

DR. PUMP, LLC

1998 Isuzu Rodeo

Atlanta, GA

Report Date: 05/24/2007

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ISUZU

Ref: NBR-SNEAK PEAK

Customer #: 4R 5084-0000 LG

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Batch #: 070524 – 237

PdM Analyst: NBR

SAMPLES & RECOMMENDATIONS:

PAGE

DRP-32LE-V6-LEV1

3.2 Liter V-6 Engine

03413

CRITICAL

1

EQUIPMENT OVER LOADED & OVER HEATED. INCREASE OIL CHANGE INTERVAL. Consider scheduling this equipment for maintenance action in the near future. Specifically, possible cylinder ring problem allowing blow-by of contaminants and fuel. Possible onset of piston wear. Sample this equipment at routine time interval.

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CRITICAL

Sample ID: DRP-32LE-V6-LEV1
Equip. Desc.: 3.2 Liter V-6 Engine
Lubricant Type: Unknown 10W-30
Reservoir Cap.: 1.25 Gal(s) 4.73 Ltr(s)
Equip. Miles: 180,000.0 Mi(s)
Lube Lube Miles: Not Provided Mi(s)

Sample Date: 5/19/2007
Received Date: 5/22/2007
Test Date: 5/24/2007
Prev. Sample: #REF! **UKN**
First Sample: 5/14/2006
No. Samples: 1

Recommendation(s):

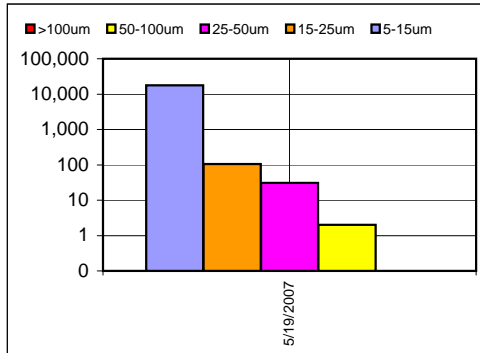
EQUIPMENT OVER LOADED & OVER HEATED. INCREASE OIL CHANGE INTERVAL. Consider scheduling this equipment for maintenance action in the near future. Specifically, possible cylinder ring problem allowing blow-by of contaminants and fuel. Possible onset of piston wear. Sample this equipment at routine time interval.

Discussion of Test Results:

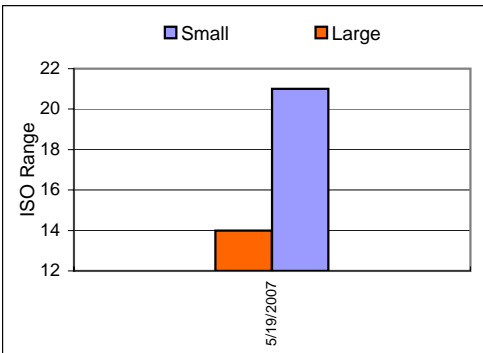
The equipment particle concentration (EPC) of 17,812 is considered higher than expected for this equipment. This elevated EPC level is directly related to the hydrocarbon blow-by resulting from incomplete combustion. Analytical results show the presence of 25 micrometer (um) white non-ferrous metal Severe Sliding wear particles. The white non-ferrous metal is most likely Aluminum. However, Nickel, Chrome and Stainless Steel are also other possibilities. More specific information regarding the metallurgy of this equipment is necessary to determine the source of this abnormal wear. Analysis also shows indications of tempered white non-ferrous metal wear particles. Tempering is the rainbow coloration resulting from elevated temperatures at the critical contact point. Temperatures to cause this tempering are in the 330°C (625°F) range.

QUANTITATIVE TESTING:

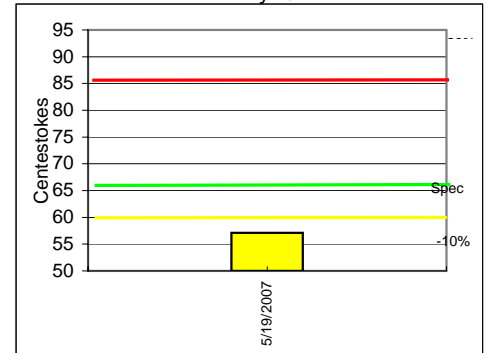
NAS-1638 Particle Count



ISO-4406 Solid Contamination Code



ASTM-D-2893 Viscosity @ 40°C



QUALITATIVE TESTING:

Ferrous Metal Wear:

Classification	Max		
	1	5	10 μm
Rubbing	1	5	≤ 15
Severe Sliding	1	5	≤ 15
Cutting/Plowing	1	5	≤ 15
Rolling Cont (Bearing)	1	5	≤ 15
Spheres	1	5	≤ 15
Gear	1	5	≤ 15
Black Oxides (Fe ₃ O ₄)	1	5	N/A
Red Oxides (Fe ₂ O ₃)	1	5	N/A
Corrosive (FeO)	1	5	N/A
Other	1	5	N/A

Non-Ferrous Metal Wear:

Classification	Max		
	1	5	10 μm
Rubbing	1	5	≤ 15
Severe Sliding	1	5	25
Cutting/Plowing	1	5	≤ 15
Rolling Cont (Bearing)	1	5	≤ 15
Spheres	1	5	≤ 15
Gear	1	5	≤ 15
Oxides	1	5	≤ 15
Other	1	5	≤ 15

Contaminants:

Classification	Max		
	1	5	10 μm
Filming	1	5	N/A
Sand & Dirt	1	5	N/A
Fibers	1	5	N/A
Spheres	1	5	N/A
Plastic/Ceramic	1	5	N/A
Carbon & Organics	1	5	N/A

Non-Ferrous Metal Composition	Copper	White	Babbitt

Particle Data		Lube Data	
5-15 μm	17,673	40°C cSt:	57.1
15-25 μm	106	Water-IR	148
25-50 μm	31	PLP	0.8%
50-100 μm	2	TAN	N/A
>100 μm	0		
EPC:	17,812		
ISO Scale:	21 14		

700 Portage Trail
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Discussion of Test Results (cont'd):

No lubricant information was provided for this sample. This sample has been compared to a stock 10W-30 motor oil. The viscosity of the sample is much lower than expected for a used lubricant of this type. The degradation of this lubricant is further demonstrated by the excessive concentration of Oxidation, Nitrates, Sulfur compounds and Fuel found in this lubricant. These contaminants also demonstrate a problem with rings sealing properly.

The high concentration of Nitrates and Sulfur compounds in combination with moisture result in the formation of strong acids. Specifically, Nitrates can form Nitric Acid (HNO_3) and Sulfur Compounds form Sulfuric Acid (H_2SO_4). These acids have an acidic attack on the internal components of this equipment.

Additionally, please review mileage calculation. O.E.M.'s m.p.g. specifications show the following:

3.2 Liter V-6 Engine Automatic Transmission 4WD
City: 16 mpg Highway: 20 mpg Combine: 18 mpg

2.2 Liter V-4 Engine 5-Speed Manual Transmission 2WD
City: 21 mpg Highway: 24 mpg Combine: 22 mpg

Note that this is the **FIRST** sample tested from this equipment.

Image 1

Interpretation:

Shown in this image is an example of the 25um tempered white non-ferrous metal Severe Sliding wear particles seen in this equipment. Note that this image was taken AFTER heat treatment.

Lighting: Red Reflected & Green Transmitted

Magnification: 500X

— 35 um —



Image 2

Interpretation:

This image was left blank.

Lighting:

Magnification: 00X

— 0 um —

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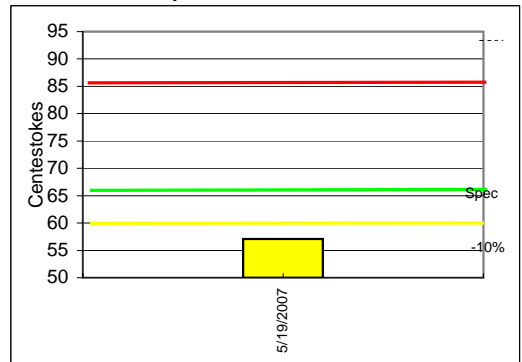
Recommendation(s):

CHANGE FLUID to reduce excessive contaminant levels of Oxidation, Nitrates, Sulfur compounds & Fuel contaminant and to correct low viscosity and additive package. Oxidation level is high at 14.16 Abs/cm, Nitrates are excessive at 21.05 Abs/cm and Sulfur levels are excessive at 16.44 Abs/cm. Fuel contamination is high at 5.94 Abs/cm. This is the **FIRST** sample tested.

PHYSICAL PROPERTIES

Viscosity cSt 40°C ASTM-D-445

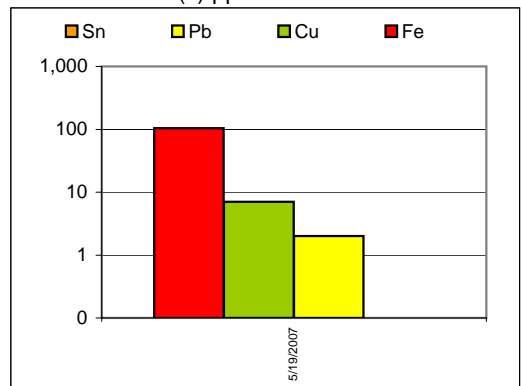
Sample Date(s)	05/19/07					REF.
Viscosity D-445	57.1					71.6
Water-IR ppm	148					≤ 700
Organics Abs/cm	N/P					2.35
Soot ppm	15					≤ 50
Oxidation Abs/cm	14.16					≤ 0.20
Nitrates Abs/cm	21.05					≤ 0.40
Sulfur Abs/cm	16.44					≤ 0.10
Fuel Abs/cm	5.94					≤ 0.10



ELEMENTAL ANALYSIS

WEAR ELEMENTS (ppm)						REF.
Iron ²⁶ (Fe) 55.84	104					3
Chromium ²⁴ (Cr) 51.99	6					1
Aluminum ¹³ (Al) 26.98	11					2
Copper ⁹ (Cu) 63.54	7					0
Lead ⁸² (Pb) 207	2					3
Tin ⁵⁸ (Sn) 118.6	0					3
Silver ¹⁷ (Ag) 107.86	0					0
Nickel ²⁸ (Ni) 58.71	7					2

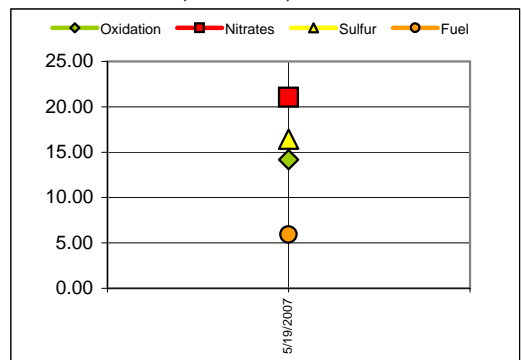
Element(s) ppm



ADDITIVE PACKAGE ELEMENTS (ppm)

Molybdenum ⁴² (Mo) 95.94	1					2
Magnesium ² (Mg) 24.30	3					12
Calcium ²⁰ (Ca) 40.08	444					2,610
Barium ⁵⁶ (Ba) 137.3	0					0
Phosphorus ¹⁵ (P) 30.97	532					1,475
Zinc ³⁰ (Zn) 65.38	749					1,565

Oxidation, Nitration, Sulfates & Solvents



CONTAMINANT ELEMENTS (ppm)

Sodium ¹¹ (Na) 22.98	8					3
Silicon ¹⁴ (Si) 28.08	10					5
Potassium ¹⁹ (K) 39.09	2					1,475
Boron ⁵ (B) 10.81	1					0

TRACE METAL ELEMENTS (ppm)

Vanadium ²³ (V) 50.94	0					0
Titanium ²² (Ti) 47.90	0					0
Cadmium ¹⁸ (Cd) 112.4	0					0

03413

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PdM Analyst: NBR