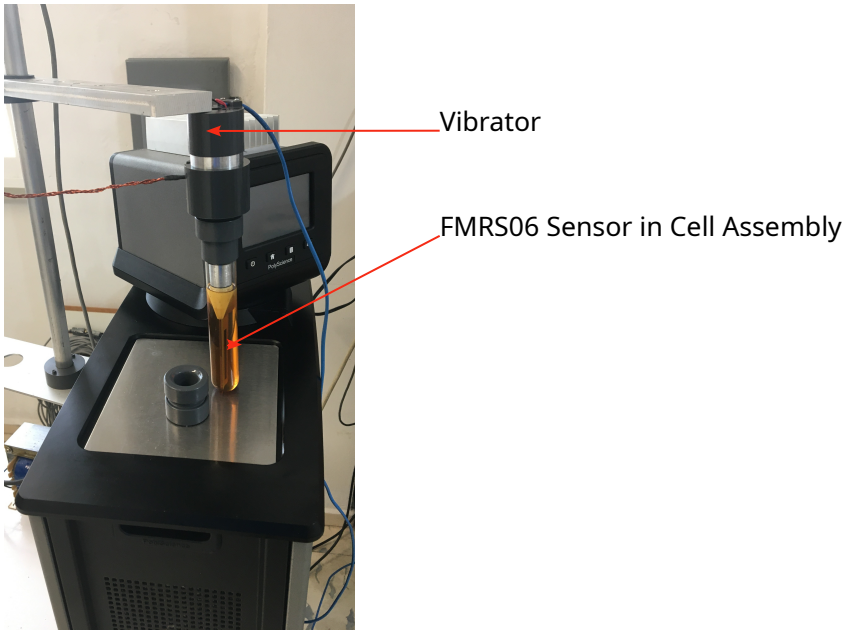
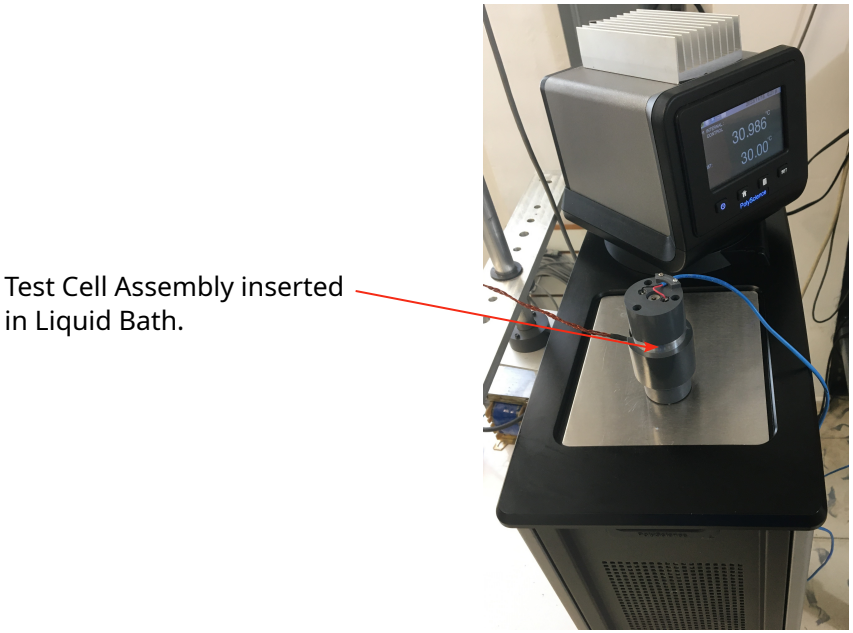
The purpose for the following metal release test for copper in motor oil is to demonstrate the temperature performance of the FMRS06 sensor in an oil filled test cell and at the same time to show differences in metal release for four new synthetic motor oils and one used synthetic motor oil. Fig. 1 and Fig. 2 serve as a reference with the sensor in ambient air inserted in the test cell and outside the test cell. The motor oils used in this test are standard of the shelf oils. The temperature test profile can be also set up differently which would show differences in metal release more clearly but in the following test the sensors performance during ramping up the oil temperature and cooling it down shall also be demonstrated. The synthetic motor oils used for this test are:

Oil A: SAE 5W-30 Mobil 1 new
Oil B: SAE 0W-20 VW 508.00/509.00 new
Oil C: SAE 5W-40 Castrol Edge
Oil D: SAE 5W-40 LiquiMoly
Oil E: Same Oil as Oil B after being used for 10 000 km in a new Audi Q3

The test is performed in 50ml borosilicate glass tubes inserted in a liquid bath as shown on Pic. 1 and 2 below. The test cell assembly below shows also a vibrator attached to it which is used to agitate the sample in the test cell. In the following tests the vibrator head was not activated. Vibrating the sensor instead of stirring the oil sample is currently still under investigation.



Pic. 1



Pic. 2

Metal release curve for copper in ambient air indoors outside the test cell

Environment: Ambient Air Indoors
Report #/Date: MRTR001/April 04, 2024
Author: Eugen Tiefnig
Sensor: FMRS06

Total Average Cu Release: ~1.6nm
Average Tarnish Thickness: ~ 4nm
Tarnish Composition: Primarily Cu2O
Total Exposure Period: 74 hours

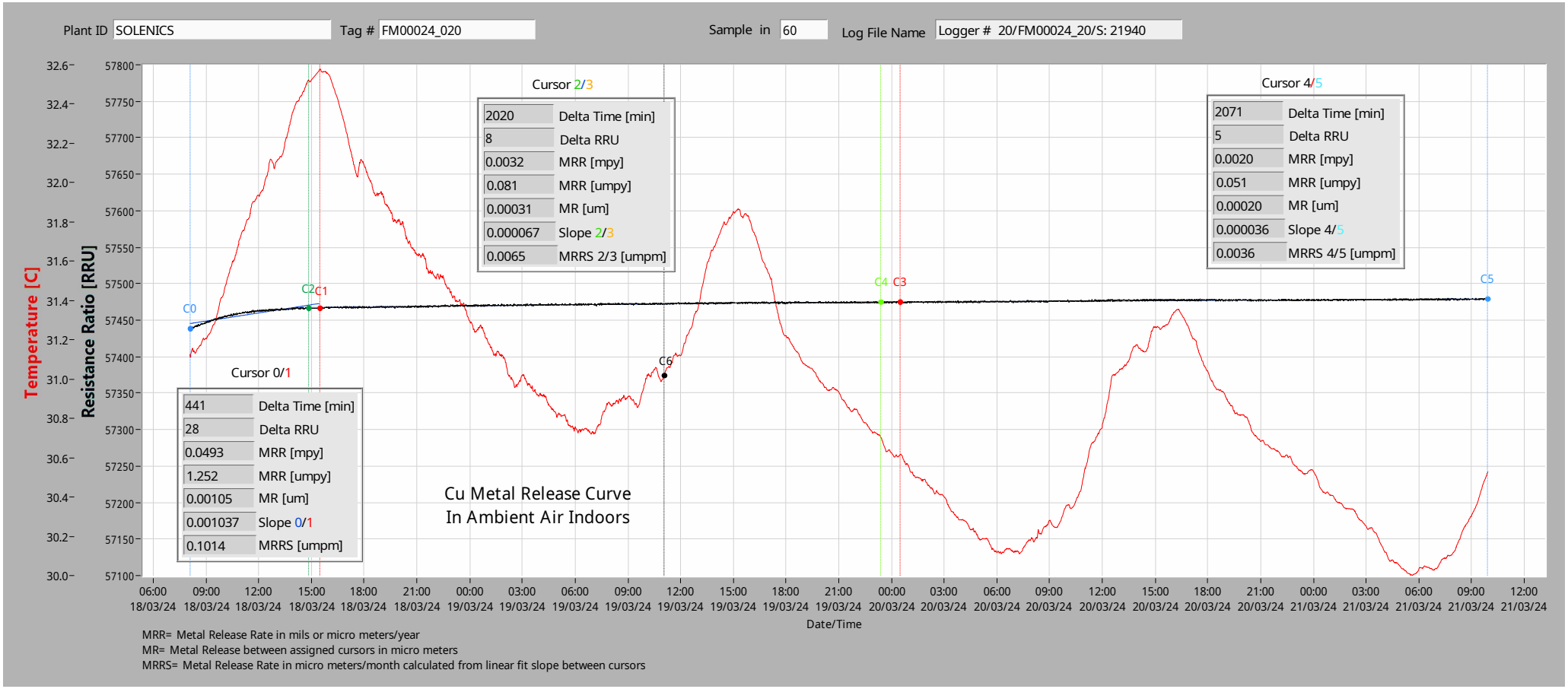


Fig. 1

Metal release curve for copper in ambient air in the empty test cell inserted in the liquid bath.

Environment: Ambient Air in Empty Test Cell
Report #/Date: MRTR001/April 04, 2024
Author: Eugen Tiefnig
Sensor: FMRS06

Total Average Cu Release: ~3.4nm
Average Tarnish Thickness: ~ 8nm
Tarnish Composition: Primarily Cu2O
Total Exposure Period: 43 hours

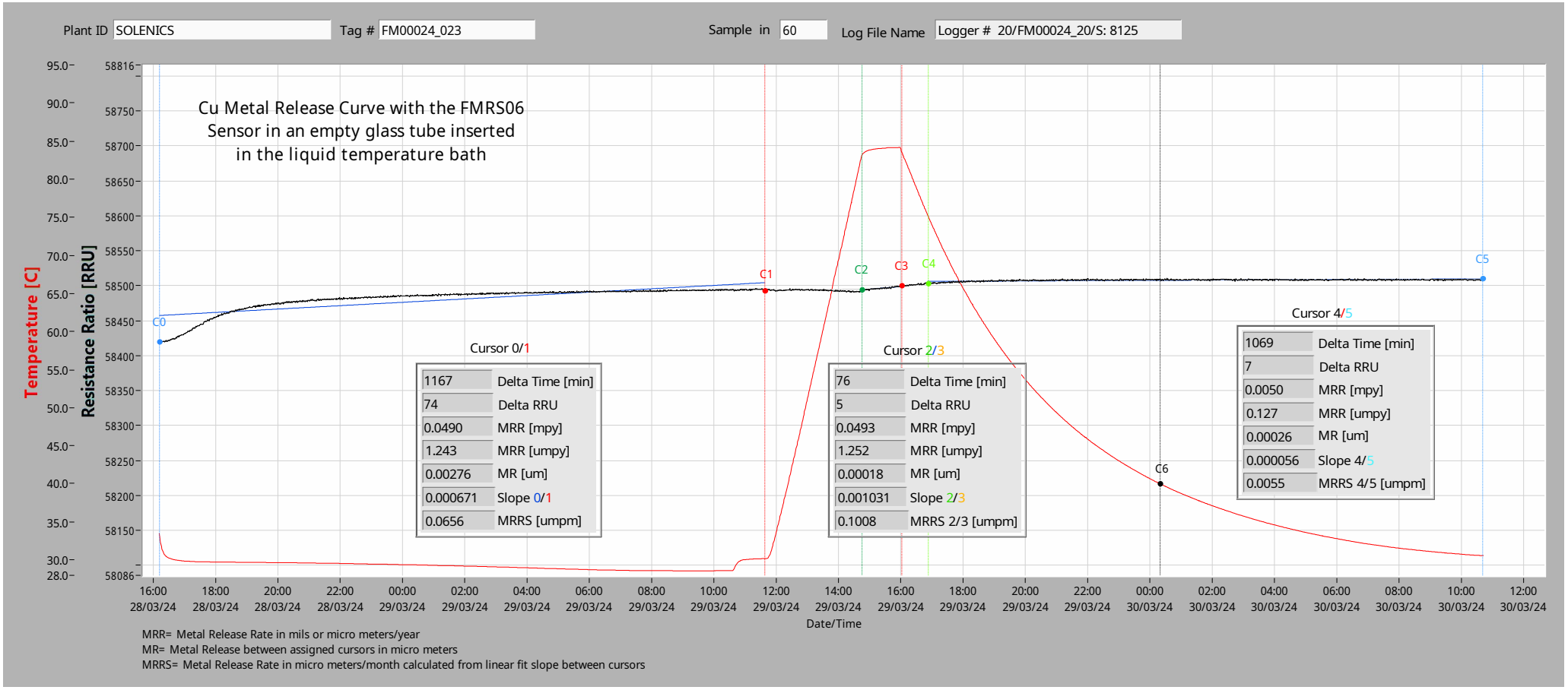


Fig. 2

Oil A, SAE 5W-40 new in test cell submerged in liquid bath.

Environment: Motor Oil in Test Cell Submerged in Liquid Bath
Report #/Date: MRTR001/April 04, 2024
Author: Eugen Tiefnig
Sensor: FMRS06

Total Average Cu Release: ~8.0nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 46 hours

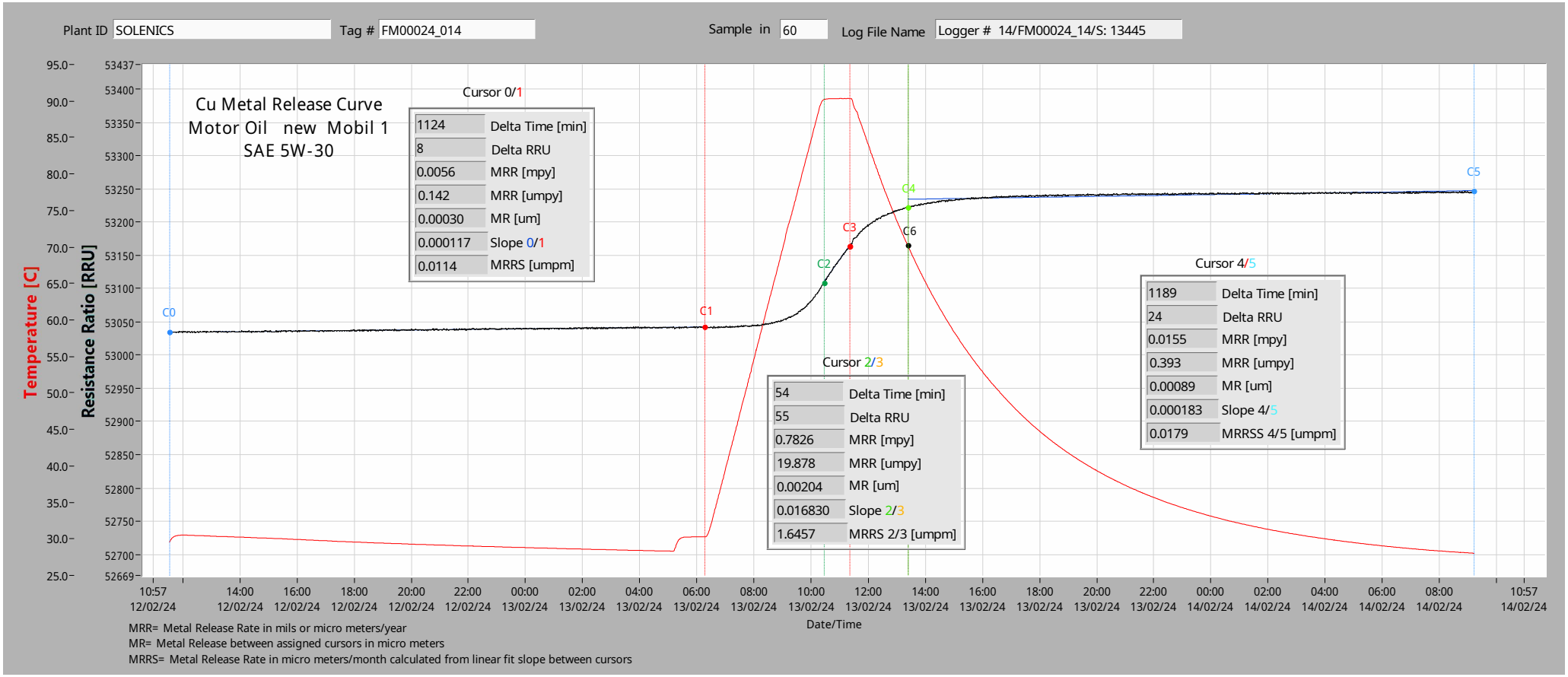


Fig. 3

Oil B, SAE 5W-40 new in test cell submerged in liquid bath.

Environment: Motor Oil in Test Cell Submerged in Liquid Bath
Report #/Date: MRTR001/April 04, 2024
Author: Eugen Tiefnig
Sensor: FMRS06

Total Average Cu Release: ~10.0nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 47 hours

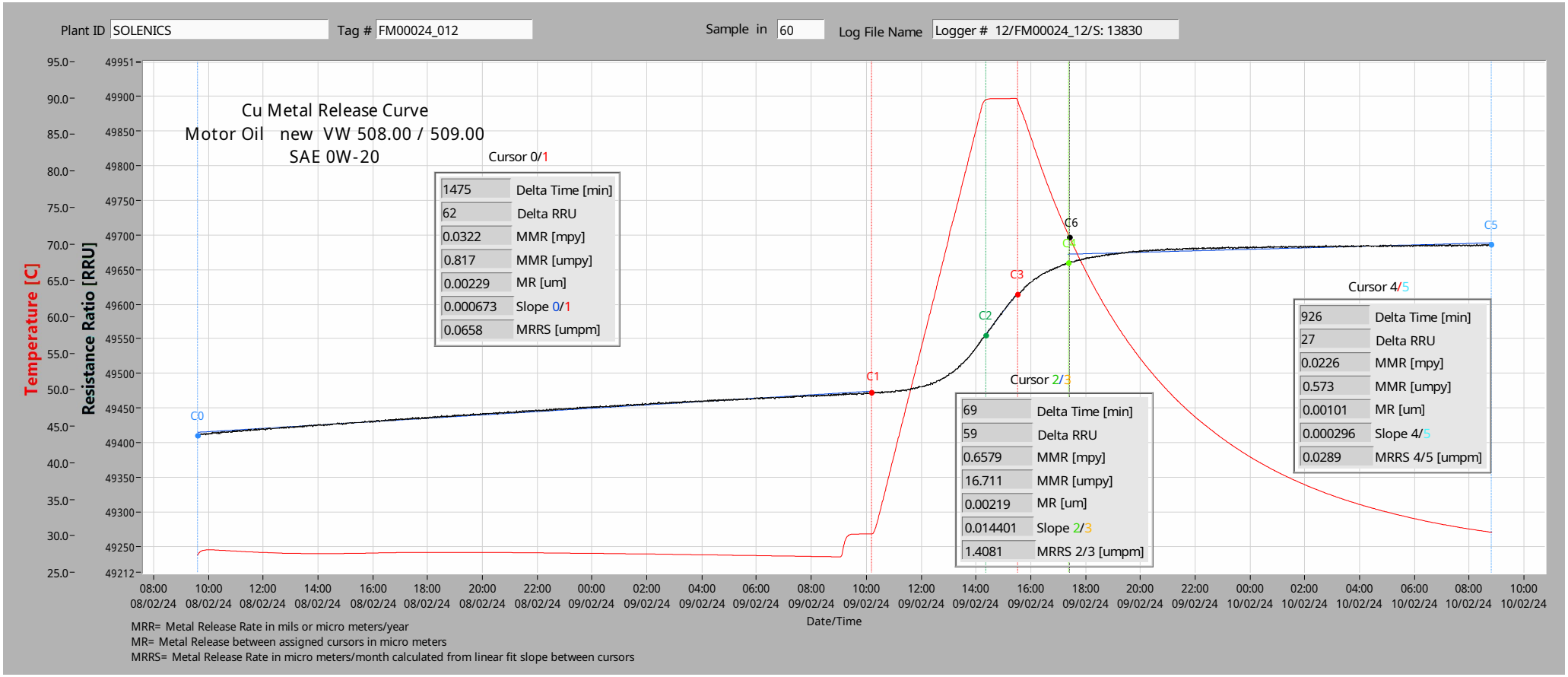


Fig. 4

Oil C, SAE 5W-40 new in test cell submerged in liquid bath.

Environment: Motor Oil in Test Cell Submerged in Liquid Bath
Report #/Date: MRTR001/April 04, 2024
Author: Eugen Tiefnig
Sensor: FMRS06

Total Average Cu Release: ~12nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 46 hours

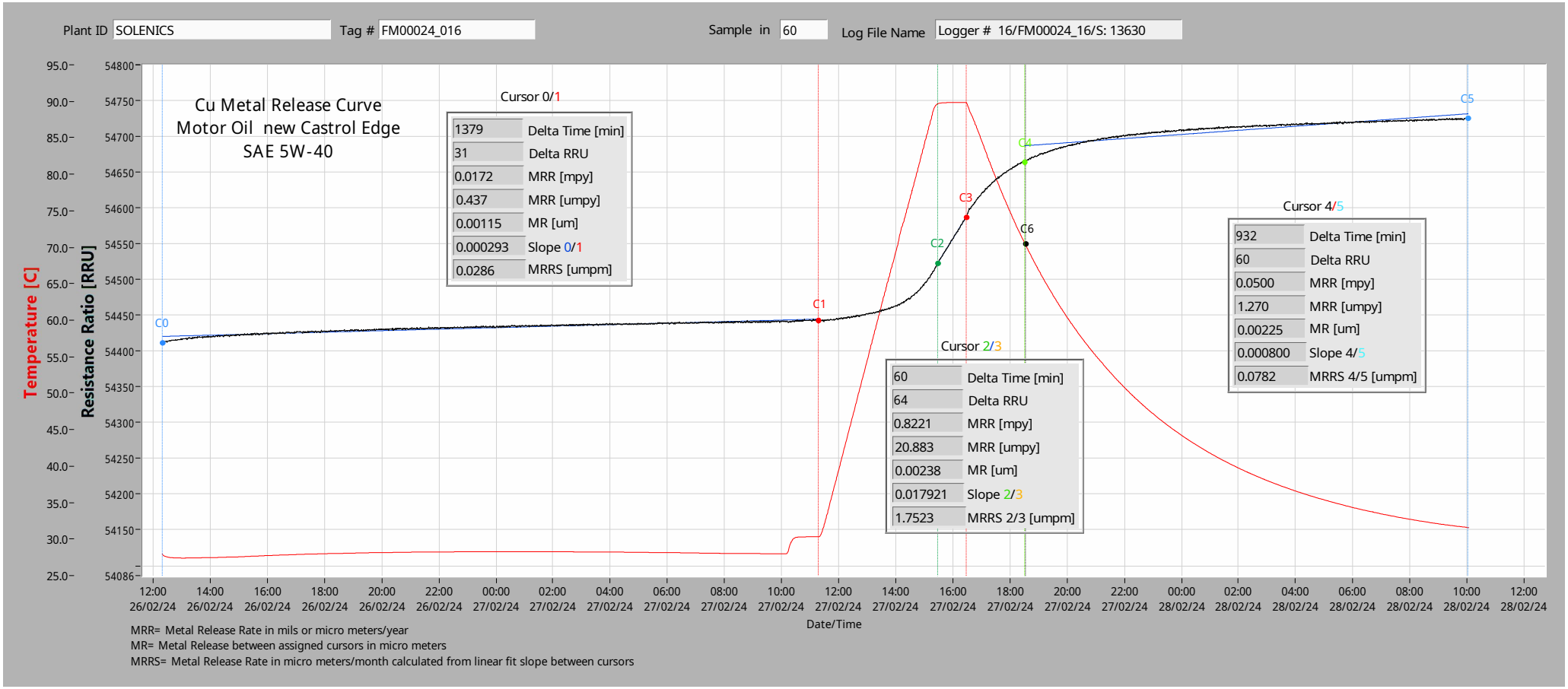


Fig. 5

Oil D, SAE 5W-40 new in test cell submerged in liquid bath.

Environment: Motor Oil in Test Cell Submerged in Liquid Bath
Report #/Date: MRTR001/April 04, 2024
Author: Eugen Tiefnig
Sensor: FMRS06

Total Average Cu Release: ~14nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 49 hours

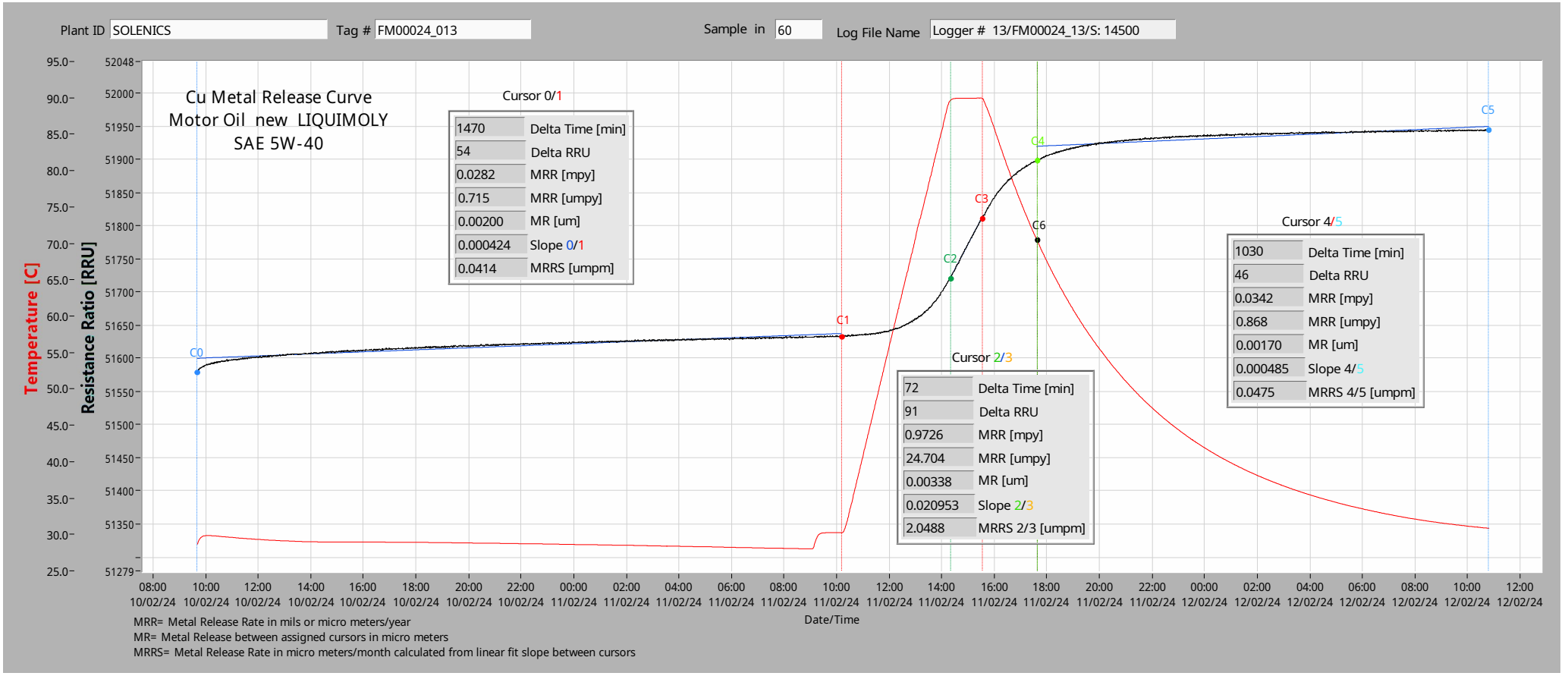


Fig. 6

Oil E, SAE 0W-20 as Oil B but used for 10 000 km in test cell submerged in liquid bath.

Environment: Motor Oil in Test Cell Submerged in Liquid Bath
Report #/Date: MRTR001/April 04, 2024
Author: Eugen Tiefnig
Sensor: FMRS06

Total Average Cu Release: ~20.0nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 41 hours

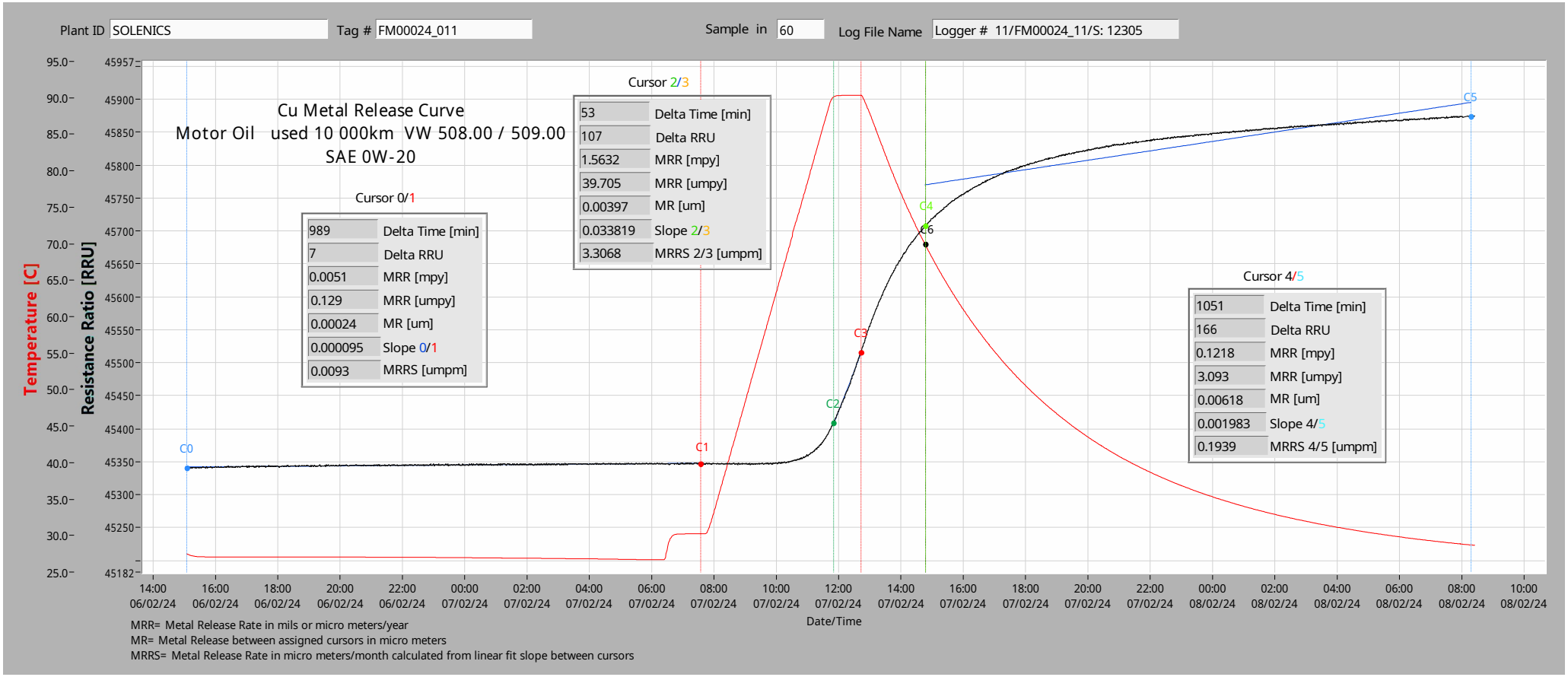


Fig. 7