

NanoLub<sup>®</sup>

SURFACE RECONDITIONING NANO-LUBRICANTS



NanoMaterials  
Active Protection NANOMaterials **APNANO**



**CALTEX**



**Delo 6130 CFO SAE 20W40**

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- In this document is consolidated 4-balls EP and AW performed on following samples :
- Delo 6 130 engine oil
- Delo 6 130 oil formulated with NanoLub additives.

# 4-ball machine

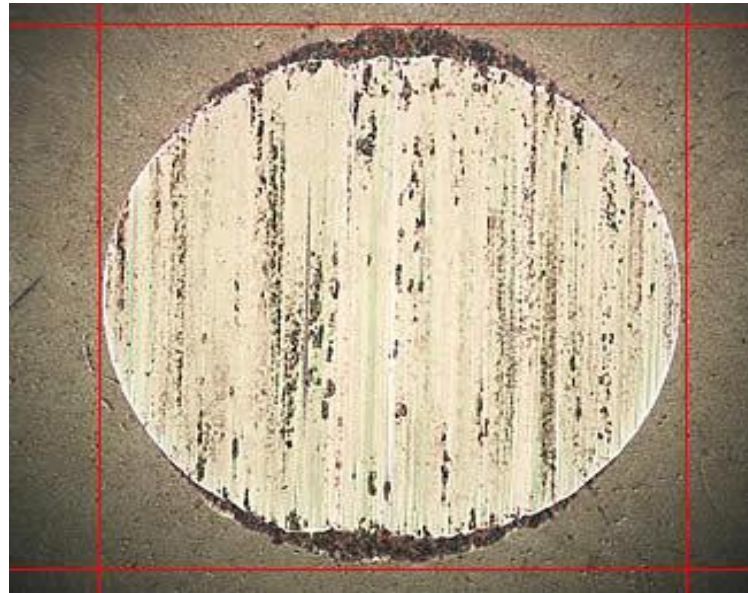


## 4 Balls AW description:

- To compare the anti-wear performances of Delo 6130 oil as is vs. Delo 6130 oil formulated with NanoLub additives. The 4 Balls ASTM D-ASTM 4172 is used at 75°C.
- This test method covers the determination of the wear preventive characteristics of oil in sliding steel-on-steel applications with total immersion of tested balls into the oil. It is not intended to predict wear characteristics with metal combinations other than steel-on-steel or to evaluate the extreme pressure characteristics of the lubricants.
- Three 1/2 inch (12.7 mm) diameter AISI 52100 steel balls are clamped together and covered with the lubricant to be evaluated. A fourth 1/2 inch diameter steel ball, referred to as the top ball, is pressed with a force of 40 kg (392 N) into the cavity formed by the three clamped balls for three-point contact. The top ball is rotated at 1200 rpm for 60 min. Lubricants are compared by using the average size of the scar diameters worn on the three lower clamped balls.

# Measuring:

- After testing, scar diameters are measured on each of the three clamped balls. Figure illustrates a typical wear scar on a ball. The measurements are made thanks to a binocular microscope associated with a numerical video camera that allows precise measurements through adequate software and calibration.
- The mean value of the three scar diameters is reported and gives the anti-wear characteristic of the tested fluid as described in ASTM D 4172. Because of repeatability questions, each lubricant is tested three times following the same procedure.



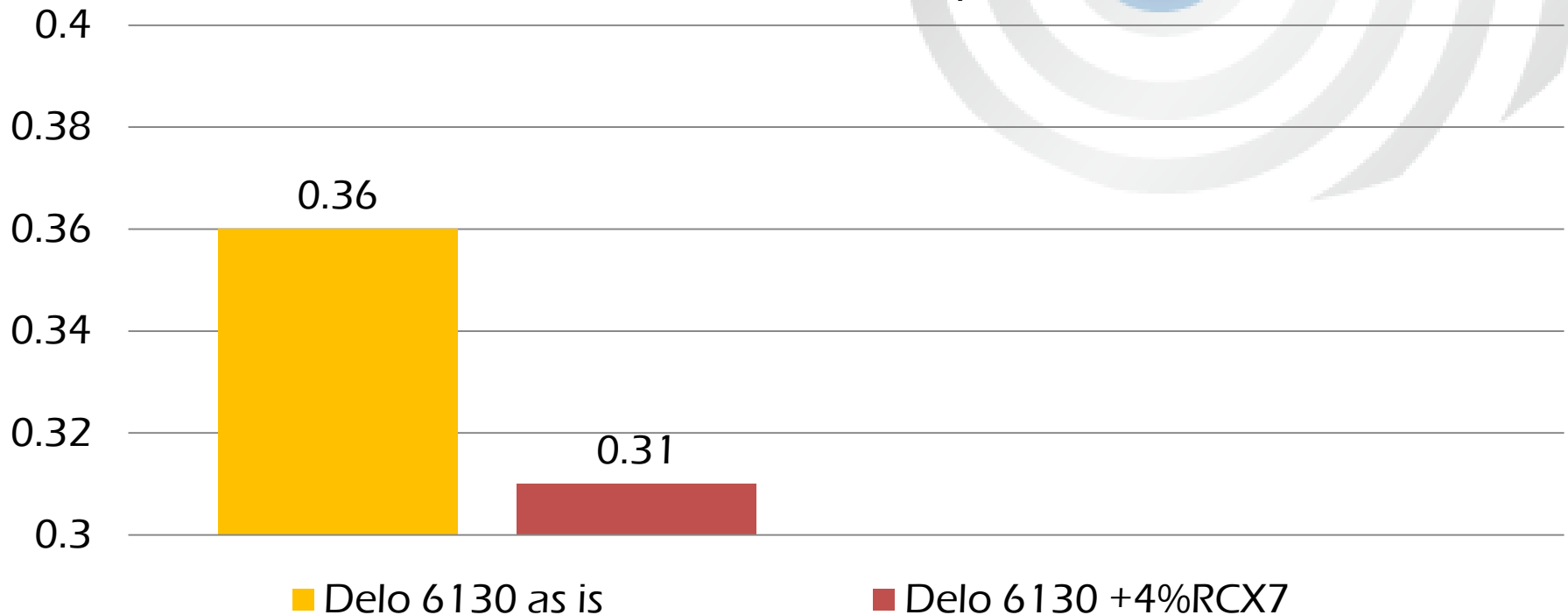
# Wear Scar Diameter Test Results:

	Delo 6130 oil as is	Delo 6130 +4%RCX7
WSD, mm	0.36	0.31

# Wear Scar Diameter test results:

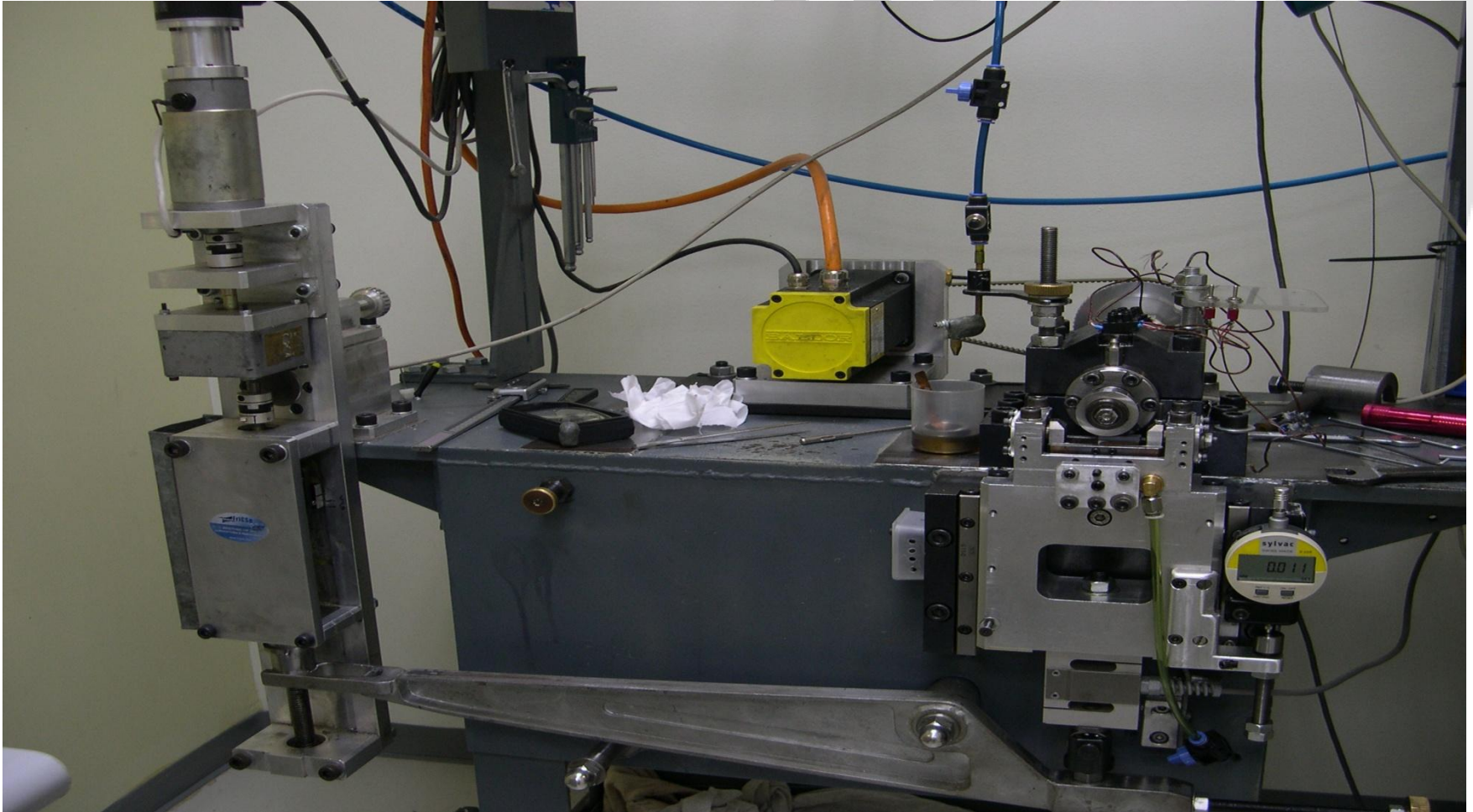
Delo 6130 oil as is vs. Delo 6130 oil formulated with Nanolub products

Wear Scar Diameter, mm





# Roller-On-Block Tribotesting Machine



# Roller-on-Block Tribotesting Machine

- Roller-on-Block
- Coefficient of friction and wear rate (WR) measures were performed using a roller -on- block test machine, approaching guidelines to the international standard ASTM G-77.
- Vertical load on the steel block (SAE 4340) ,roller is rubs on the surface of the block with the constant speed .
- The tests was done under boundary lubrication conditions.
- The measurements were performed according to the parameters given below:
- Load 300 N
- Speed 0.6 m/s
- Roller diameter 38 mm, width 10 mm
- Block width 10 mm
- Way 1000 meters

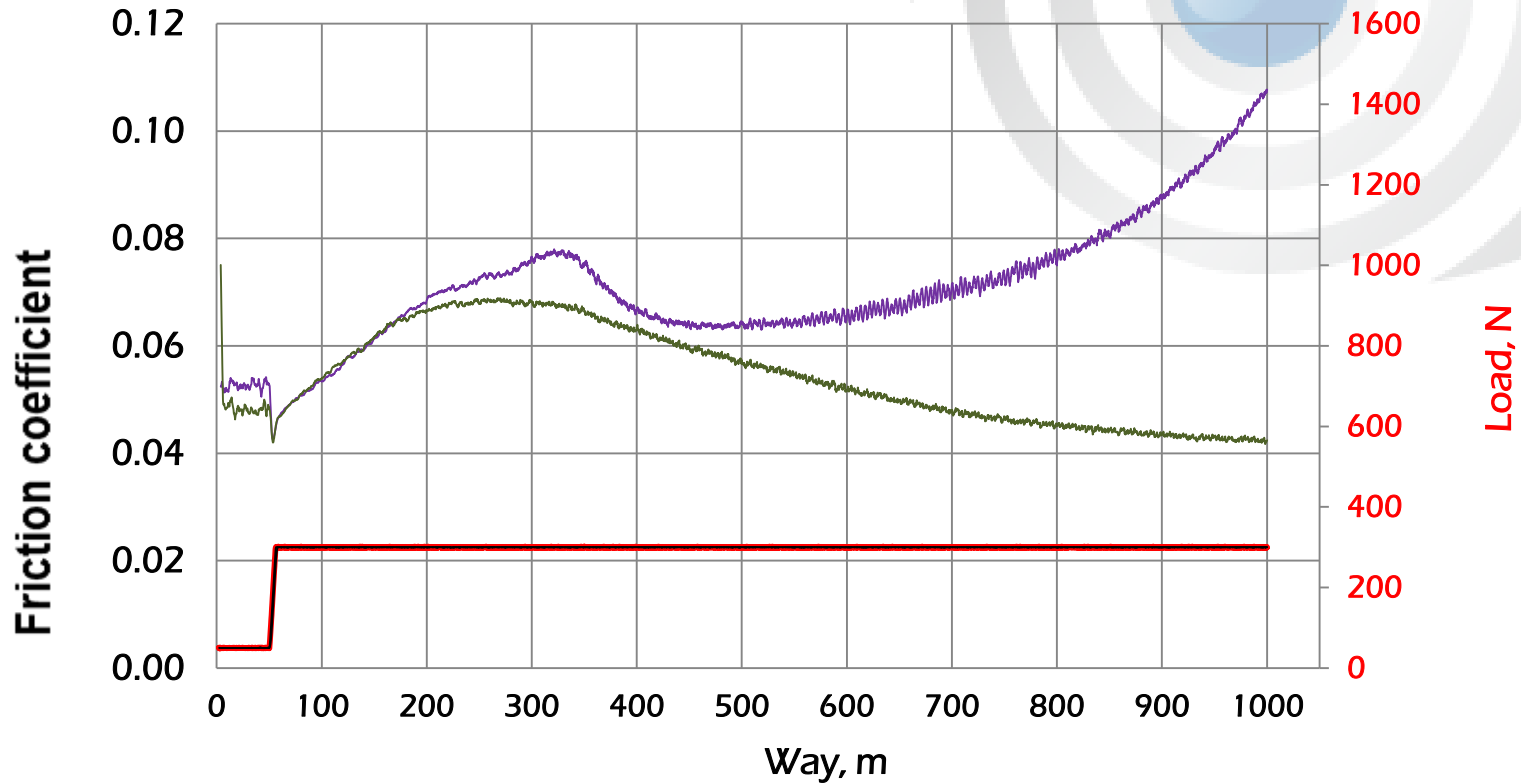
# Test "Roller-on-Block"

## Friction Coefficient

Delo 6 130 vs. Delo 6 130 +4% RCX7

Way 1000 meters

300 N, velocity 0.6 m/sec

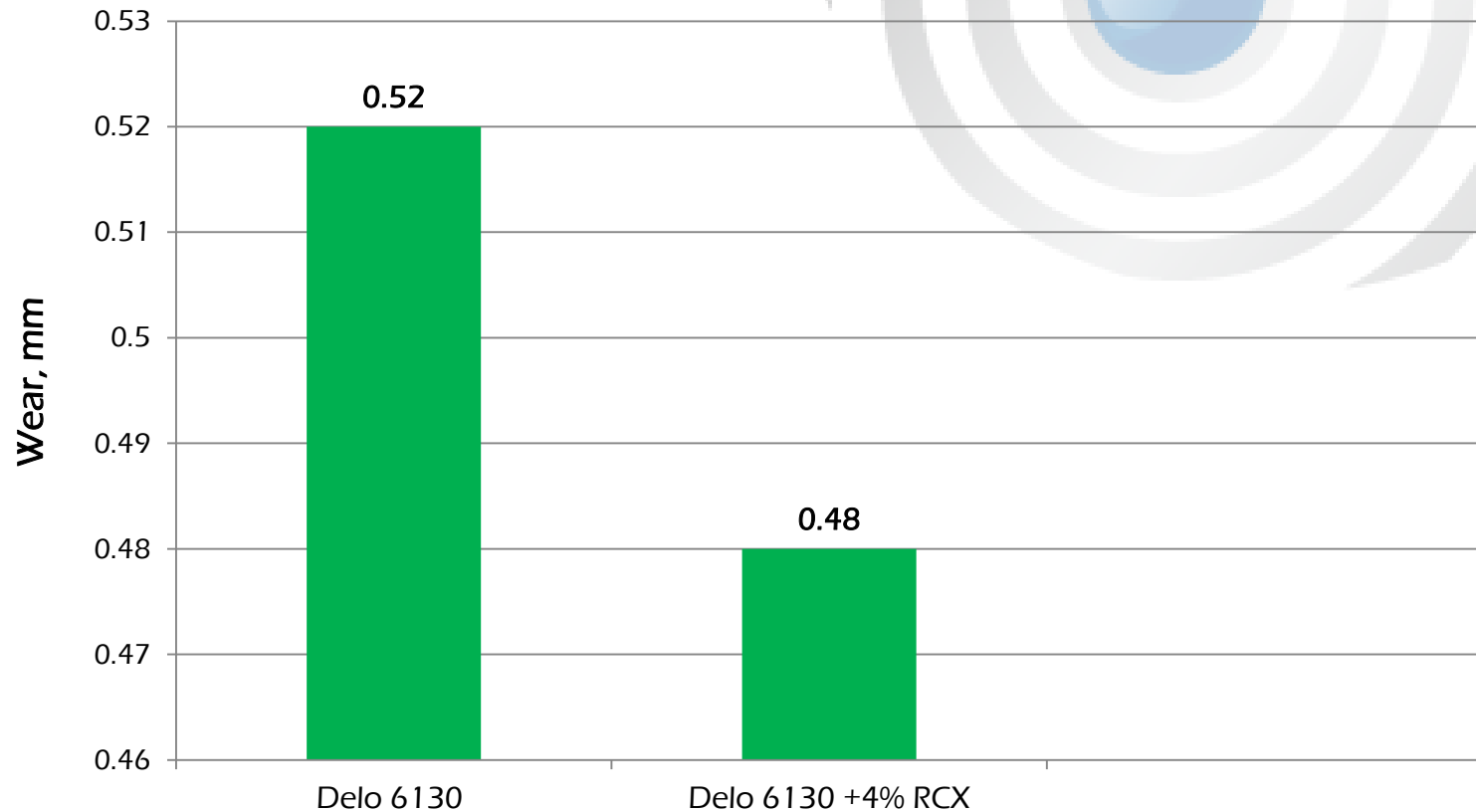


Delo 6 130

Delo 6 130 + 4%RCX7

# Roller-on-Block test results: Wear Data

Delo 6130 vs. Delo 6130 formulated with 4% RCX



# Conclusions:

- The laboratory study using 4-ball machine and further testing on Roller-on-block friction machine, clearly demonstrates the positive impact of NanoLub RCX7 on lubricants used for railroad applications.
- According to all the test results we can conclude that the NanoLub RCX7 reduces wear of about 15%.
- Considering the chart dependence of COF on length, we should note that the oil without additives after 500 meters of run does not ensure a normal lubrication, which is expressed by a sharp COF and wear magnification.
- While the same lubricant, formulated with Nanolub doped under the equal test conditions retains excellent lubricity, which is shown in CoF reduction and wear termination.
- This work is an attempt to trace important mechanisms of friction on commonly used oils vs. formulated with our additives lubricants and physical aspects of the sliding surfaces.
- Recommended treat rate is 4% of RCX.