



What is RULER™ ?

RULER stands for **R**outine **U**seful **L**ife **E**valuation **R**outine by Linear Sweep Voltammetry (LSV)

RULER :> Test to determine and monitor the Remaining Useful Life (RUL) of turbine oils .

- > By measuring remaining Antioxidant Additives (oxidation inhibitors) in turbine oils.
- > Result in % remaining of antioxidant additive (oxidation inhibitors) in turbine oils .
- > RULER is ASTM approval test method : ASTM D-6971-04³ and ASTM D-6810-02⁴

“ Testing and monitoring antioxidant additives (oxidation inhibitors) level is important for controlling the degradation of turbine oils and industrial oils and their remaining useful life (RUL) ”

Refer : ASTM D-4739-02¹ and ASTM D-6224-02²

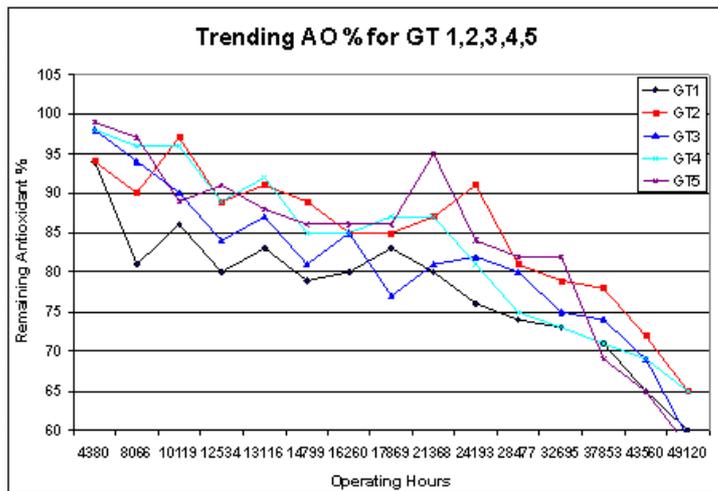


Figure 1 : The trending graphs for RULER data (antioxidant concentration) for 5 Gas Turbine (GT1-5) v.s. operating hours of gas turbines.

Note for Turbine Oil Monitoring Program :

- RULER can be screening tool and more frequent scheduling test to monitor remaining useful life(RUL) of turbine oils which can prompt end-users to perform RPVOT (RBOT) when needed . See Figure 2 .
- RULER is not a replacement for RPVOT (RBOT) and FTIR , but it will be complementary test or as an effective way to monitor remaining useful life (RUL) of turbine oils . See Figure 2
- RPVOT(RBOT) test will often provide not only poor repeatability data but also high fluctuation data .
- By combining RULER+RPVOT+FTIR , will be more reliable information for right and better decision . See Figure 2
- Recommend to be an effective Turbine RUL monitoring program , with monthly testing of RULER and FTIR and testing RPVOT every 6 month and/or whenever RULER and FTIR show some abnormal data. See Figure 2

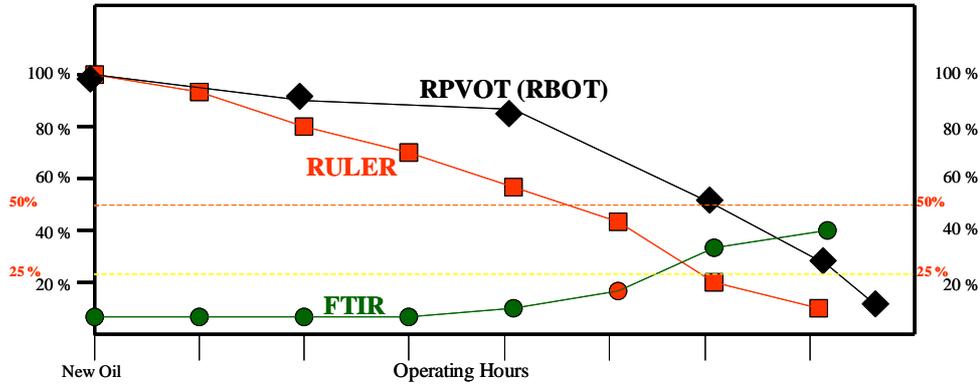
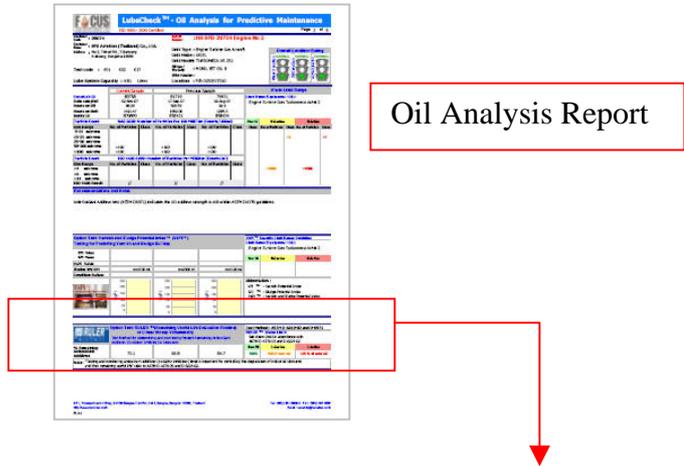


Figure 2: Effective Monitoring Program for Turbine Oils System

Reference :

1. ASTM D-4738-02 : Standard Practice for In-Service Monitoring of Mineral Turbine Oils for Steam and Gas Turbine
2. ASTM D-6224-02 : Standard Practice for In-Service Monitoring of Lubricating Oils for Auxiliary Plant Equipment
3. ASTM D-6971-04 : Standard Test Method for Measurement of Hindered Phenolic and Aromatic Amine Antioxidant content in Non Zinc Turbine Oil by Linear Sweep Voltammetry (LSV).
4. ASTM D-6810-02 : Standard Test Method for Measurement of Hindered Phenolic Antioxidant Content in HL Turbine Oil by Linear Sweep Voltammetry (LSV)



 Option Test: RULER™ (Remaining Useful Life Evaluation Routine) or Linear Sweep Voltammetry Test Method for determining and monitoring Percent Remaining Antioxidant Additives (Oxidation Inhibitor) in lubricants.			Test Method : ASTM D-6810-02 and D-6971 RULER™ Alarm Limit: Set Alarm Limit in accordance with ASTM D-4378-03 and D-6224-02		
% Remaining Antioxidant Additives			New Oil	L-Caution	L-Action
	73.1	66.8	100%	<50 of new oil	<25 % of new oil
Note: "Testing and monitoring antioxidant additives (oxidation inhibitors) level is important for controlling the degradation of industrial lubricants and their remaining useful life" refer to ASTM D-4378-02 and D-6224-02.					