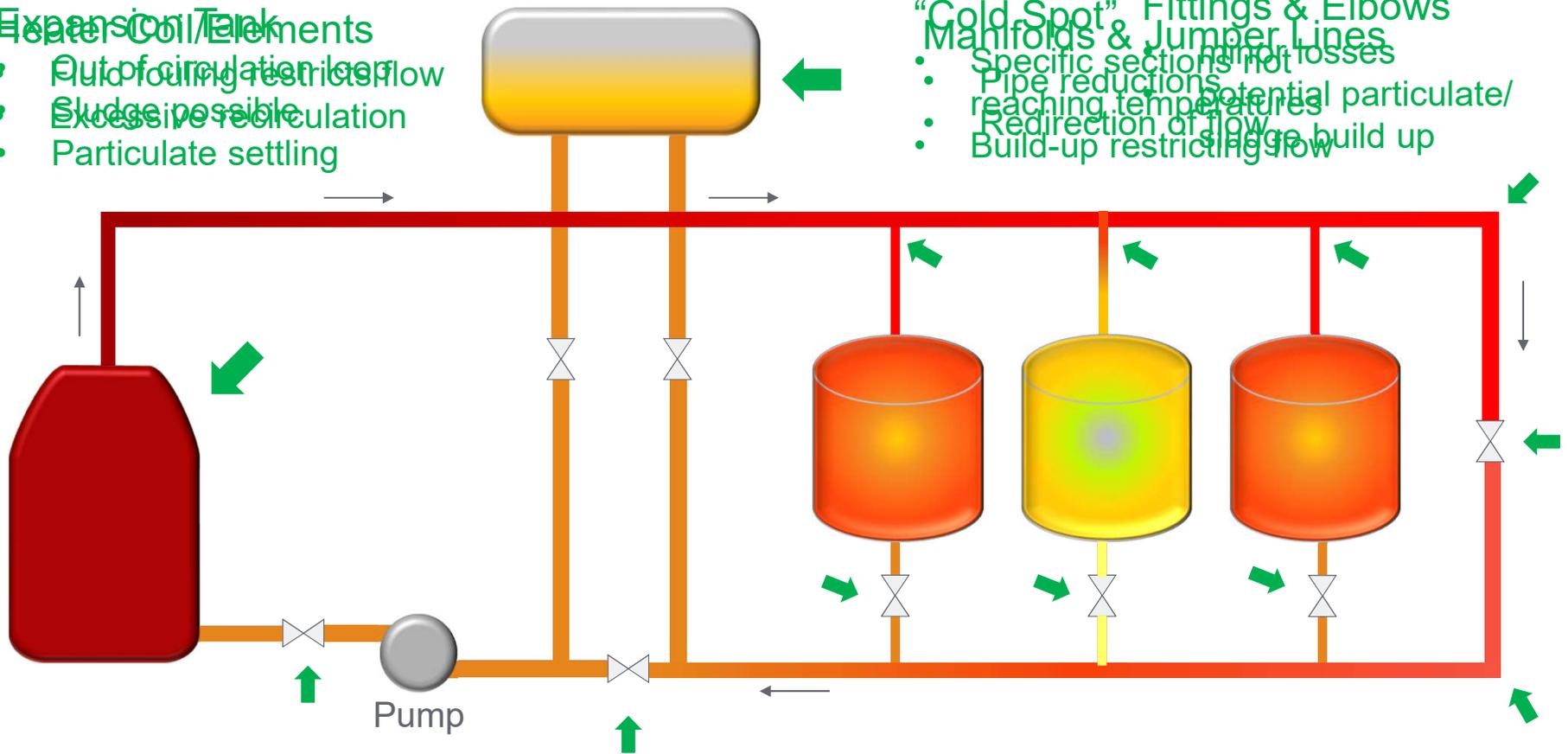
System Flow Review – Cold Spots & Restrictions

Expansion Tank

- Out of circulation flow
- Sudge possible
- Excessive recirculation
- Particulate settling

“Cold Spot” Fittings & Elbows

- Specific sections not reaching temperatures
- Pipe reductions
- Redirection of flow
- Build-up restricting flow



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