Lubricants at the Limit: Operating in Extreme Temperatures

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Agenda

- Concept Review: Fluids and Grease
- Effects of Excessive Temperatures on Lubricants
- Signs of Temperature-Related Degradation
- How Close Can We Get to the Limits?
- Selecting Lubricants for Extreme Temperatures
- CITGO and Mystik Products to Know
- Maintenance of Lubricants Used at Extreme Temperatures

Concept Review

Fluids and Grease

Lubricant Concepts Review: Fluids

Pour point:

- The temperature below which the liquid loses its flow characteristics

Floc point:

- The temperature at which wax will separate from the oil

Flash point:

- The lowest temperature at which a liquid gives off vapors in a quantity capable of forming an ignitable vapor/air mixture

Fire point:

- The lowest temperature at which the vapors keep burning after the ignition source is removed

Lubricant Concepts Review: Fluids

Viscosity index:

- A unit-less measure of a fluid's change in viscosity relative to temperature change

Arrhenius Rate Rule:

- The Arrhenius rule is based on a maximum operating temperature of 60°C (140°F) for optimum oxidation life of the lubricant.
- For every 10°C (18°F) increase beyond the maximum allowable temperature, a lubricant's oxidation life is halved
- Example: A fluid intended for use up to 150°C (302°F)

Temperature	Expected Life
150°C (302°F)	4000 hours
160°C (320°F)	2000 hours
170°C (338°F)	1000 hours
180°C (356°F)	500 hours

Lubricant Concepts Review: Grease

Grease constituents:

- Base oil: 60-98%
- Thickener: 2-40%
- Additives: 0-10%

NLGI grade:

- Quantifies the consistency of the grease, from #000 (semi-fluid) to #6 (very stiff) @ 77°F (25°C)

Dropping point:

- The temperature at which a drop of material falls from the orifice of a test cup under a ramped temperature program

Effects of Excessive Temperatures on Lubricants

Possible Effects of Excessive Heat

Effect on Lubricant:

- Accelerated decomposition or degradation of oil and additives
- Volatilization of additives
- Microbial growth
- Leakage due to thinning
- Oil separation in grease

Effect on Equipment:

- Wear increases due to failure of oil films
- Seals degrade
- Filter life shortens
- Corrosion accelerates
- Gumming of oil
- Generation of carbon deposits

Possible Effects of Excessive Cold

Effect on Lubricant:

- Excessive stiffening/viscosity increase
- Additive separation from fluid (fallout)
- Wax molecule agglomeration in fluid (mineral oils)

Effect on Equipment:

- Lubricant does not reach moving parts, resulting in seizure/failure
- Pressure is lost (flow-limited)
- Air enters pumping system and suction is lost (air-binding)

Signs of Temperature-Related Degradation of In-Service and Stored Lubricants

Signs of Temperature-Related Degradation of In-Service and Stored Products

Too Hot:

- Discoloration/darkening outside allowable color range
- Oxidation odor
- Significant change in NLGI consistency (grease)

Too Cold:

- Separation/stratification (emulsifiable metalworking fluids, water glycol, compounded oils)
- Significant change in NLGI consistency (grease)

How Close Can We Get to the Limits?

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Fluids:

- Pour point: at least 10ºC (18ºF) above pour point
- Flash point: at least 20ºC (36ºF) below flash point

Typical Properties for CITGO HyDurance AW Synthetic Fluids:

Flash Point, ASTM D92, °C (°F)	266 (510)	246 (475)
Pour Point, ASTM D97, °C (°F)	-60 (-76)	-50 (-58)

Greases:

- Dropping point is NOT the upper operating temperature!
- Over-greasing and under-greasing can cause excess heat
- Factors affecting grease operating temperature include base oil type and thickener type
- Consult the Mystik Grease Application and Performance Chart* for ranges

*Available in digital and print versions from the MarketNet Print Store

Considerations for Selecting Products for Extreme Temperatures

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- Lower temperature causes the viscosity of oil to increase (thicker).
- Higher temperature causes the viscosity of oil to decrease (thinner).
- The viscosity index (VI) is an indication of the change in viscosity with a change in temperature. A higher VI is an indication of a wider operating temperature range.
- Synthetic PAO and PAG fluids and certain types of esters have high VI .
- PAO, PAG, and some esters have a very wide operating temperature range

- Diester fluids are synthetic but have low VI.

- Higher temperature causes grease to become softer and lower temperature causes grease to become stiffer.

CITGO and Mystik Products to Know

Low-Temperature Fluids

- Commonly needed in:
  - Refrigeration (food grade and other)
  - Hydraulic systems that operate at low temperature

- Synthetic fluids typically have very low pour points, making then ideal for low-temperature applications.

- Naphthenic base oils are naturally low in wax and have naturally low pour points, but also have lower VI, so can become significantly viscous at low temperatures.

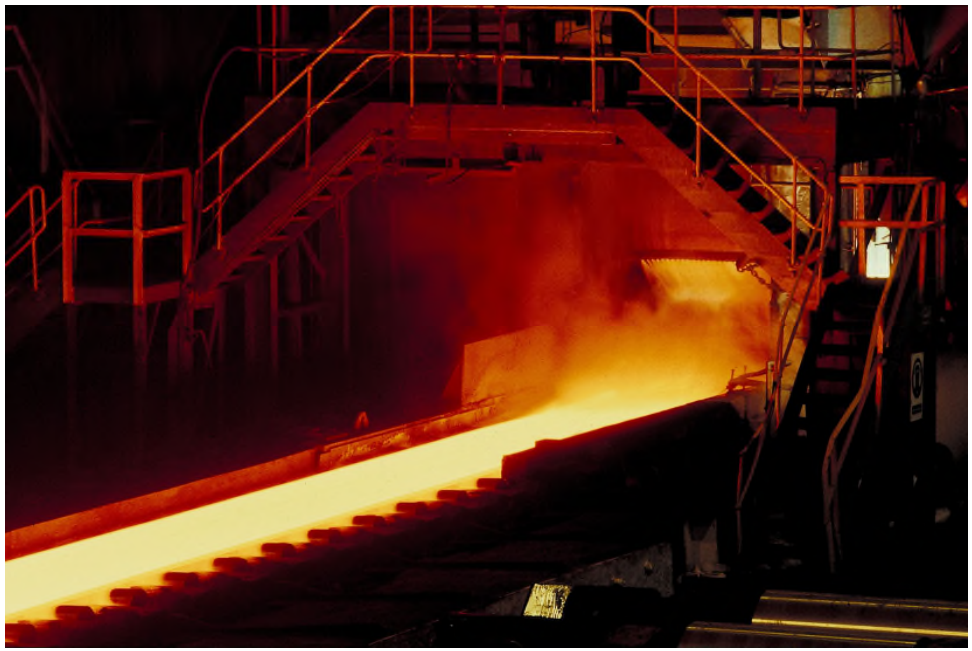
- Pour point depressants (PPD) are additives used to disrupt the formation of wax crystals in lubricants exposed to low temperatures.

High-Temperature Fluids

- Commonly needed in:
  - Industrial applications
  - Primary metals

- Synthetic fluids often have a higher flash point than a mineral oil of the same viscosity grade, allowing for higher temperature operation.

- Different OEMs specify different types of synthetic lubricants based on the expected equipment operating conditions.



Low-Temperature Greases

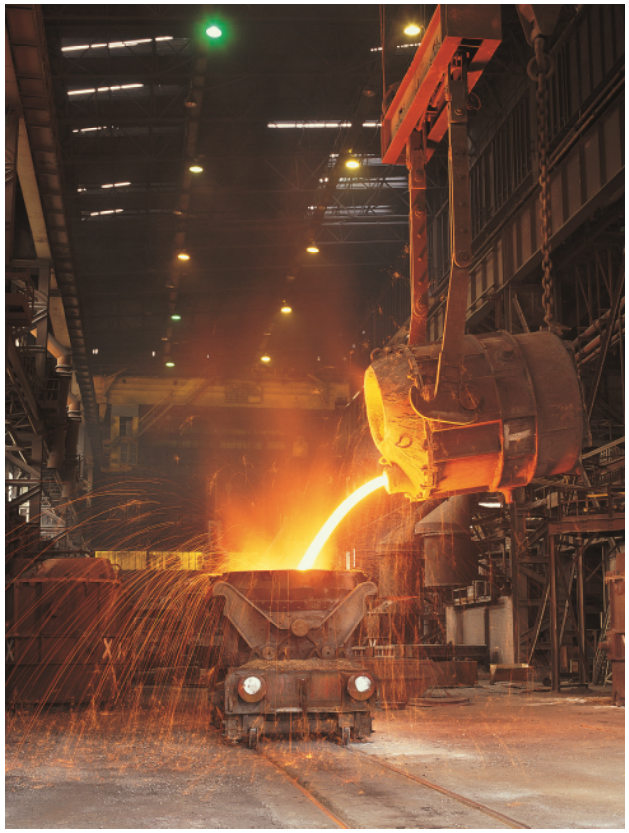
- Commonly needed in:
  - Mining
  - Agriculture
  - Automotive/trucking
  - Recreation (snowmobiles, snowblowers)

Mystik Grease Series	Lower Operating Limits
JT-6 greases	Various from -40ºF to 0ºF
LithoPlex greases	Various from -5ºF to 5ºF

- JT-6 Low Temp #2 (-40º to 250º)
- JT-6 Low Temp SynBlend #2 (-20º to 325º)
- JT-6 Synthetic 100 #1 (-40º to 350º)

High-Temperature Greases

- Commonly needed in:
  - Heavily loaded applications
    - Steel mills
    - Mining
    - Construction
  - Components with severe service requirements
    - Disc brake wheel bearings
    - Backhoe hinge pins



- JT-6 High Temp #1, #2: up to 325ºF
- JT-6 High Temp 3% Moly #2: up to 325ºF
- JT-6 Synthetic 100, 220, 460 greases: up to 350ºF
- Most Clarion greases: up to 350ºF

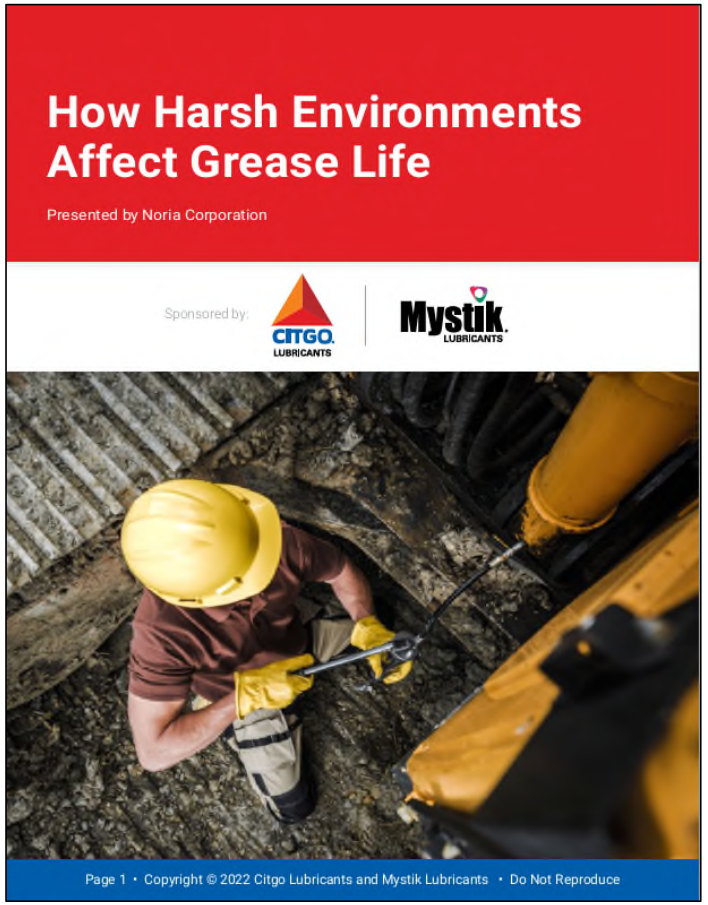
A Couple More Notes About Grease

- Non-melt grease: usually bentone-based (bentonite clay)
  - No dropping point
  - Used for heavy-duty applications
  - Consider quality of base oil and effect of extended/repeated exposure to high temperatures

- Dielectric grease: usually silicone
  - Silicone oil with a soap or PTFE thickener
  - May be referred to as silicone paste
  - Wide operating temperature range

New Noria White Paper

- General guidelines for grease, grease thickener, and base oil temperature limitations
- How to select the right NLGI consistency for an application
- Available free for download



Maintenance of Lubricants Used at Extreme Temperatures

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- Changes in operating conditions can affect the performance and service life of lubricants.
- Look for changes in operating conditions when a product is no longer performing as it did previously.
- Oil properties that should be monitored for lubricants used at high temperatures:
  - Oxidation Stability
  - Total Acid Number
  - Viscosity

Grease Handling and Dispensing at Low Temperature

- Grease should be stored in a warm area, or brought into a warm area overnight prior to intended use
- DO NOT use a band heater to warm grease containers
- When dispensing grease at low temperatures, use a product with the required base oil viscosity, but a softer consistency

Extension of Service Life for Synthetics

- Savings derived from the use of synthetic lubricants:
  - Less Maintenance
  - Less Downtime
  - More Production
  - Possible Lubricant Consolidation
  - Less Used Oil Disposal
  - Less Inventory
  - Improved Operating Temperature

- Potential savings from the use of synthetic lubricants can be estimated when taking the above factors into account.

Questions

- Please post your questions using the Q&A function.

How to Contact Us

- Lubes Answer Line

800-248-4684

8:00 AM - 12:00 PM, 1:00 PM – 5:00 PM CT
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February 17, 2023	Industrial Wear Modes and Failure Analysis
March 17, 2023	Bearings and Bearing Lubrication