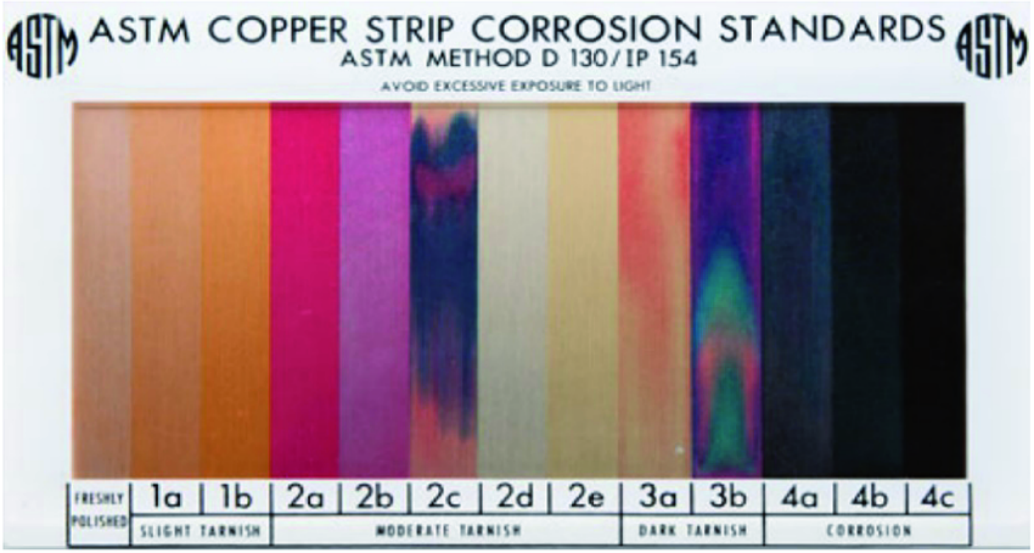
This test demonstrates the differences in metal release from a copper surface at ambient temperature conditions for five greases. The test shall demonstrate that a visually observed tarnish accordingly to the ASTM D130 or 4048 copper strip corrosion test does not show a visible difference between the tested greases at ambient temperature conditions as well as at elevated temperature conditions. All greases came with a rating of 1a to 1b given by their manufacturers or resellers. The actual metal release rates are significantly higher which cannot be detected visually by tarnish color because the tarnish (primarily CU2O) is getting partially or completely dissolved by the grease even at ambient temperature conditions.

Grease A: Mfg: Mobil, Thickener: Calcium Base
Grease B: Mfg: Truper, Thickener: Calcium Base
Grease C: Mfg: Truper, Thickener: Lithium Base
Grease D: Mfg: Akron, Thickener: Bentonite Base
Grease E: Mfg: Truper, Thickener: Bentonite Base

The test is performed at ambient conditions in the laboratory without a test cell. The grease was applied onto a clean sensing element only. Test duration's are approximately 24 hours at ambient temperature conditions.
All greases would have passed the ASTM 4048 copper strip corrosion test with a rating of 1a to 1b but only Grease E would deserve such a rating.
Grease D shows even at ambient temperature high corrosivity to copper. All greases were prior to this test tested at elevated temperature around 60C and all except Grease E caused high metal release rates at elevated temperature.

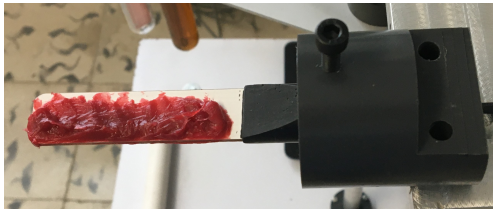


Metal release curve for copper with surface covered in grease in ambient air indoors.

Environment: Surface covered in grease
Report #/Date: MRTR002/April 10, 2024
Author: Eugen Tiefnig
Sensor: FMRS06
Grease Mfg: Mobil
Color: red
Thickener: Calcium Based
Grade: NGLI-2

Total Average Cu Release: ~8nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 23 hours in ambient air

Sensor surface after exposure. Tarnish was completely dissolved by the grease.



Experiment setup with grease on sensor surface at ambient conditions.

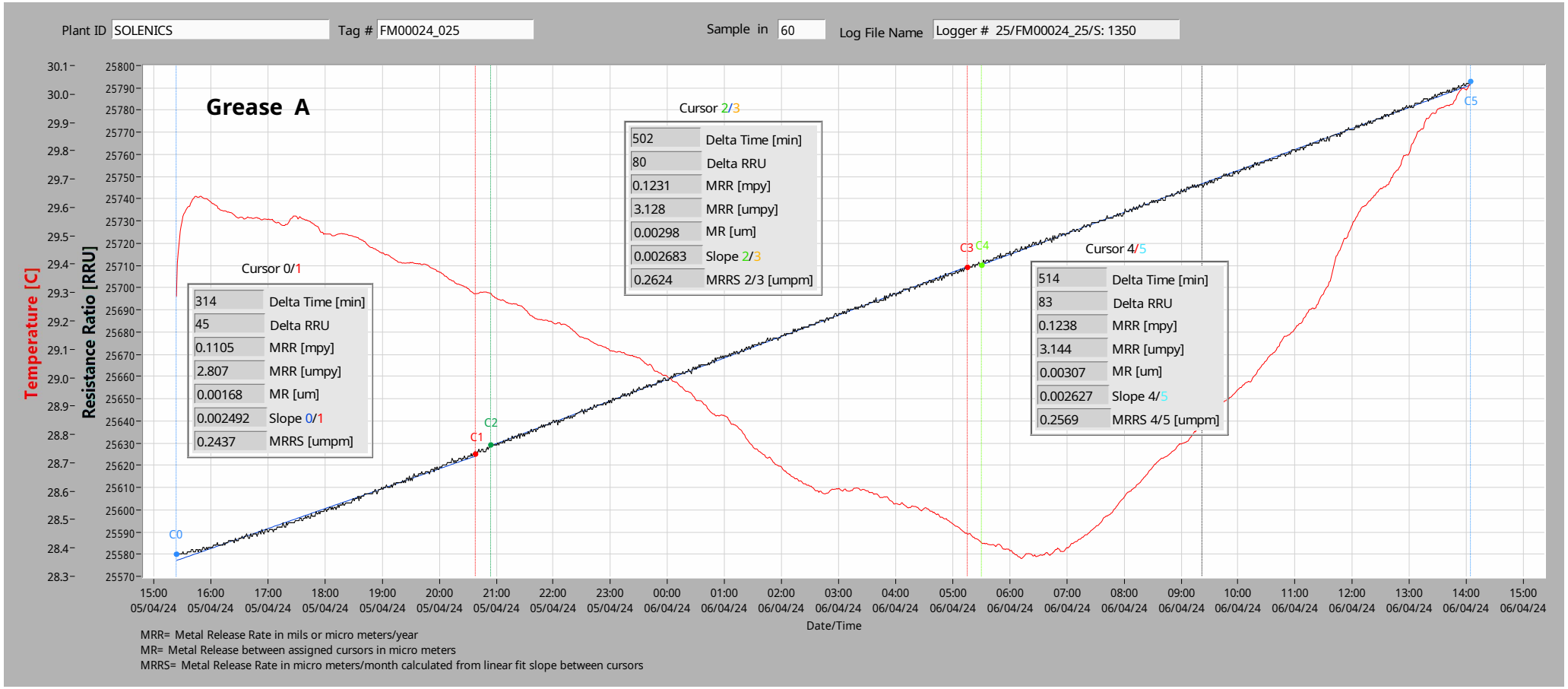


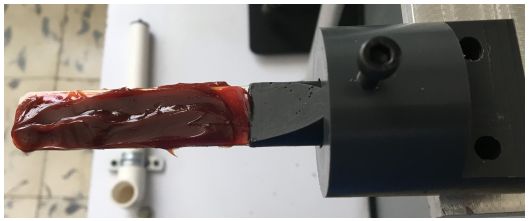
Fig. 1

Metal release curve for copper with surface covered in grease in ambient air indoors.

Environment: Surface covered in grease
Report #/Date: MRTR002/April 10, 2024
Author: Eugen Tiefnig
Sensor: FMRS06
Grease Mfg: Truper
Color: red
Thickener: Calcium Based
Grade: NGLI-2

Total Average Cu Release: ~2.3nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 23 hours in ambient air

Sensor surface after exposure. Tarnish was completely dissolved by the grease.



Test setup with grease on sensor surface at ambient conditions.

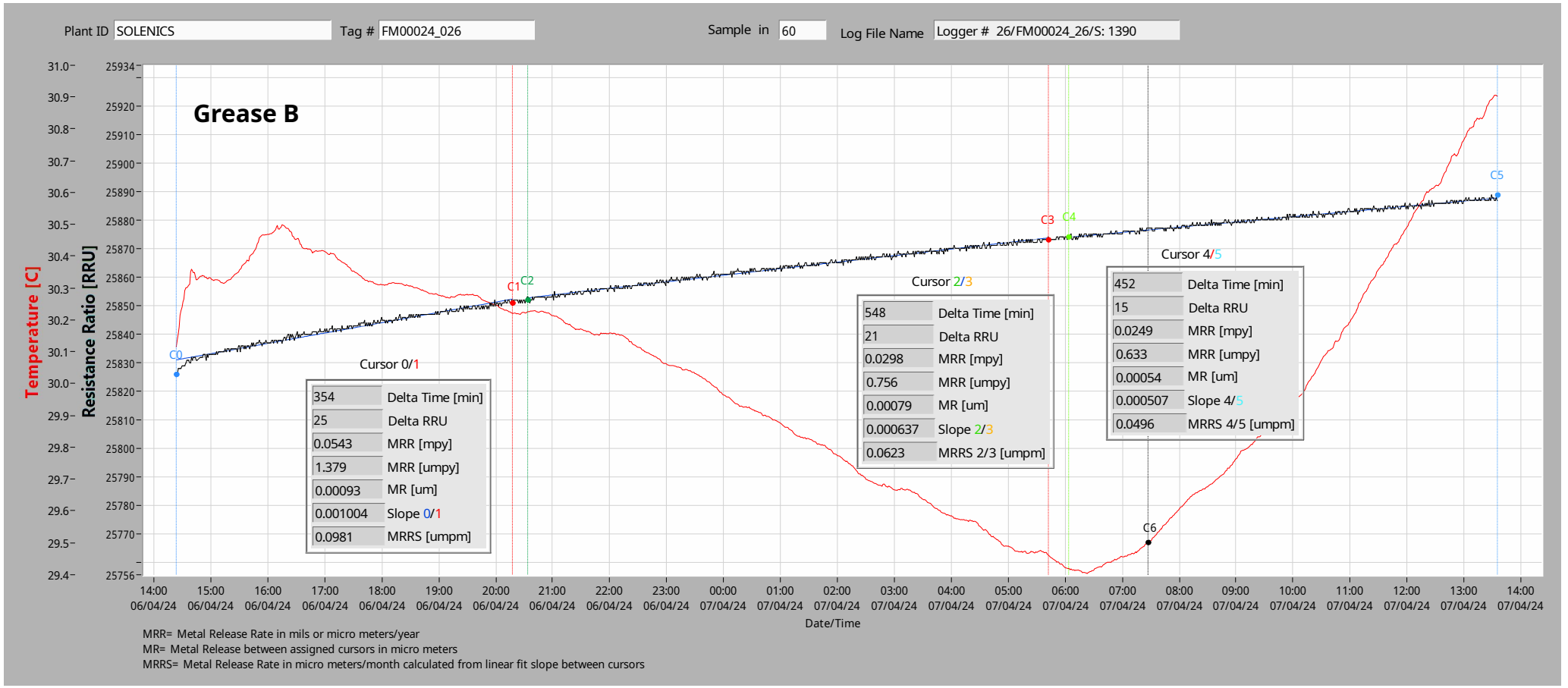
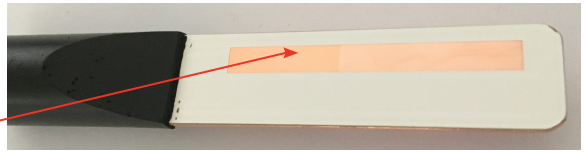


Fig. 2

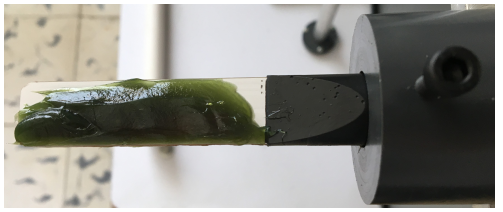
Metal release curve for copper with surface covered in grease in ambient air indoors.

Environment: Surface covered in grease
Report #/Date: MRTR002/April 10, 2024
Author: Eugen Tiefnig
Sensor: FMRS06
Grease Mfg: Truper
Color: green
Thickener: Lithium Based
Grade: NGLI-2

Total Average Cu Release: ~2nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 23 hours in ambient air



Sensor surface after exposure. Tarnish was Partially dissolved by the grease.



Test setup with grease on sensor surface at ambient conditions.

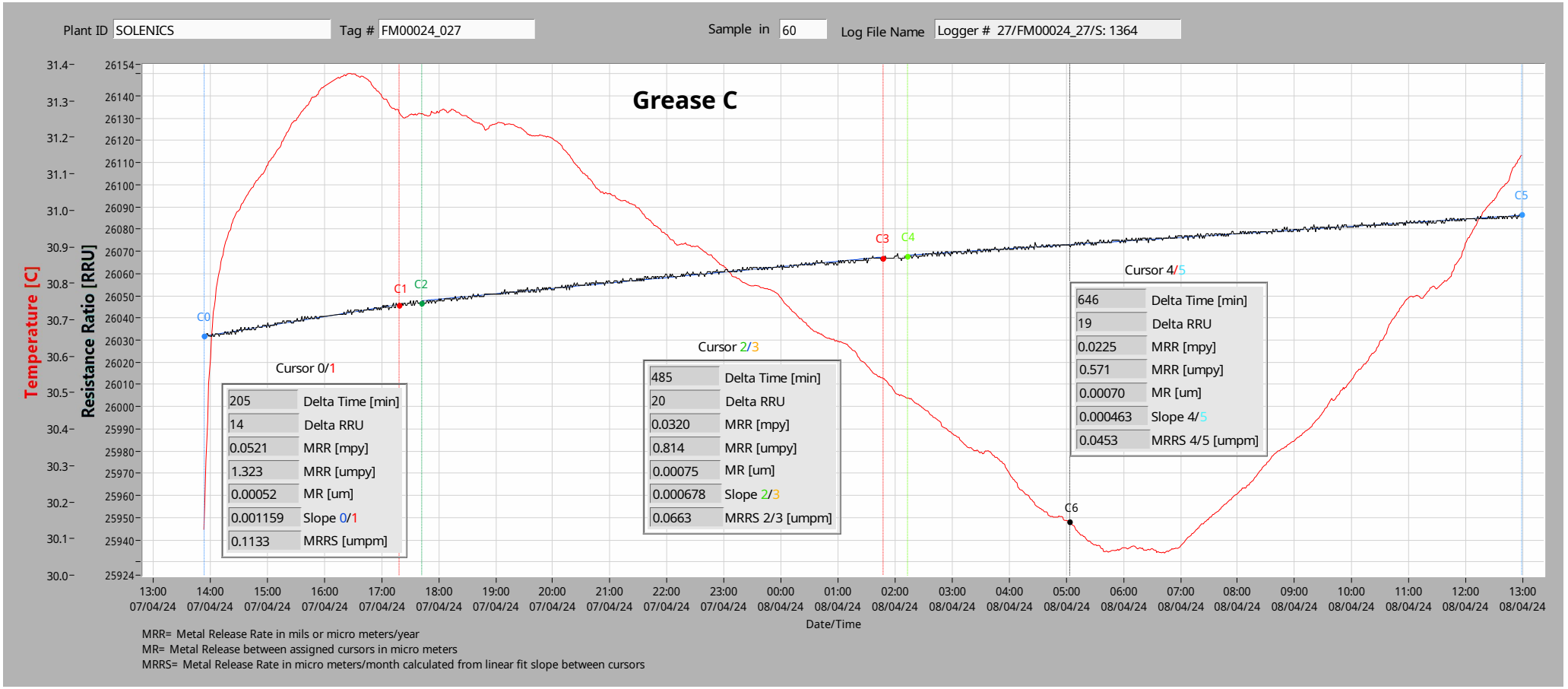
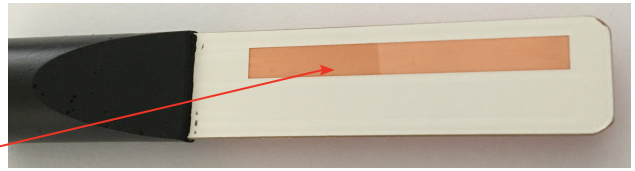


Fig. 3

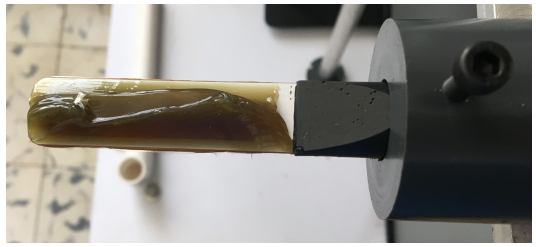
Metal release curve for copper with surface covered in grease in ambient air indoors.

Environment: Surface covered in grease
Report #/Date: MRTR002/April 10, 2024
Author: Eugen Tiefnig
Sensor: FMRS06
Grease Mfg: Akron
Color: dark amber
Thickener: Bentonite Based
Grade: NGLI-2

Total Average Cu Release: ~23nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 22 hours in ambient air



Sensor surface after exposure. Tarnish was partially dissolved by the grease.



Test setup with grease on sensor surface at ambient conditions.

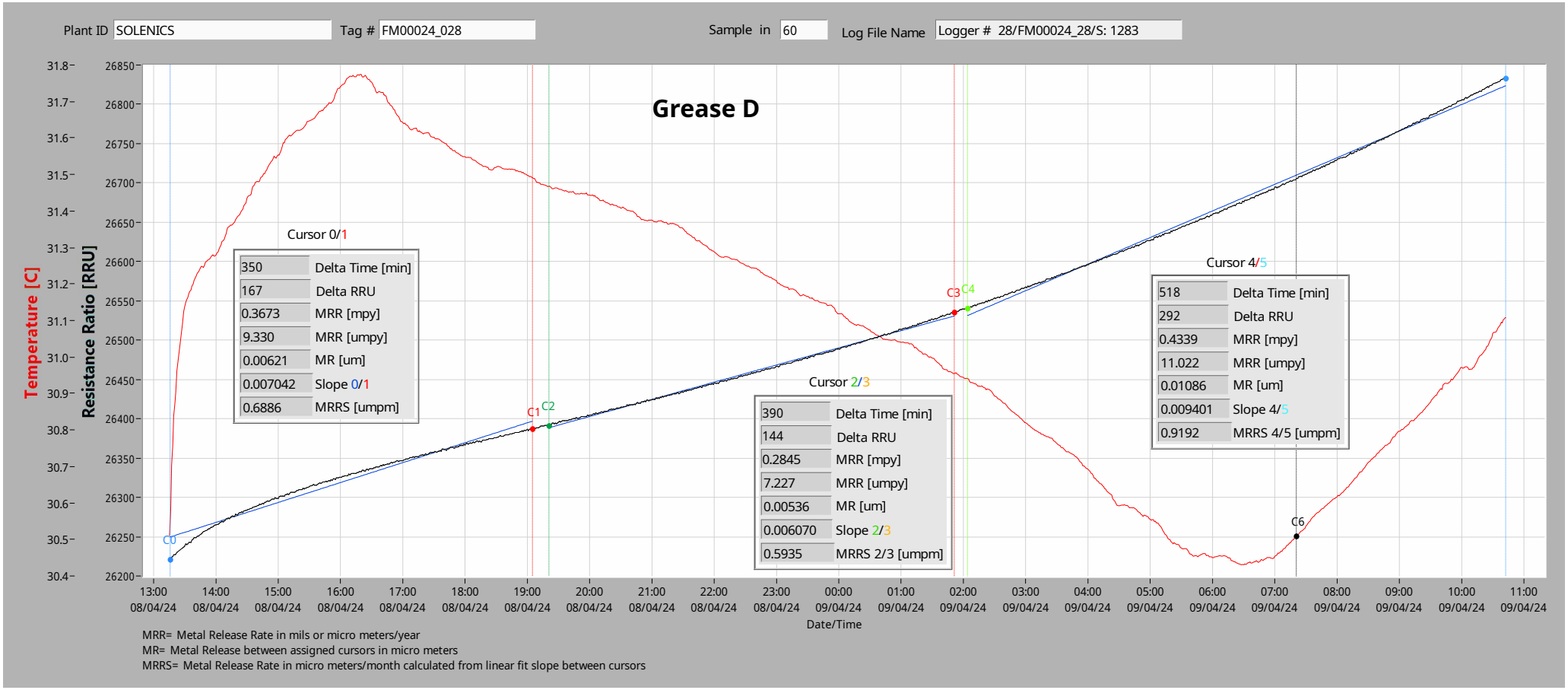
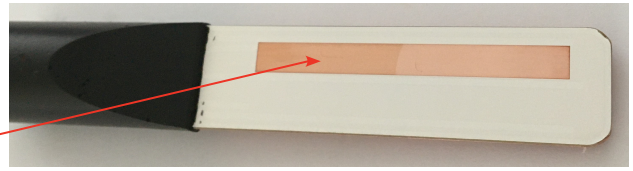


Fig. 4

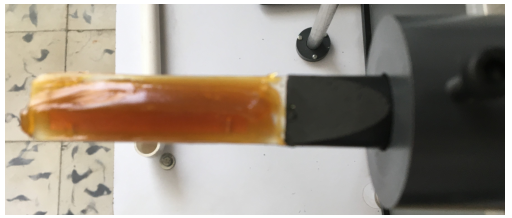
Metal release curve for copper with surface covered in grease in ambient air indoors.

Environment: Surface covered in grease
Report #/Date: MRTR002/April 10, 2024
Author: Eugen Tiefnig
Sensor: FMRS06
Grease Mfg: Truper
Color: amber
Thickener: Bentonite Based
Grade: NGLI-3

Total Average Cu Release: ~0.7nm
Average Tarnish Thickness: not known
Tarnish Composition: not known
Total Exposure Period: 25 hours in ambient air



Sensor surface after exposure. Tarnish was not dissolved by the grease.



Test setup with grease on sensor surface at ambient conditions.

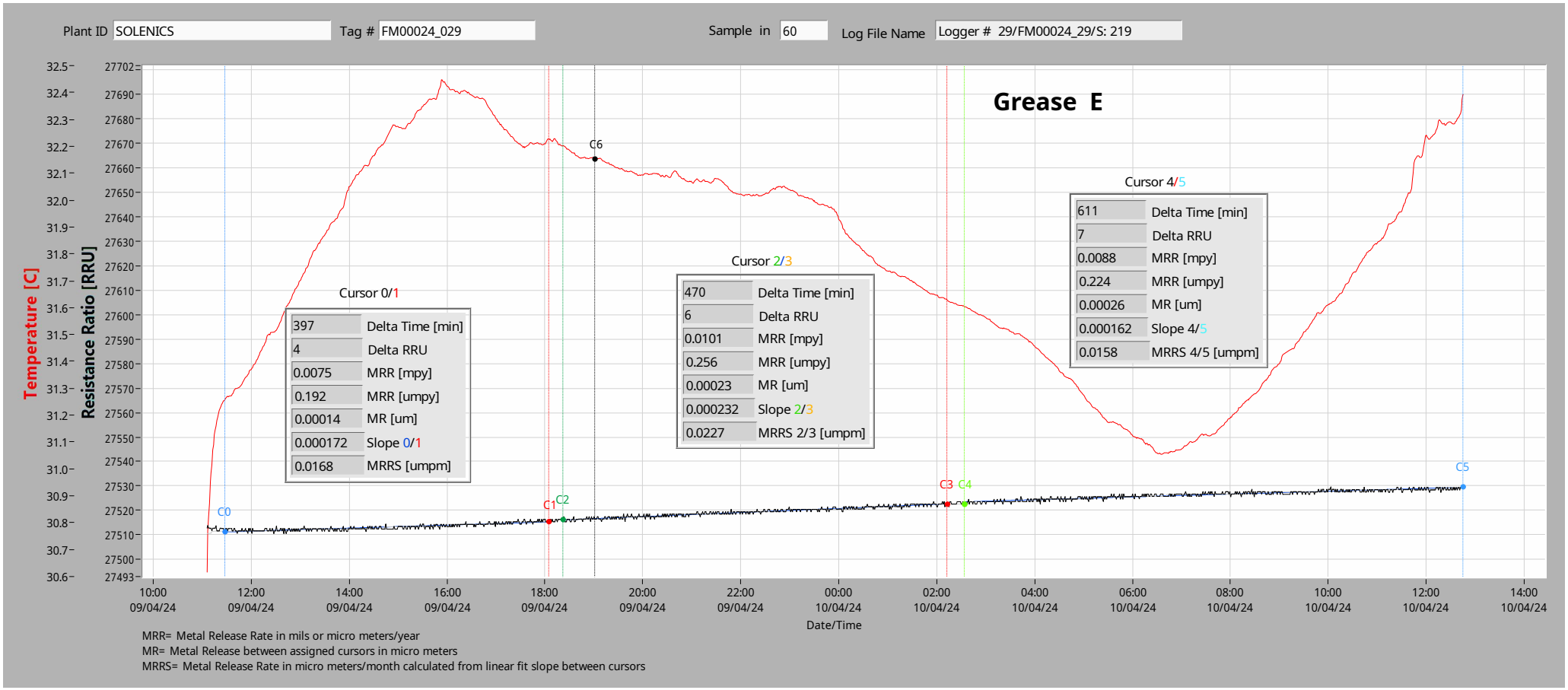


Fig. 5