



Spectro Scientific

Confidence in knowing

火車引擎 油液分析解決方案



About Spectro Scientific Inc.

- 1981年成立，總部位於Chelmsford, MA, USA
- 業界最大整合油液分析解決方案廠商
- 2012併購Emerson CSI
- 2013併購Wilks Enterprise
- 2014併購On-site Analysis
- 2019加入SPECTRO集團
- ISO 9001:2008 品質認證



全球各地現有鐵路業客戶



油液分析降低維護成本

■ 維持油品續航力

■ 正確油種

■ 乾淨

■ 乾燥

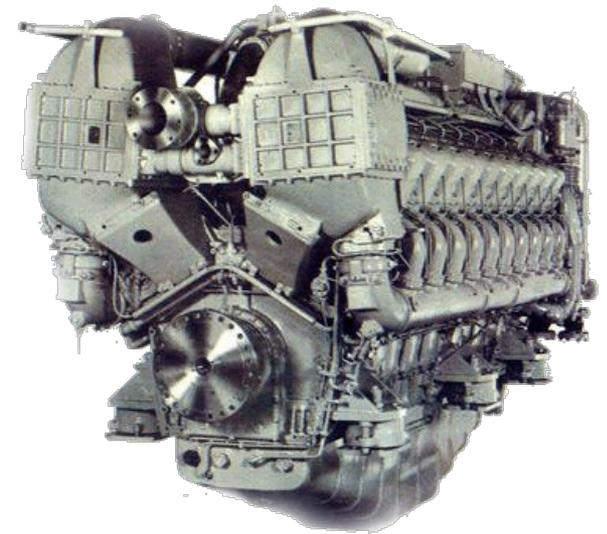
■ 正確應用

■ 預防先期機器故障 (預知保養)



Oil analysis for locomotive engines

- Machine wear monitoring 機械磨耗監測
 - Elemental analysis 元素分析
 - Total ferrous wear 含鐵量
 - Ferrography 粒子分析 / Particle Count 粒徑分析
- Fuel Dilution 燃油稀釋
 - Direct fuel dilution measurement 燃油稀釋量測
 - Viscosity 黏度
- Soot 煤灰
- Coolant leak 冷卻液洩漏
 - IR 紅外線分析
 - Elemental Analysis 元素分析
- Moisture in oil 油中水分
 - Water 水
- Oil condition monitoring 油液狀態監測
 - TBN/TAN, Oxidation, Viscosity 總鹼/總酸價，氧化度，黏度
- New oil inspection 新油管制
 - Viscosity, water, oxidation, additive elements 黏度，水分，氧化度，添加劑



Spectro Scientific 引擎油測試儀器

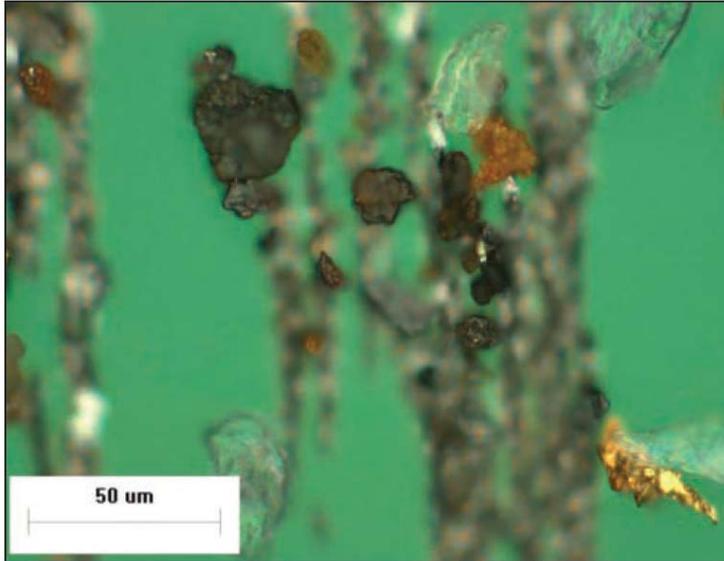
- Solvent free 無須溶劑
- Small sample volume (< 5ml total) 樣品容量小 (總量小於 5ml)
- Fast (< 5 minutes) 快速 (小於5分鐘)
- Comprehensive Oil Analysis 綜合油液分析
 - 24 elements 24個元素
 - IR Oil condition - TBN, Oxidation, Nitriton, Sulfation
紅外線油液狀態 – 總鹼值，氧化度，硝化度，硫化度
 - Contamination - water, soot, glycol
油液汙染-水分，煤灰，乙二醇
 - Fuel dilution 燃油稀釋
 - Viscosity 黏度
 - Total Ferrous wear 含鐵量
- ASTM compliance 遵從 ASTM 標準方法
 - ASTM D6595 – elemental analysis 元素分析
 - ASTM D7889 – IR 紅外線分析
 - ASTM D 8004 – Fuel dilution 燃油稀釋
 - ASTM D 8092 – Viscosity 黏度
 - ASTM D 8120 – Total ferrous 含鐵量



柴油引擎發電機組分析

- 潤滑油 (發電機油)
 - 黏度
 - 燃油稀釋
 - 煤灰
 - 元素分析
 - TAN / TBN
- 冷卻液
 - 是否洩漏 – 元素分析SpectrOil 100
- 燃油 (柴油)

客戶實例 – 愛爾蘭鐵路局



18種不同磨耗金屬在液體冷卻柴油機車引擎顯現多種警示訊息。

根據分析報告，該次分析發現了**大尺寸滑動磨耗粒子**，以及一些深色氧化物粒子

這也表示“可能因潤滑不佳，已經從普通的磨損變成嚴重磨損”

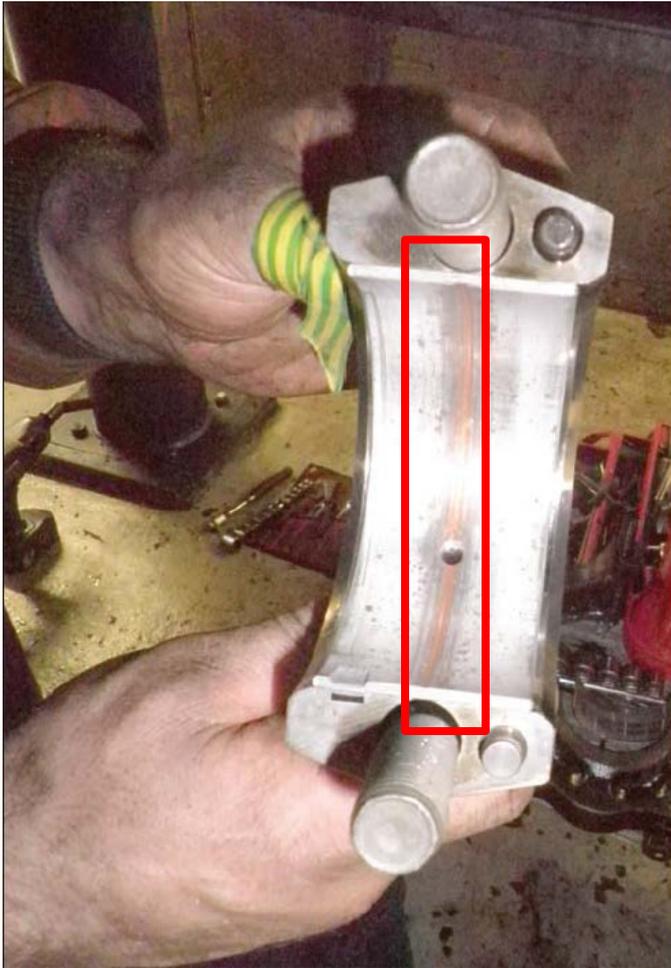
使用儀器：T2FM Q500 分析鐵譜儀

替代做法：

SpectrOil 120C 元素分析 +

LaserNet 220 磨耗粒子分析儀

客戶實例 – 愛爾蘭鐵路局



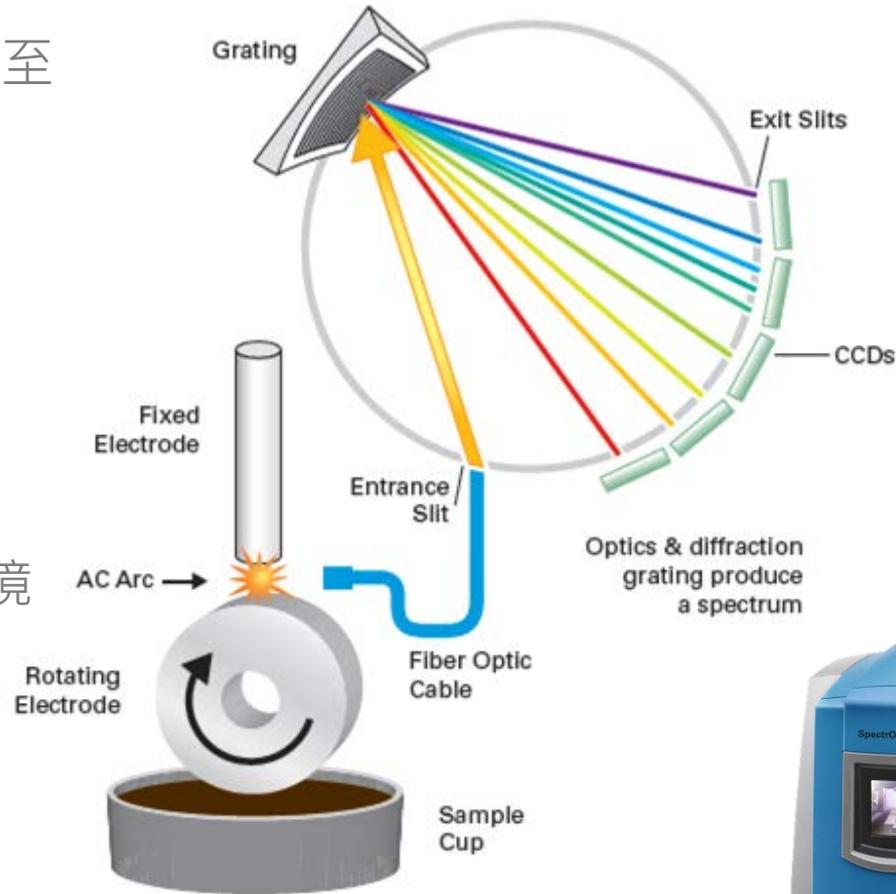
發現機器部件已有嚴重的磨損



油底殼實際狀況

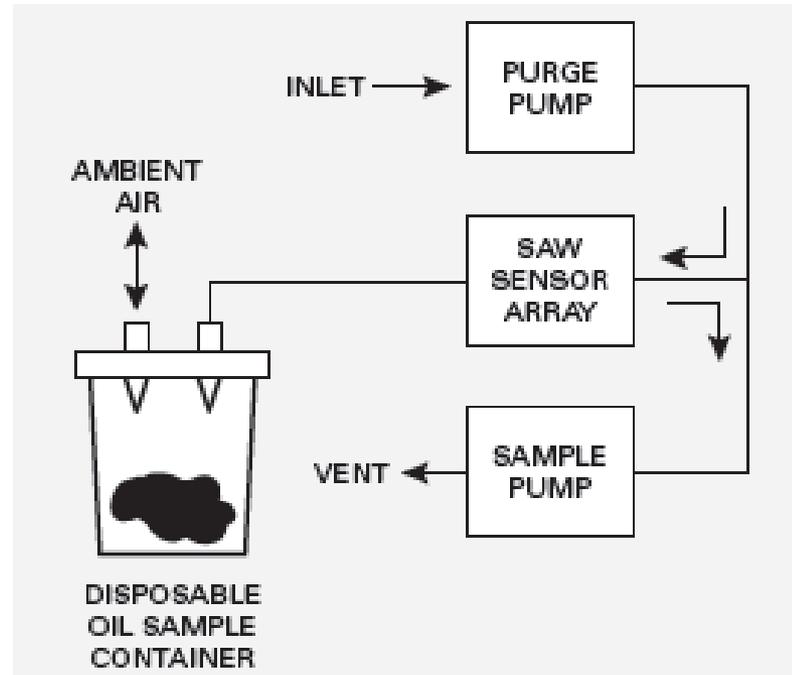
SpectrOil 120C RDE OES – 元素分析

- 標配 24個元素，最多可擴增至 31個
- 符合ASTM D6595
- 只需要2 ml 油樣
- 分析時間30秒
- 無須前置處理
- 無須溶劑
- 無須特殊氣體或特殊工作環境



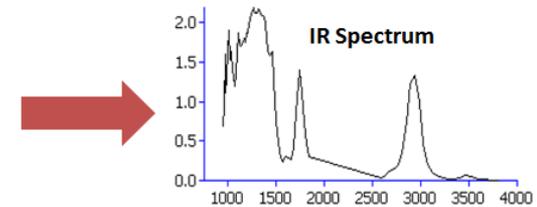
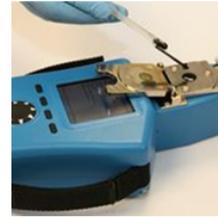
FDM 6000 燃油稀釋分析儀

- 直接量測機油中的燃油含量
- 符合 ASTM D8004
- 可量測 0.2% 到 15%
- 只需 0.5ml 油樣
- 分析時間少於 1分鐘
- 無須前處理
- 無須清洗溶劑



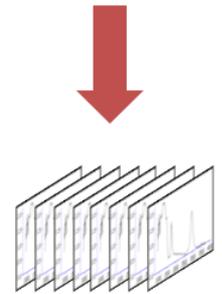
Fluidscan 1000 - 手持式紅外線分析儀

- 不到一分鐘檢測9種化學性質
 - 引擎油：總鹼值、氧化度、硝化度、硫化度
 - 旋轉設備：總酸值、氧化度
 - 水、乙二醇、煤灰
- 符合 ASTM D7889
- 只需一滴油樣
- 無須前處理
- 無須清洗溶劑
- 應用
 - 齒輪箱、引擎、傳輸系統中的礦物/合成油
 - 液壓系統、渦輪、其他機械部件
 - 生質柴油/燃油
 - 新油品質管制



Measure Fluid → Results	
Sample ID:	sample 1
CAT:	NGEO EL250 SAE 40
Date:	21 May 2014 01:31:15
AW Additive	105 %
Glycol	0.5 %
Nitration	1.4 abs/0.1
Oxidation	12.4 abs/0.1
Soot	0.00 %wt
Sulfation	18.1 abs/0.1
TAN	0.73 mgKOH/L
TBN	5.0 mgKOH/L
Water	102 ppm

Measured fluid properties

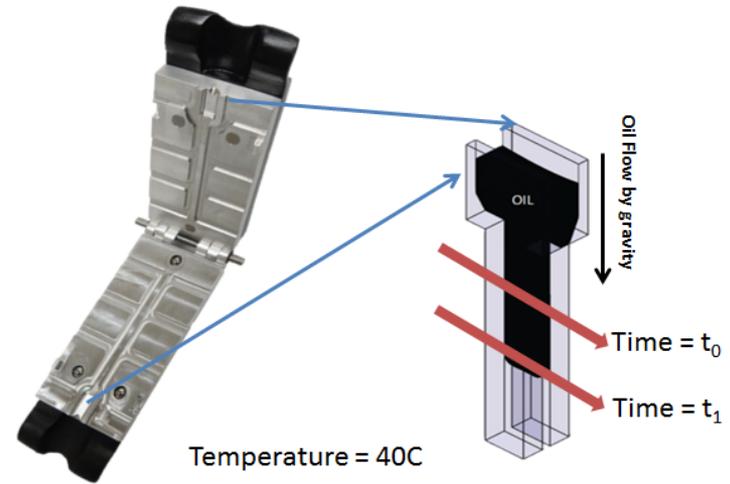


Built-in Fluid Reference Library



MiniVisc 3050 運動黏度分析儀

- 40C 運動黏度
- 使用黏度指數推算100C黏度
- 可分析 1-700 cSt
- 符合 ASTM D8092
- 只需 60 μ l 油樣
- 分析時間依黏度
短至幾秒，長至 5分鐘
- 無須清洗溶劑

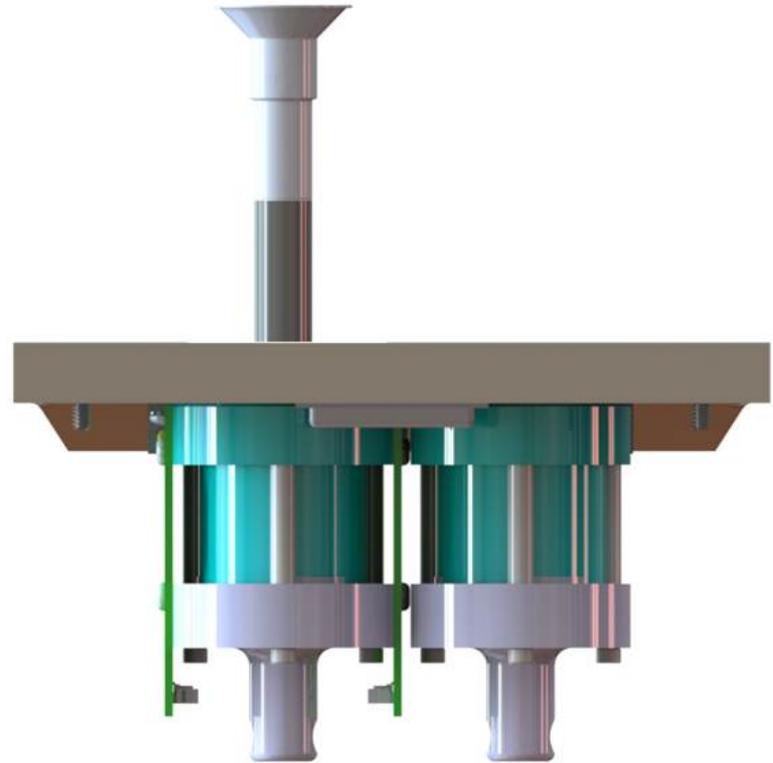


$$\text{Kinematic Viscosity (40C)} = A * (t_1 - t_0) + B$$

*A and B are calibration coefficients

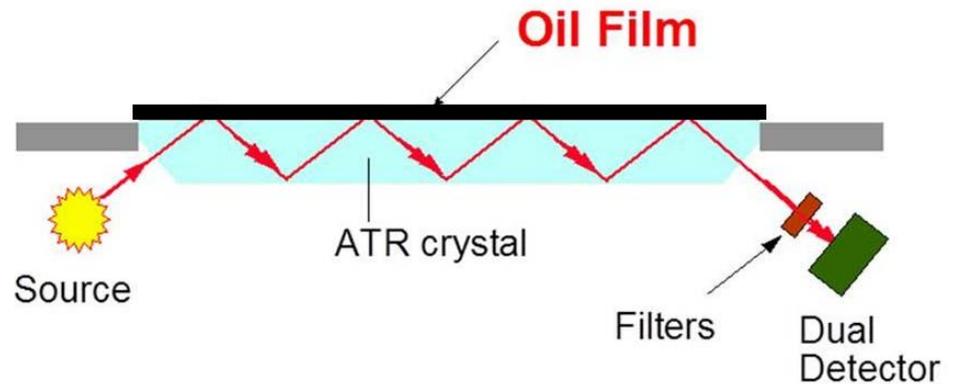
FerroCheck 2000 含鐵量 - 鐵磁性粒子分析儀

- 鐵磁性粒子量測
- 可分析最多 10,000ppm 粒子含量
- 全尺寸皆可量測
- 符合 ASTM D8120 (新)
- 只需 1.5ml 油樣
- 分析時間 30 秒
- 無須前處理
- 無須清洗溶劑
- 可量測油脂及油膏(油泥、汙泥)



選配 – 煤灰量測儀

- 可分析高達15%的煤灰
- 符合ASTM D7686
- 只需少於1ml 的油樣
- 分析時間15秒
- 無須前處理
- 無須清洗溶劑



TruVu 360 智慧油液分析平台



TruVu 360 智慧油液分析平台

- **Device Console 裝置主控台**：同時控制多台儀器，不再是一個軟體控制一個儀器
- **數據顯示**：所有儀器的輸出數據，同時顯示於畫面右方，一目瞭然

The screenshot displays the TruVu 360 Device Console interface. At the top, the breadcrumb navigation reads: POWER GENERATION → PHILADELPHIA → UNIT ONE → UNIT 1 TURBINE > TURBINE THRUST BEARING > AFTER FILTER. The main interface is divided into several sections:

- Control Panel (Left):** Contains five analysis modules, each with a play/pause button and a status indicator:
 - ELEMENTAL ANALYSIS:** Status: Ready
 - VISCOSITY:** Viscosity Index: 0, Status: Ready
 - INFRARED:** Category and Substance dropdowns, Status: Ready
 - PARTICLE ANALYSIS:** Dilution Ratio: 0, Status: Ready
- Data Tables (Center-Right):**
 - ELEMENTAL ANALYSIS:**

Aluminum (Al)	0
Antimony (Sb)	0
Cadmium (Cd)	7.37
Chromium (Cr)	0
Copper (Cu)	0.31
Iron (Fe)	0.48
Lead (Pb)	2.44
Manganese (Mn)	2.24
Nickel (Ni)	0.7
Silver (Ag)	0
Tin (Sn)	6.63
Titanium (Ti)	0
Potassium (K)	1.78
Sodium (Na)	0.9
Vanadium (V)	0.81
Silicon (Si)	1.4
Boron (B)	10.22
Calcium (Ca)	62.18
Barium (Ba)	8.03
Magnesium (Mg)	9.97
Molybdenum (Mo)	0
Phosphorus (P)	86.23
Zinc (Zn)	3.36
 - VISCOSITY:**

v40	98.83
-----	-------
 - INFRARED:**

Total Acid	1.16
PPM Water	322.1
Oxidation	2.87
 - PARTICLE ANALYSIS:**

ISO 4/6/14	16/14/10
Cnts >4	953.23
Cnts >6	205.32
Cnts >14	10.33
Total Fe	84.3
Large Fe	0.2
% Large Ferrous	0.24
Fe Wear Severity Index	16.86
Cutting >20	4
Sliding >20	7
Fatigue >20	3
Oxide >20	3.68
- Visual Analysis (Right):** Six panels showing particle analysis results:
 - Fatigue: Shows small black dots.
 - Cutting: Shows small black dots with tails.
 - Sliding: Shows small black dots with long tails.
 - Non-Metallic: Shows irregular black shapes.
 - Water: Shows small black circles.
 - Unknown: Shows various irregular black shapes.
- Images (Bottom Right):** Three panels labeled Image 1, Image 2, and Image 3, showing photographs of oil samples and components.
- Summary (Bottom):**
 - Hours on Oil:
 - Hours on Asset:
 - NOTES:

TruVu 360 智慧油液分析平台



Boston Power Site

Location: Generator Unit One
 Unit ID: **Boiler Feed Pump A Pump Before Filter**
 Model:
 Machine Type: Pump, Centrifugal



Observations :
 Particle count (ISO >4) is severely high; Particle count (ISO >6) is severely high

Diagnostics :

- Secondary sources include filter bypass or clogged filters.
- Suspect source of particulate to be dirt, dust ingestion, or soft contaminants.
- Wearing components are also suspected.

Recommended Actions :

- Clean system oil by filtration or centrifuging.

Additional Recommendations :

25 Sep 2018

Oil Shell Tellus 46	Sample ID	180925121255	180925121221	180925114709	180925114702	180925131632
Note:	Sampled on	25 Sep 2018	25 Aug 2018	25 Jul 2018	25 Jun 2018	25 May 2018
	Received on	25 Sep 2018	25 Aug 2018	25 Jul 2018	25 Jun 2018	25 May 2018
	h Total					
	h Oil					
	Top up (L)					
		⚠	⬢	⬢	⊘	⚠
	Iron ppm	<1.00	1.48	<1.00	<1.00	<1.00
	Lead ppm	<1.00	6.74	4.84	2.44	<1.00
	Copper ppm	<1.00	3.81	2.11	<1.00	<1.00
	Tin ppm	1.43	9.13	18.33	6.63	1.43
	Fe Wear Severity Index	0.00	0.00	0.00	0.00	0.00
ML Wear	Chrome ppm	<1.00	<1.00	<1.00	<1.00	<1.00
	Nickel ppm	<1.00	1.70	1.10	<1.00	<1.00
	Aluminium ppm	<1.00	<1.00	<1.00	<1.00	<1.00
	Titanium ppm	<1.00	<1.00	<1.00	<1.00	<1.00
	Silver ppm	<1.00	<1.00	<1.00	<1.00	<1.00
	Antimony ppm	0.00	0.00	0.00	0.00	0.00
	Cadmium ppm	0.34	4.87	3.57	7.37	0.34
	Manganese ppm	1.47	7.94	6.54	2.24	1.47
	Silicon ppm	4.40	7.40	9.22	1.40	4.40
	ISO 4406 Code (>4µm)	19	18	19	18	16
ISO 4406 Code (>6µm)	16	16	16	16	14	
ISO 4406 Code (>14µm)	12	11	12	11	10	
ML Contamination	Boron ppm	20.72	4.42	6.82	10.22	20.72
	Sodium ppm	<1.00	2.40	1.40	<1.00	<1.00
	Vanadium ppm	<1.00	2.15	6.65	<1.00	<1.00
	Potassium ppm	0.38	5.58	4.68	1.78	0.38
	TAN mg KOH/g	0.38	3.22	0.76	0.54	0.38
ML Chemistry	Oxidation abs/mm2	0.90	1.44	0.90	0.84	0.90
	Visc 40 cSt	101.2	98.8			
	Molybdenum ppm	<1.00	<1.00	<1.00	<1.00	<1.00
	Calcium ppm	21.68	58.98	71.38	62.18	21.68
	Magnesium ppm	1.07	13.37	11.17	9.97	1.07
	Phosphorus ppm	210.89	68.33	36.82	86.23	210.89
	Zinc ppm	3.26	8.62	15.52	3.36	3.26
Barium ppm	<1.00	12.63	17.33	8.03	<1.00	

■ 資料庫

內建多種機械、部件分類油種
異常值、警戒值

■ 顏色、圖示標示

超過異常/警戒值，即用黃色、紅色字體標示；若整體數據異常，用對應標示提醒操作者。

■ 數據診斷、建議措施

超過異常/警界值皆有對應的維護措施，根據整體數據，報告上方皆會列出。

總結

- Spectro Scientific 引擎油監測系統是最適合鐵路系統實驗室設備
- 經濟實惠
- 不須溶劑/化學藥品以及特殊環境
- 快速、簡單、準確
- 各項儀器皆符合ASTM標準



Boston Power Site

Location: Generator Unit One
 Unit ID: **Boiler Feed Pump A Pump Before Filter**
 Model: Pump, Centrifugal
 Machine Type: Pump, Centrifugal

Observations:
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Diagnostics:
 • Secondary sources include filter bypass or clogged filters.
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Recommended Actions:
 • Clean system oil by filtration or centrifuging.

Additional Recommendations:

25 Sep 2018

Oil	Shell Tellus 46	Sample ID	180925121255	180925121221	180925114709	180925114702	180925131632
Note:		Sampled on	25 Sep 2018	25 Aug 2018	25 Jul 2018	25 Jun 2018	25 May 2018
		Received on	25 Sep 2018	25 Aug 2018	25 Jul 2018	25 Jun 2018	25 May 2018
		In Total					
		F OI					
		Top up (L)					
			⚠	⬇	⬇	⊘	⚠
Iron	ppm	<1.00	1.48	<1.00	<1.00	<1.00	<1.00
Lead	ppm	<1.00	6.74	4.85	2.44	<1.00	<1.00
Copper	ppm	<1.00	3.81	2.11	<1.00	<1.00	<1.00
Tin	ppm	1.43	9.13	18.33	6.63	1.43	1.43
Fe Wear Severity Index		0.00	0.00	0.00	0.00	0.00	0.00
Chromium	ppm	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Nickel	ppm	<1.00	1.70	1.10	<1.00	<1.00	<1.00
Aluminum	ppm	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Titanium	ppm	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Silver	ppm	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Antimony	ppm	0.00	0.00	0.00	0.00	0.00	0.00
Cadmium	ppm	0.34	4.87	3.57	7.37	0.34	0.34
Manganese	ppm	1.47	7.94	6.54	2.24	1.47	1.47
Silicon	ppm	4.40	7.60	8.22	1.40	4.40	4.40
ISO 4406 Code (>4µm)		19	16	19	16	16	16
ISO 4406 Code (>6µm)		16	16	16	16	16	14
ISO 4406 Code (>14µm)		13	11	12	11	11	10
Contamination							
Boron	ppm	20.72	4.42	6.82	10.22	20.72	20.72
Sodium	ppm	<1.00	2.40	1.40	<1.00	<1.00	<1.00
Vanadium	ppm	<1.00	2.15	6.55	<1.00	<1.00	<1.00
Potassium	ppm	0.38	5.58	4.68	1.78	0.38	0.38
TAN	mg KOH/g	0.38	3.22	0.76	0.54	0.38	0.38
Oxidation	atkinem2	0.90	1.44	0.90	0.84	0.90	0.90
Visc 40	cSt	101.2	99.8				
Molybdenum	ppm	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Calcium	ppm	21.68	58.98	71.38	62.18	21.68	21.68
Magnesium	ppm	1.07	13.37	11.17	9.97	1.07	1.07
Phosphorus	ppm	210.89	68.33	36.82	86.23	210.89	210.89
Zinc	ppm	3.26	8.62	15.52	3.36	3.26	3.26
Barium	ppm	<1.00	12.63	17.33	8.03	<1.00	<1.00

謝謝



Fast.



Simple.



Accurate.

