Durability and Retention of Performance in Hydraulic Fluid

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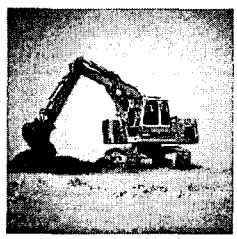
Fluid technologies for a better world™

Durability and Retention of Performance In Hydraulic Fluids

Hydraulic Equipment Trends



- Systems are becoming smaller
- Reduced reservoir sizes
- Operating pressures are increasing
- Higher lubricant temperatures
- Drain intervals are increasing
- Increased focus on cleanliness/filterability
- Noise Legislation

Less oil + More Work = Increased oil stress

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Demands Continue to Increase

- Additives are consumed at a greater rate in providing protection in these harsher systems.
- With less oil in the system and expectations for longer lifetimes, a greater performance reserve is essential.
- Additive quality and careful formulating are more critical then ever before.

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Questions

- "Will your product continue to protect my pumps?"
- "Will your product retain its demulsibility characteristics with service?"
- "What is the expected oxidation life of your fluid?"

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Specifications

- Not very dynamic
- Little change in OEM specifications over past years.

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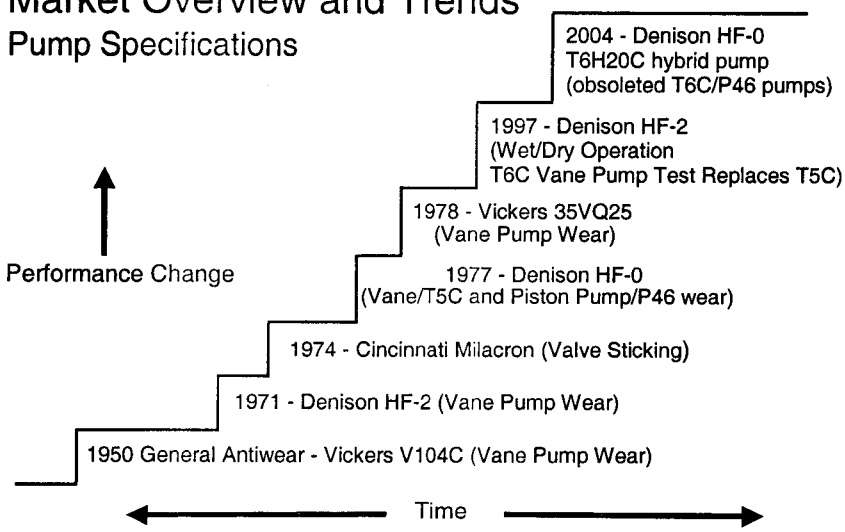
Market Overview and Trends

Pump Specifications



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Specifications

- "Why haven't specifications kept up with demands?"
- "How do we measure demands if the specifications haven't changed?"

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Durability and Retention of Performance Study

- Mono-grade
  - Lubrizol 5178F + Group I Base Stock
- Multi-grade
  - Lubrizol 5178F + Lubrizol 7775 + Group I Base Stocks

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Durability Study

- Use of industry standard pump tests
  - –Extend length of test
  - –Run at elevated temperatures

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Pump Conditions

Denison T-5D Vane Pump

Fluid Volume	50 US gallons
Test temperature	160 ± 5°F for 60 hours 210 ± 5°F for 20 hours
Test Duration	100 Hours
Pressure	2500 ± 25 psi
Pump Speed	2400 ± 60 rpm
Flow rate	70 US gallons/min.

Assessment/Requirements

All components are assessed visually for signs of wear and discoloration at the EOT

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Pump Conditions

Vickers 35VQ25

Fluid Volume	52 US gallons
Test temperature	200 ± 5°F
Test Duration	50 hrs x 3 cartridges (extended to 1000hours)
Pressure	3000 psi
Pump Speed	2400 ± 60 rpm
Flow rate	38 US gallons/min.

Assessment/Requirements

Cam and ring weight loss = 90 mg. max.

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Pump Conditions

Sundstrand Piston pump – Series 22

Fluid Volume	12 US gallons
Test temperature	**180 °F (1% water added)** **Heat stressed 250°F**
Test Duration	225 Hours, double length 450 hrs
Pressure	**5000 psi**
Pump Speed	**3100 rpm**
Flow rate	25 gallons/min.

Assessment/Requirements

All components are assessed visually for signs of wear and discoloration at the EOT

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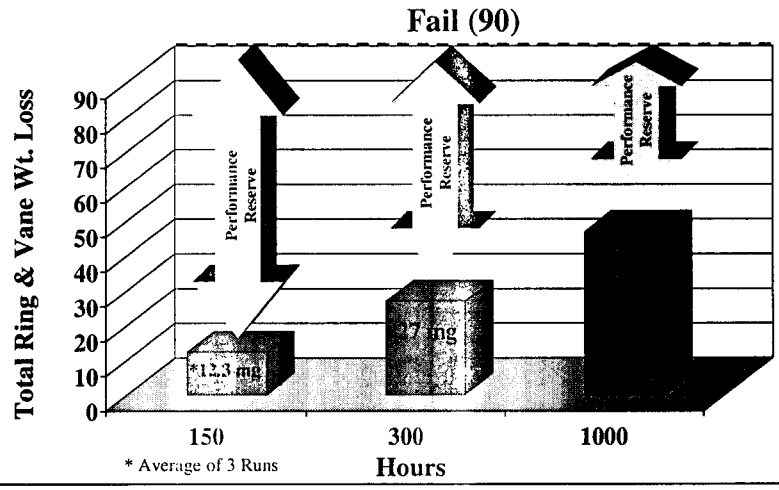
Durability

Standard vs. Extended Length
Vickers 35VQ, Vane Pump
(Weight Loss)



* Average of 3 Runs

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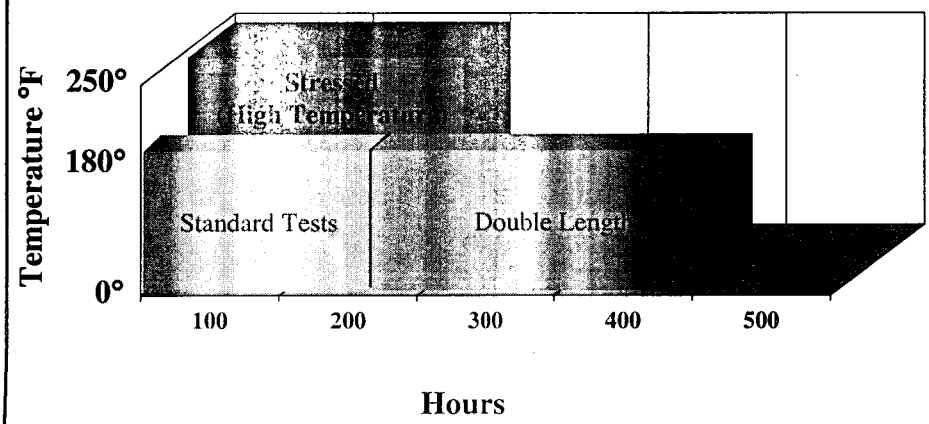
Sundstrand Piston Pump



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Durability Conclusions

- Eaton Vickers 35VQ25 vane pump.
  - Fluid robustness to exceed 1000 hours and remain within weight loss limits
- Sunstrand Piston Pump
  - Endurance to exceed limits of both higher temperatures and extended test duration
- Denison T5-D Vane Pump
  - Used to generate stressed fluid for Retention of Performance portion of program.

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Retention of Performance

- Use of standard bench tests
  - D 943, Oxidation
  - D 2619, Hydrolytic Stability
  - D 4310,1000 Hour Sludge
  - D 2070, Cincinnati Thermal Stability
  - Denison Filterability, TP-02100-A.
  - Other Tests

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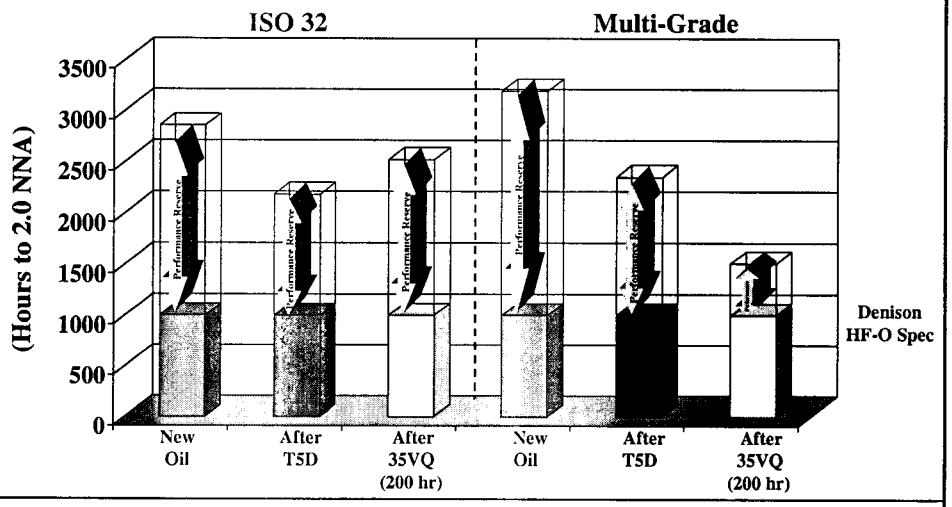
Retention of Performance

Oxidation D-943

(After Group I Vane Pump Testing)



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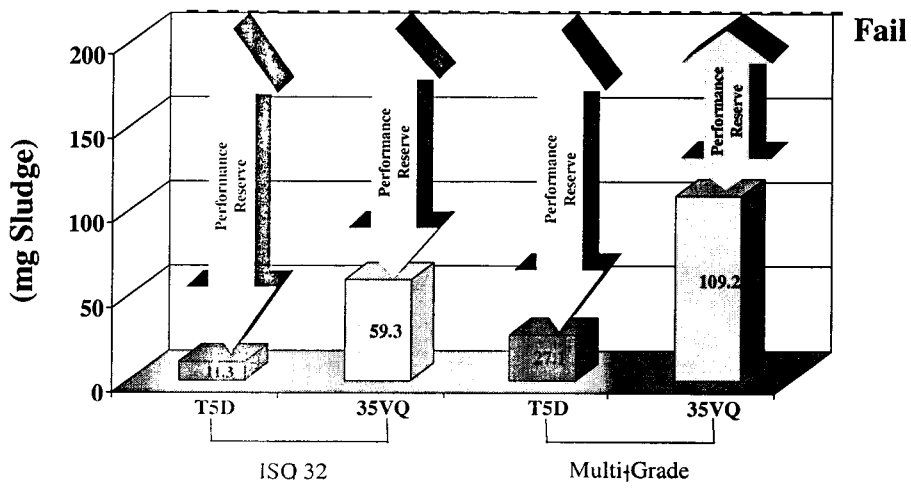
Retention of Performance

Sludging D-4310

(After Vane Pump Testing)



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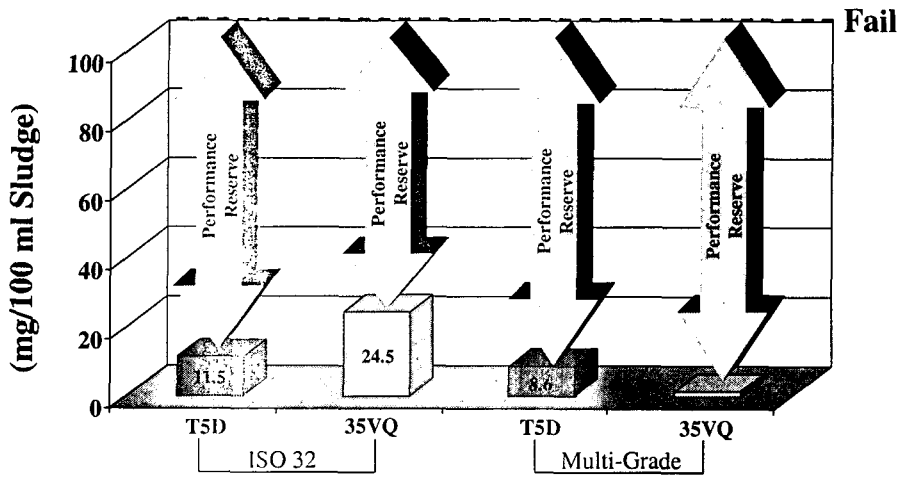
Retention of Performance

Thermal Stability D-2070
(After Group I Vane Pump Testing)



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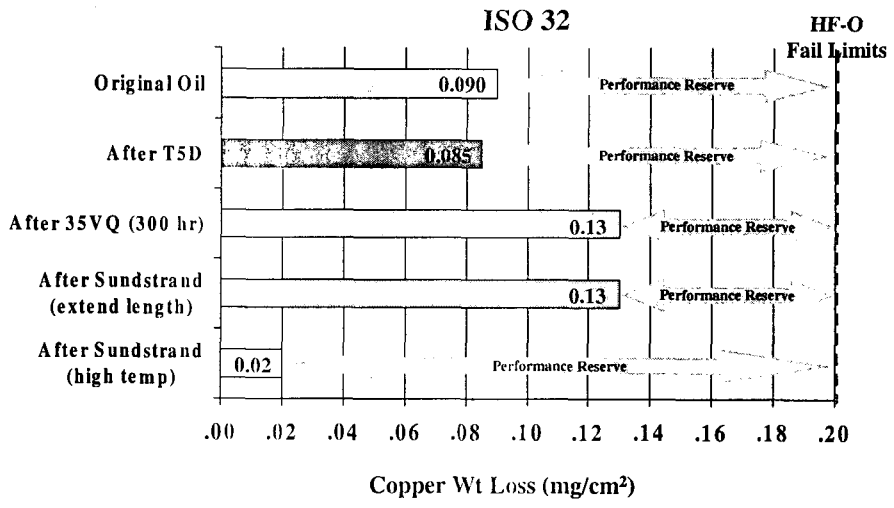
Hydrolytic Stability - D-2619

(After Pump Testing)



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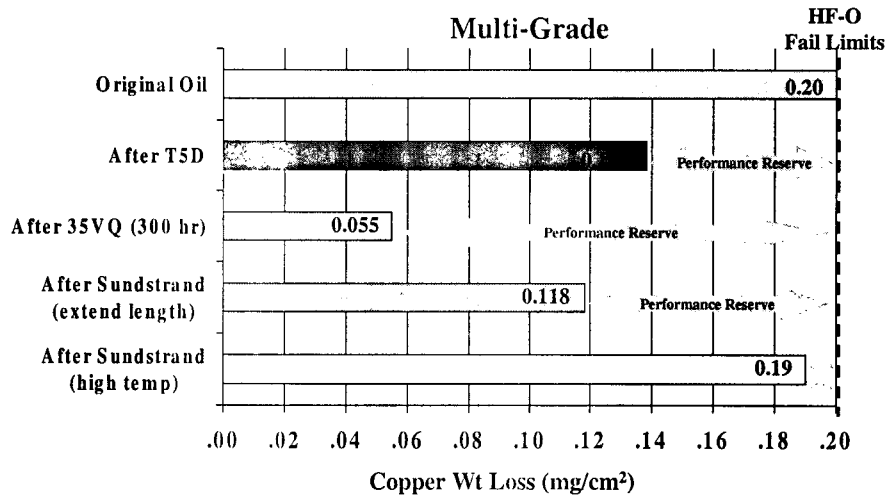
Hydrolytic Stability - D-2619
(After Pump Testing)



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Retention of Performance

- Other Tests

	After Denison Piston pump	After Sunstrand 250 hours	After Vickers 35VQ25
Rust D 665			
Part A	Pass	Pass	Pass
Part B	Pass	Pass	Pass
Demulsibility D 1401			
Oil/ water/emul (min.)	41/39/0 (30)	37/23/20 (60)	39/40/1 (15)
Foam D 892			
Seq I	80 – 0		80 – 0
Seq II	20 – 0		20 – 0
Seq III	30 - 0		30 - 0

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Summary:

- Performance can be evaluated beyond specification and requirements using existing pump tests
- Bench Testing of stressed fluids can demonstrate Retention of Performance

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Conclusions:

- Hydraulic fluids formulated with a premium anti-wear package can provide the benefits of Durability and Retention of Performance
- Hydraulic fluids having these qualities are not commodities but are true Specialty Fluids for modern equipments

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