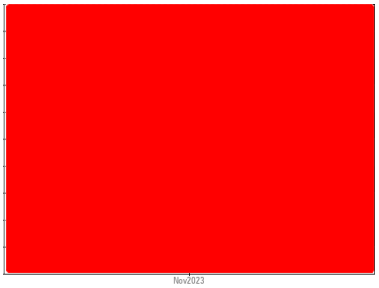
# PROBLEM SUMMARY

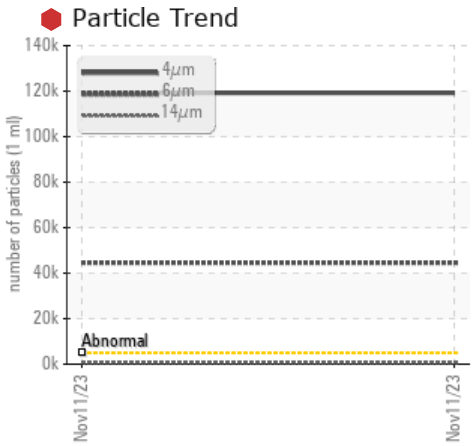
**Sample Rating Trend**

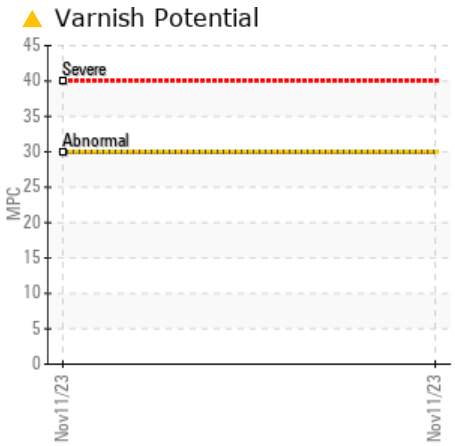


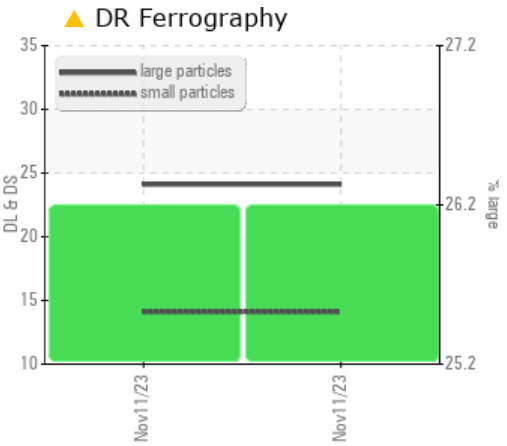
**OFF SPEC**

Machine Id
## UNIT #3 RUNNER
Component
**Reference Hydraulic System**
Fluid
**PETRO CANADA TURBOFLO XL46 (11415 QTS)**

## COMPONENT CONDITION SUMMARY




## RECOMMENDATION

We recommend that you perform vacuum distillation and/or air drying to attempt to remove any residual water and/or entrained gases from this oil that may be contributing to abnormal foaming and/or poor water separability. We advise that you check all areas where contaminants can enter the system. We recommend that you investigate the system for introduction of a surfactant to the reservoir. Some potential surfactants include incorrect oil make-up with an oil containing emulsifying agents (engine oil, compressor oil, gear oil), or soaps entering the system after wash down. We advise that you perform a filter service, and use off-line filtration to improve the cleanliness of the system fluid. The air breather requires service. If unrated, we recommend that you replace with a suitable micron rated and/or desiccant air breather. If rated, we recommend that you service/replace the breather. We recommend that you use electrostatic filtration to remove insolubles from the oil and to reduce the levels of varnish in the system. Alternatively draining a percentage of the oil and topping up with fresh oil (sweetening the oil) may provide a reduction in the varnish potential level. Resample in 30-45 days to monitor this situation. Please specify the component make and model with your next sample.

## PROBLEMATIC TEST RESULTS

| | | | | | | |
|---|---|---|---|---|---|---|
| Sample Status | | | | **SEVERE** | --- | --- |
| Large Particles | | DR-Ferr* | | ▲ **24.1** | --- | --- |
| Small Particles | | DR-Ferr* | | ▲ **14.1** | --- | --- |
| Total Particles | | DR-Ferr* | >--- | ▲ **38.2** | --- | --- |
| Severity Index | | DR-Ferr* | | ▲ **241** | --- | --- |
| Lubricant Degradation | Scale 0-10 | ASTM D7684* | | ▲ **3** | | |
| Particles >4µm | | ASTM D7647 | >5000 | ⬢ **119206** | --- | --- |
| Particles >6µm | | ASTM D7647 | >1300 | ⬢ **44565** | --- | --- |
| Particles >14µm | | ASTM D7647 | >160 | ▲ **718** | --- | --- |
| Particles >21µm | | ASTM D7647 | >40 | ▲ **93** | --- | --- |
| Oil Cleanliness | | ISO 4406 (c) | >19/17/14 | ⬢ **24/23/17** | --- | --- |
| MPC Varnish Potential | Scale | ASTM D7843(m)* | >15 | ▲ **30** | --- | --- |
| Foam Tendency | I/II/III | ASTM D892* | 0 | ▲ **560/70/490** | --- | --- |
| Foam Stability | I/II/III | ASTM D892* | 0 | ⬢ **120/0/0** | --- | --- |

**Customer Id:** MUSHAP
**Sample No.:** WC0412127
**Lab Number:** 02604408
**Test Package:** AOM 3

*To manage this report scan the QR code*

*To discuss the diagnosis or test data:*
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Bill.Quesnel@wearcheck.com

*To change component or sample information:*
Gloria Gonzalez +1 (289)291-4643 x4643
gloria.gonzalez@wearcheck.com

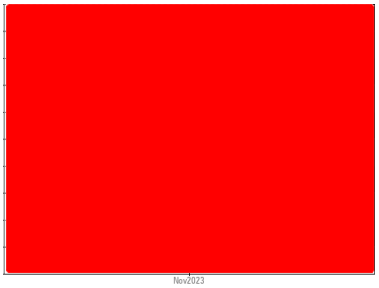
## RECOMMENDED ACTIONS

| Action | Status | Date | Done By | Description |
|---|---|---|---|---|
| Change Filter | --- | --- | ? | We advise that you perform a filter service, and use off-line filtration to improve the cleanliness of the system fluid. |
| Resample | --- | --- | ? | Resample in 30-45 days to monitor this situation. |
| Information Required | --- | --- | ? | Please specify the component make and model with your next sample. |
| Check Breathers | --- | --- | ? | The air breather requires service. If unrated, we recommend that you replace with a suitable micron rated and/or desiccant air breather. If rated, we recommend that you service/replace the breather. |
| Check Dirt Access | --- | --- | ? | We advise that you check all areas where contaminants can enter the system. |
| Filter Fluid | --- | --- | ? | We advise that you perform a filter service, and use off-line filtration to improve the cleanliness of the system fluid. |

## HISTORICAL DIAGNOSIS

# OIL ANALYSIS REPORT

Sample Rating Trend




**OFF SPEC**

Machine Id
## UNIT #3 RUNNER
Component
**Reference Hydraulic System**
Fluid
**PETRO CANADA TURBOFLO XL46 (11415 QTS)**

## DIAGNOSIS

**Recommendation**

We recommend that you perform vacuum distillation and/or air drying to attempt to remove any residual water and/or entrained gases from this oil that may be contributing to abnormal foaming and/or poor water separability. We advise that you check all areas where contaminants can enter the system. We recommend that you investigate the system for introduction of a surfactant to the reservoir. Some potential surfactants include incorrect oil make-up with an oil containing emulsifying agents (engine oil, compressor oil, gear oil), or soaps entering the system after wash down. We advise that you perform a filter service, and use off-line filtration to improve the cleanliness of the system fluid. The air breather requires service. If unrated, we recommend that you replace with a suitable micron rated and/or desiccant air breather. If rated, we recommend that you service/replace the breather. We recommend that you use electrostatic filtration to remove insolubles from the oil and to reduce the levels of varnish in the system. Alternatively draining a percentage of the oil and topping up with fresh oil (sweetening the oil) may provide a reduction in the varnish potential level. Resample in 30-45 days to monitor this situation. Please specify the component make and model with your next sample.

**Wear**

Large Particles, small particles, severity index and total particles levels are abnormal. The ferrography results are normal indicating no abnormal wear in the system.

**Contaminants**

There is a high amount of particulates (2 to 100 microns in size) present in the oil. MPC (Membrane Patch Colorimetry) test indicates a moderate concentration of varnish present. The water content is negligible.

**Oil Condition**

Foaming Stability stage I (ASTM D892) result is abnormal indicating an oil foaming problem that could lead to erratic operation. Rust Prevention test (ASTM D665) indicates the oil retains good anti-corrosion properties. The AN level is acceptable for this fluid. The oil is still serviceable provided that the contaminant(s) can be reduced to acceptable levels.

| SAMPLE INFORMATION | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Sample Number | | Client Info | | **WC0412127** | --- | --- |
| Sample Date | | Client Info | | **11 Nov 2023** | --- | --- |
| Machine Age | hrs | Client Info | | **0** | --- | --- |
| Oil Age | hrs | Client Info | | **0** | --- | --- |
| Oil Changed | | Client Info | | **N/A** | --- | --- |
| Sample Status | | | | **SEVERE** | --- | --- |

| WEAR METALS | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| PQ | | ASTM D8184* | | **0** | --- | --- |
| Iron | ppm | ASTM D5185(m) | >20 | **<1** | --- | --- |
| Chromium | ppm | ASTM D5185(m) | >10 | **0** | --- | --- |
| Nickel | ppm | ASTM D5185(m) | >10 | **<1** | --- | --- |
| Titanium | ppm | ASTM D5185(m) | | **0** | --- | --- |
| Silver | ppm | ASTM D5185(m) | | **0** | --- | --- |
| Aluminum | ppm | ASTM D5185(m) | >10 | **<1** | --- | --- |
| Lead | ppm | ASTM D5185(m) | >10 | **<1** | --- | --- |
| Copper | ppm | ASTM D5185(m) | >75 | **1** | --- | --- |
| Tin | ppm | ASTM D5185(m) | >10 | **0** | --- | --- |
| Antimony | ppm | ASTM D5185(m) | | **0** | --- | --- |
| Vanadium | ppm | ASTM D5185(m) | | **0** | --- | --- |
| Beryllium | ppm | ASTM D5185(m) | | **0** | --- | --- |
| Cadmium | ppm | ASTM D5185(m) | | **0** | --- | --- |

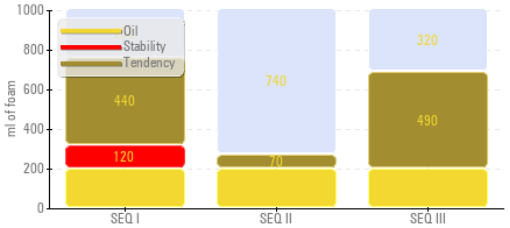
| ADDITIVES | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Boron | ppm | ASTM D5185(m) | | **<1** | --- | --- |
| Barium | ppm | ASTM D5185(m) | | **0** | --- | --- |
| Molybdenum | ppm | ASTM D5185(m) | | **0** | --- | --- |
| Manganese | ppm | ASTM D5185(m) | | **0** | --- | --- |
| Magnesium | ppm | ASTM D5185(m) | | **<1** | --- | --- |
| Calcium | ppm | ASTM D5185(m) | | **<1** | --- | --- |
| Phosphorus | ppm | ASTM D5185(m) | | **4** | --- | --- |
| Zinc | ppm | ASTM D5185(m) | 0 | **1** | --- | --- |
| Sulfur | ppm | ASTM D5185(m) | | **674** | --- | --- |
| Lithium | ppm | ASTM D5185(m) | | **<1** | --- | --- |

| CONTAMINANTS | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Silicon | ppm | ASTM D5185(m) | >20 | **1** | --- | --- |
| Sodium | ppm | ASTM D5185(m) | | **0** | --- | --- |
| Potassium | ppm | ASTM D5185(m) | >20 | **<1** | --- | --- |
| Water | % | ASTM D6304* | >0.1 | **0.007** | --- | --- |
| ppm Water | ppm | ASTM D6304* | >1000 | **71** | --- | --- |

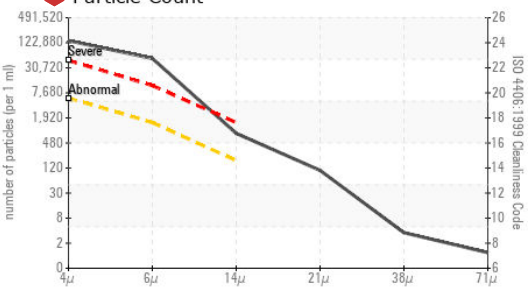
| INFRA-RED | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Soot % | % | ASTM D7844* | | **0** | --- | --- |
| Nitration | Abs/cm | ASTM D7624* | | **1.9** | --- | --- |
| Sulfation | Abs/.1mm | ASTM D7415* | | **10.6** | --- | --- |

# OIL ANALYSIS REPORT

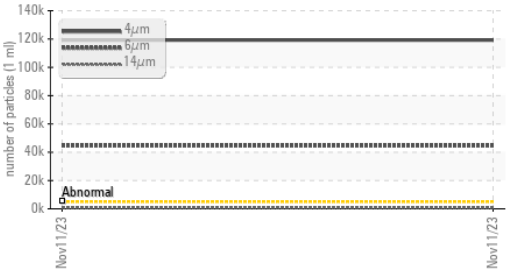
Foaming SEQ I/II/III



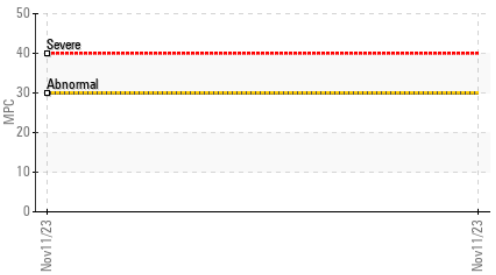

Particle Count



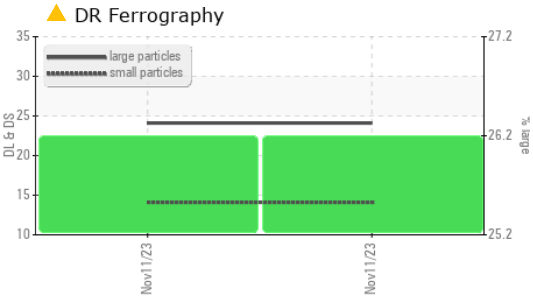

Particle Trend




Varnish Potential




DR Ferrography



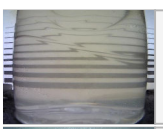
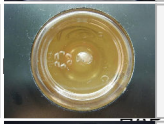
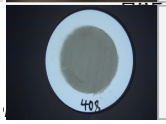

| FLUID CLEANLINESS | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Particles >4µm | | ASTM D7647 | >5000 | **119206** | --- | --- |
| Particles >6µm | | ASTM D7647 | >1300 | **44565** | --- | --- |
| Particles >14µm | | ASTM D7647 | >160 | **718** | --- | --- |
| Particles >21µm | | ASTM D7647 | >40 | **93** | --- | --- |
| Particles >38µm | | ASTM D7647 | >10 | **3** | --- | --- |
| Particles >71µm | | ASTM D7647 | >3 | **1** | --- | --- |
| Oil Cleanliness | | ISO 4406 (c) | >19/17/14 | **24/23/17** | --- | --- |

| FLUID DEGRADATION | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Oxidation | Abs/.1mm | ASTM D7414* | | **1.9** | --- | --- |
| Acid Number (AN) | mg KOH/g | ASTM D974* | 0.04 | **0.08** | --- | --- |
| Anti-Oxidant 1 | % | ASTM D6971* | <25 | **100** | --- | --- |
| Anti-Oxidant 2 | % | ASTM D6971* | <25 | **69** | --- | --- |
| MPC Varnish Potential | Scale | ASTM D7843(m)* | >15 | **30** | --- | --- |

| VISUAL | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| White Metal | scalar | Visual* | NONE | **NONE** | --- | --- |
| Yellow Metal | scalar | Visual* | NONE | **NONE** | --- | --- |
| Precipitate | scalar | Visual* | NONE | **NONE** | --- | --- |
| Silt | scalar | Visual* | NONE | **NONE** | --- | --- |
| Debris | scalar | Visual* | NONE | **NONE** | --- | --- |
| Sand/Dirt | scalar | Visual* | NONE | **NONE** | --- | --- |
| Appearance | scalar | Visual* | NORML | **NORML** | --- | --- |
| Odor | scalar | Visual* | NORML | **NORML** | --- | --- |
| Emulsified Water | scalar | Visual* | >0.1 | **NEG** | --- | --- |
| Free Water | scalar | Visual* | | **NEG** | --- | --- |

| FLUID PROPERTIES | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Visc @ 40°C | cSt | ASTM D7279(m) | 46.39 | **45.7** | --- | --- |
| Visc @ 100°C | cSt | ASTM D7279(m) | 6.79 | **6.8** | --- | --- |
| Viscosity Index (VI) | Scale | ASTM D2270* | 100 | **102** | --- | --- |
| Separability | oil/h2o/em | ASTM D1401* | 40/40/0 | **41/39/0 (25)** | --- | --- |
| Air Release Time | min | ASTM D3427* | 4 | **6.90** | --- | --- |
| Foam Tendency | I/II/III | ASTM D892* | 0 | **560/70/490** | --- | --- |
| Foam Stability | I/II/III | ASTM D892* | 0 | **120/0/0** | --- | --- |
| ASTM Color | scalar | ASTM D1500* | 0.5 | **<1.0** | --- | --- |
| Rust Prevention | PASS/FAIL | ASTM D665* | | **PASS** | --- | --- |
| Oxidation Test (RPVOT) | minutes | ASTM D2272* | 2700 | **5061** | --- | --- |

| SEDIMENT | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Pentane Insolubles | % | ASTM D893(m)* | | **0.031** | --- | --- |
| Toluene Insolubles | % | ASTM D893(m)* | | **0.027** | --- | --- |

| SAMPLE IMAGES | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|
| Color | | |  | no image | no image |
| Bottom | | |  | no image | no image |
| MPC | | |  | no image | no image |

CALA
ISO 17025:2017 Accredited Laboratory

**Laboratory**
**Sample No.**
**Lab Number**
**Unique Number**
**Test Package**

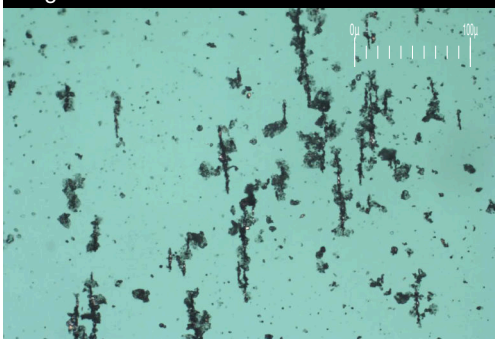
*To discuss this sample report, cc*
*Test denoted (*) outside scope o*
*Validity of results and interpretation are based on the sample and information as supplied.*

F:

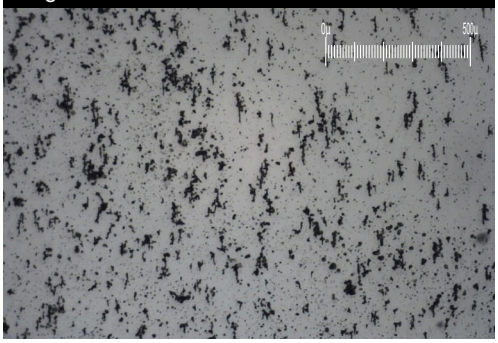
# FERROGRAPHY REPORT

Machine Id
## UNIT #3 RUNNER
Component
**Reference Hydraulic System**
Fluid
**PETRO CANADA TURBOFLO XL46 (11415 QTS)**

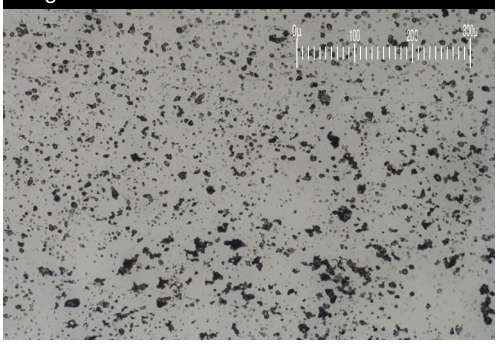
Magn: 200x Illum: BC



Magn: 50x Illum: RW



Magn: 100x Illum: RW

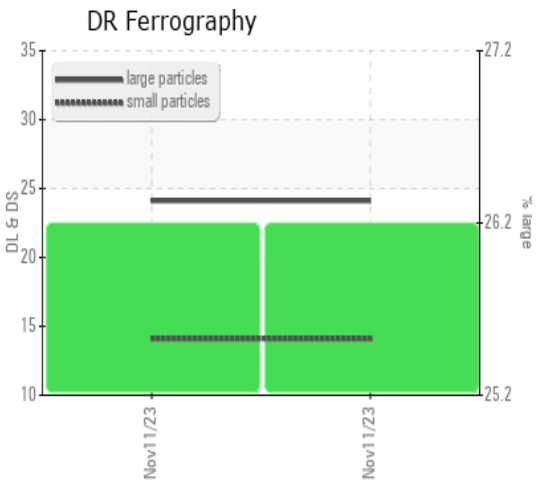


| DR-FERROGRAPHY | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Large Particles | | DR-Ferr* | | ▲ **24.1** | --- | --- |
| Small Particles | | DR-Ferr* | | ▲ **14.1** | --- | --- |
| Total Particles | | DR-Ferr* | >--- | ▲ **38.2** | --- | --- |
| Large Particles Percentage | % | DR-Ferr* | | **26.2** | --- | --- |
| Severity Index | | DR-Ferr* | | ▲ **241** | --- | --- |

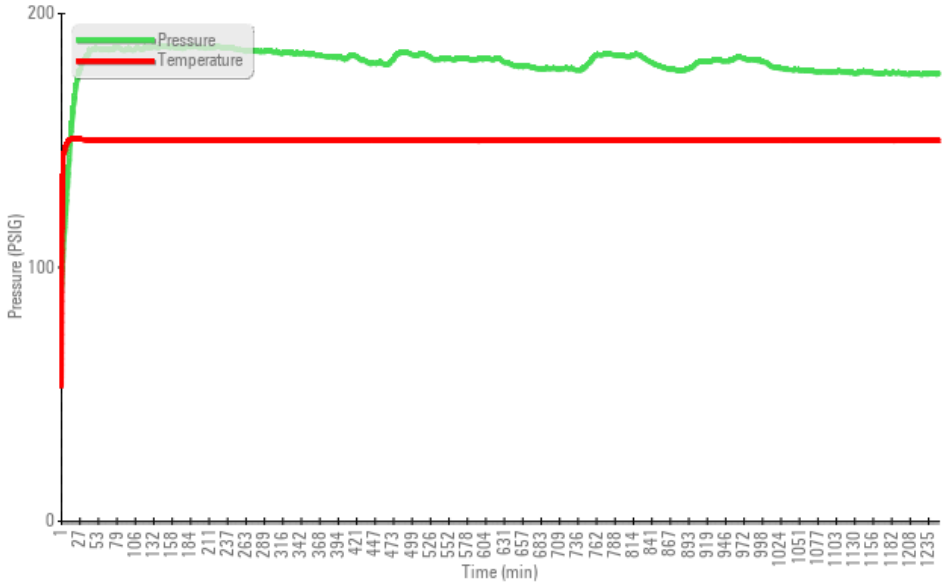
| FERROGRAPHY | | method | limit/base | current | history1 | history2 |
|---|---|---|---|---|---|---|
| Ferrous Rubbing | Scale 0-10 | ASTM D7684* | | **2** | | |
| Ferrous Sliding | Scale 0-10 | ASTM D7684* | | | | |
| Ferrous Cutting | Scale 0-10 | ASTM D7684* | | | | |
| Ferrous Rolling | Scale 0-10 | ASTM D7684* | | **1** | | |
| Ferrous Break-in | Scale 0-10 | ASTM D7684* | | | | |
| Ferrous Spheres | Scale 0-10 | ASTM D7684* | | | | |
| Ferrous Black Oxides | Scale 0-10 | ASTM D7684* | | | | |
| Ferrous Red Oxides | Scale 0-10 | ASTM D7684* | | | | |
| Ferrous Corrosive | Scale 0-10 | ASTM D7684* | | **1** | | |
| Ferrous Other | Scale 0-10 | ASTM D7684* | | | | |
| Nonferrous Rubbing | Scale 0-10 | ASTM D7684* | | | | |
| Nonferrous Sliding | Scale 0-10 | ASTM D7684* | | | | |
| Nonferrous Cutting | Scale 0-10 | ASTM D7684* | | | | |
| Nonferrous Rolling | Scale 0-10 | ASTM D7684* | | | | |
| Nonferrous Other | Scale 0-10 | ASTM D7684* | | | | |
| Carbonaceous Material | Scale 0-10 | ASTM D7684* | | | | |
| Lubricant Degradation | Scale 0-10 | ASTM D7684* | | ▲ **3** | | |
| Sand/Dirt | Scale 0-10 | ASTM D7684* | | **1** | | |
| Fibres | Scale 0-10 | ASTM D7684* | | | | |
| Spheres | Scale 0-10 | ASTM D7684* | | | | |
| Other | Scale 0-10 | ASTM D7684* | | **2** | | |

### WEAR

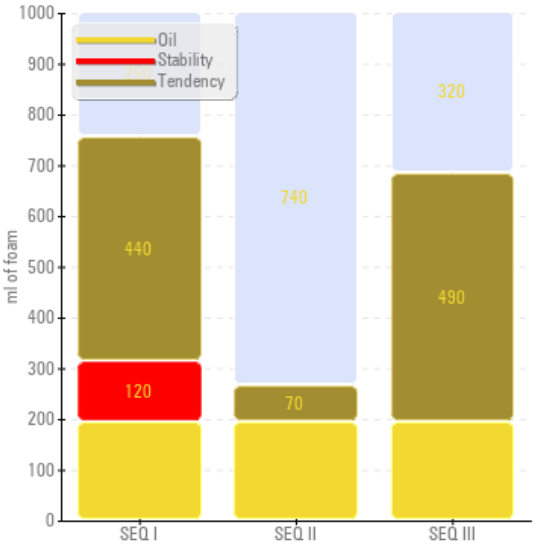
Large Particles, small particles, severity index and total particles levels are abnormal. The ferrography results are normal indicating no abnormal wear in the system.



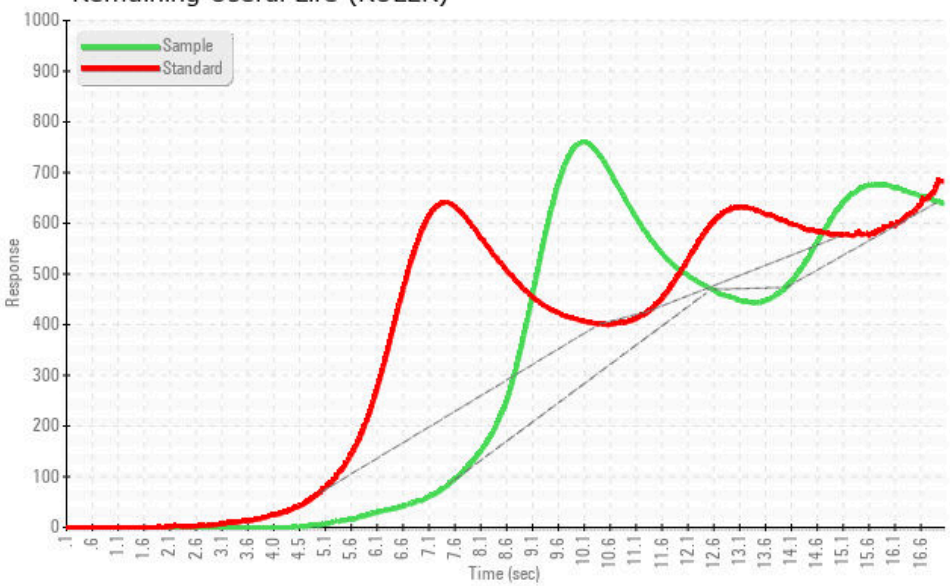
## Rotating Pressure Vessel Oxidation Test



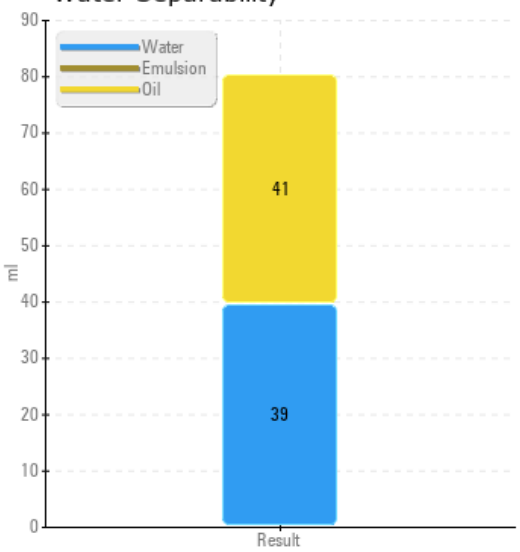

## Foaming SEQ I/II/III



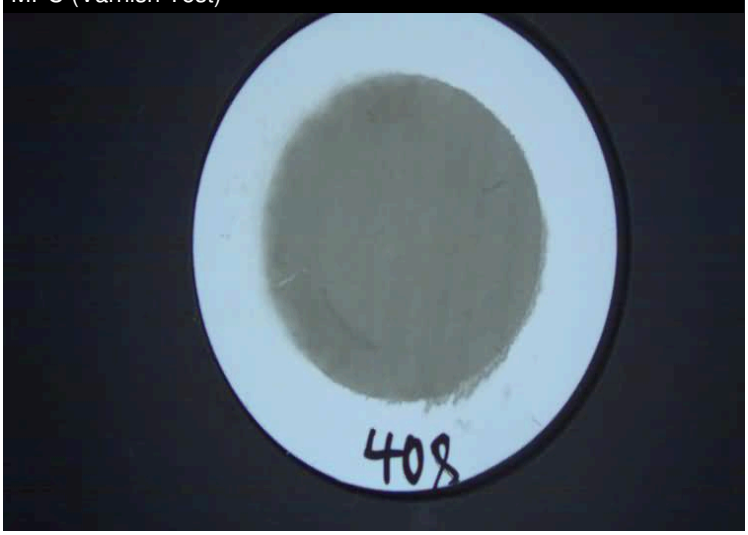

## Remaining Useful Life (RULER)




## Water Separability




## MPC (Varnish Test)




## Sample Color & Clarity