



U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – C5ISR CENTER

Analyzing Reflectance Data for Various Black Paints and Coatings

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Distribution Statement A: Approved for public
release. Distribution is unlimited.



OVERVIEW



- Examples of black paints and coatings applications
- List of dataset
- Laboratory instruments
- Reflectance data
- Comparisons
- Conclusion



SOME PURPOSES FOR BLACK PAINT:



- Optical coating
- Baffles
- Calibration targets
- Minimize stray light/signal



DIFFERENCES IN PAINTS AND COATINGS



- Application
- Cost
- Efficiency/Life-time
- Environmentally friendly and resistant



DATASET



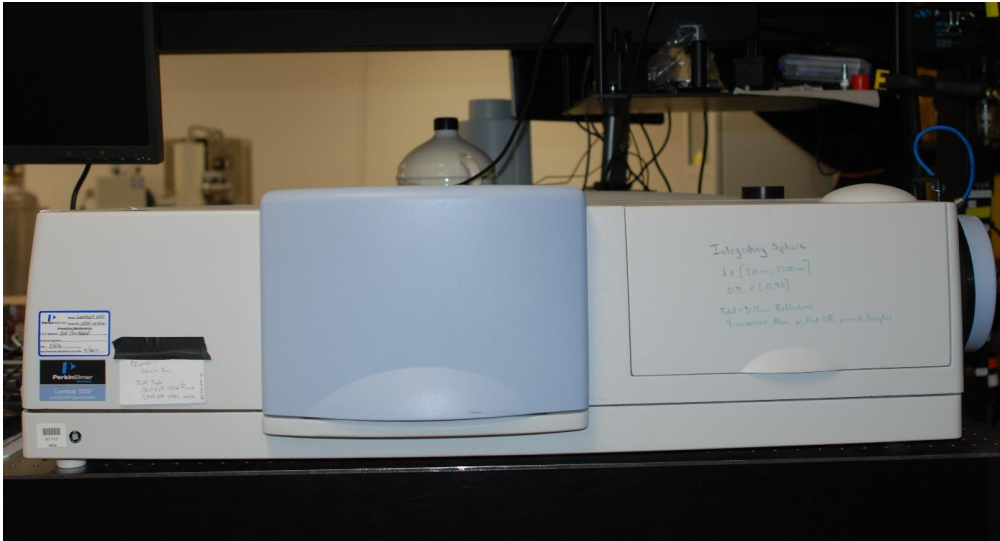
- Acktar Spectral Black (custom)
- Avian Black-S
- BLACK 3.0
- Black Pioneer Coating (custom)
- Current US Army Military Paint
- Electroless Nickel Boron Black (custom)
- Fountain Plating Black Nickel (custom)
- Krylon Ultra Black
- Optical Black Anodized Coating (custom)
- Permaflect (sample)
- Spectralon
- Vince's super-secret coating



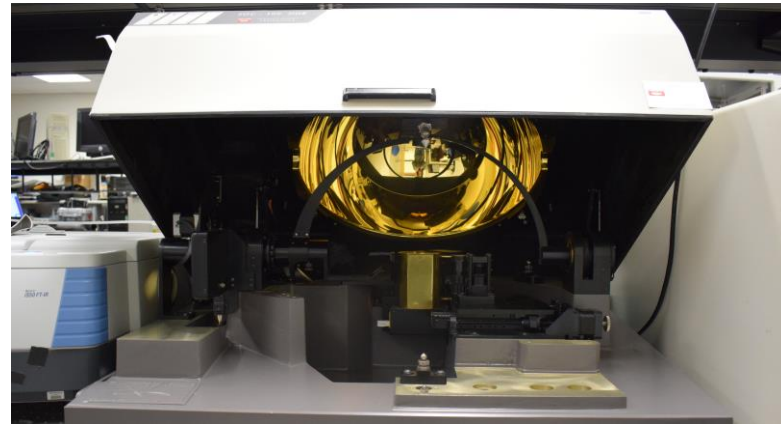
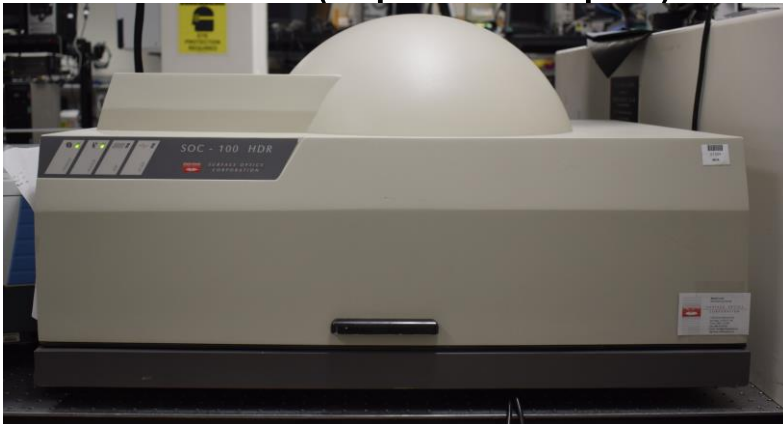
LABORATORY INSTRUMENTS



- PerkinElmer Lambda 1050 (250nm – 2000 nm)



- SOC-100 (2 μm – 25 μm)





Reflectance Data

Results for all samples



DISCLAIMERS



- The following specs were not closely monitored (or known): Coating density, coating thickness, application, and sample age.
- Some samples are measured at different times using the same instrument but utilizing different methods.
- The PerkinElmer and SOC-100 have gains that may or may not be equal to each other.
- This is just an initial gathering of data.

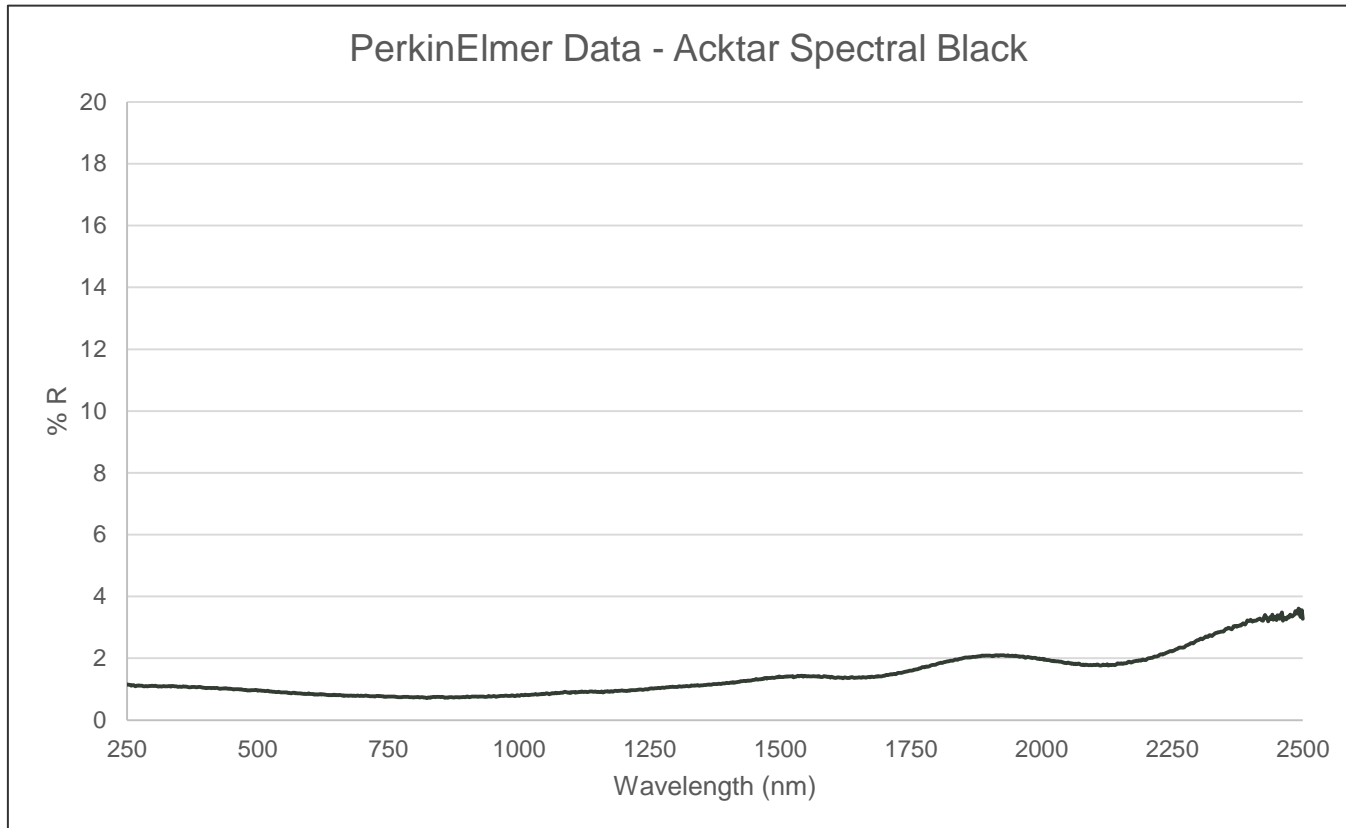


ACKTAR SPECTRAL BLACK

Samples acquired and provided by LLNL. Data collected by NVESD.

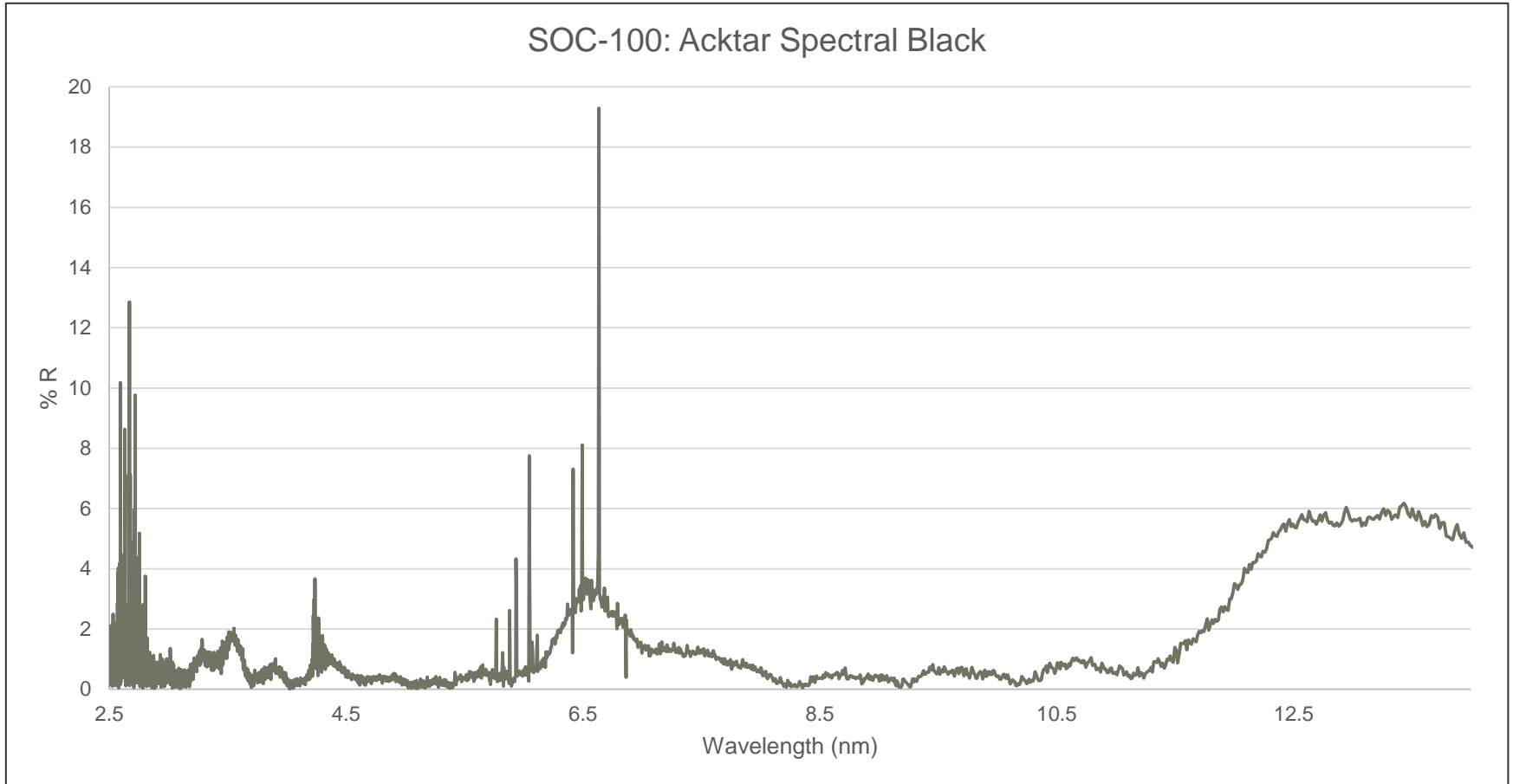


- Vacuum deposited on smooth aluminum.
- Samples were created for LLNL. Cost and specific application N/A.





ACKTAR SPECTRAL BLACK

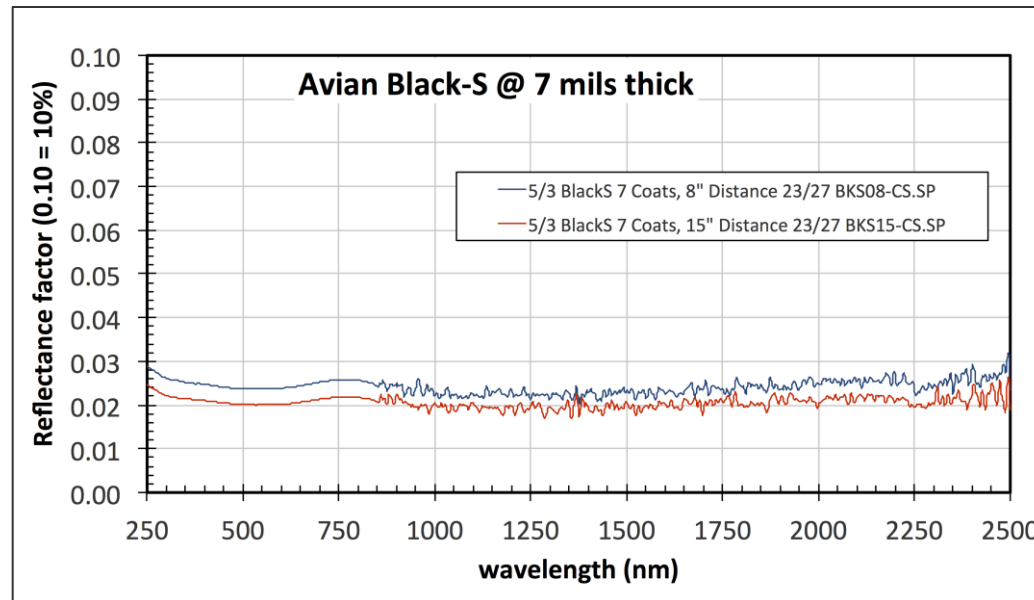




AVIAN BLACK-S

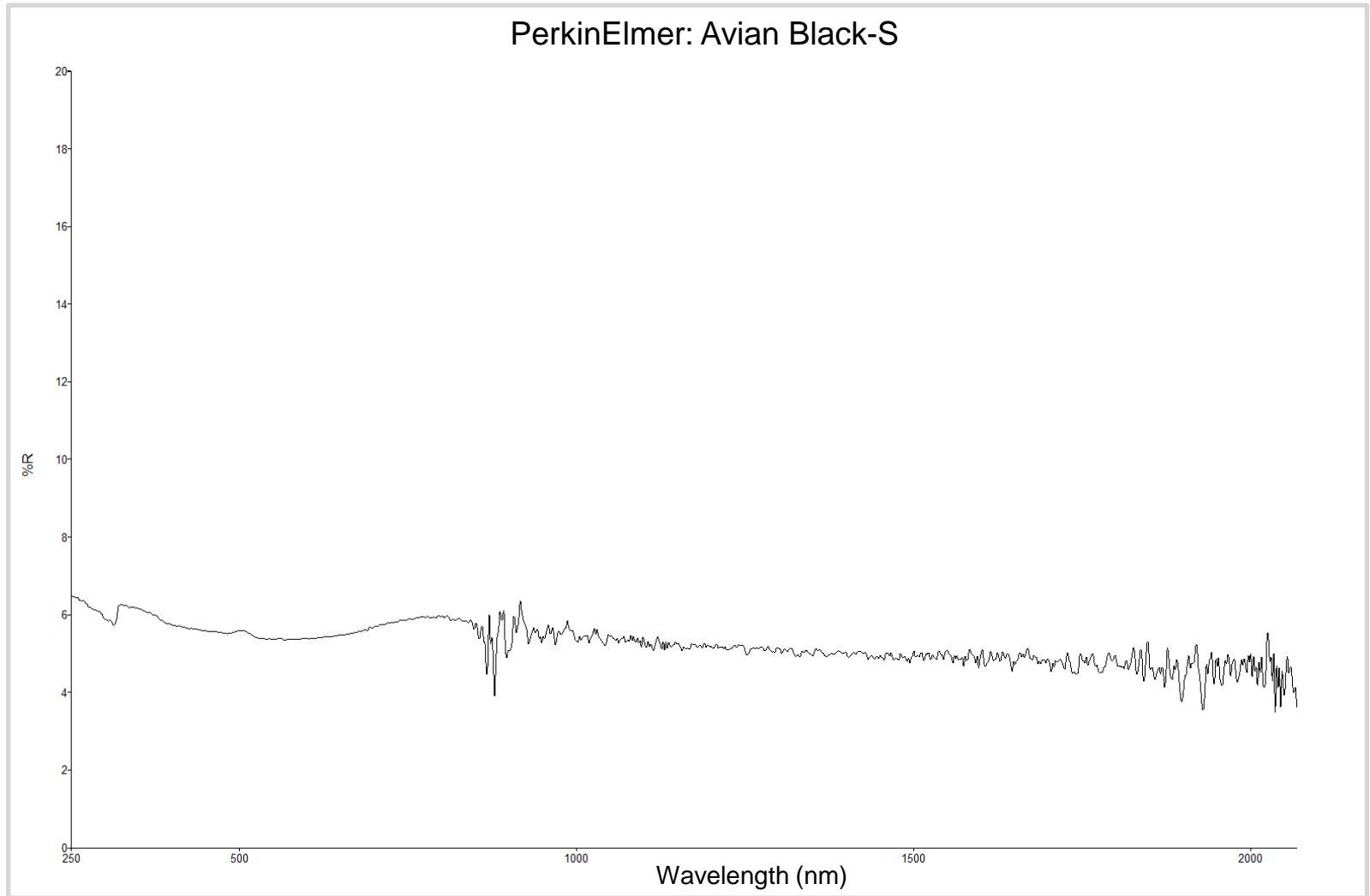


- A two part water-based urethane paint made by Avian Technologies, LLC. Water-based, spray-on diffused black coating
- Cost & Availability: Available upon request. Quote provided for quart, gallon, custom.
- Details: Pretty weather resistant.
- Sample we have is dated 2011. Measurement/sample online is dated 2012.
- Decrease the coatings' reflectance to around 2%R by adding more coats, and even further by spraying from a longer distance to get a rougher texture.



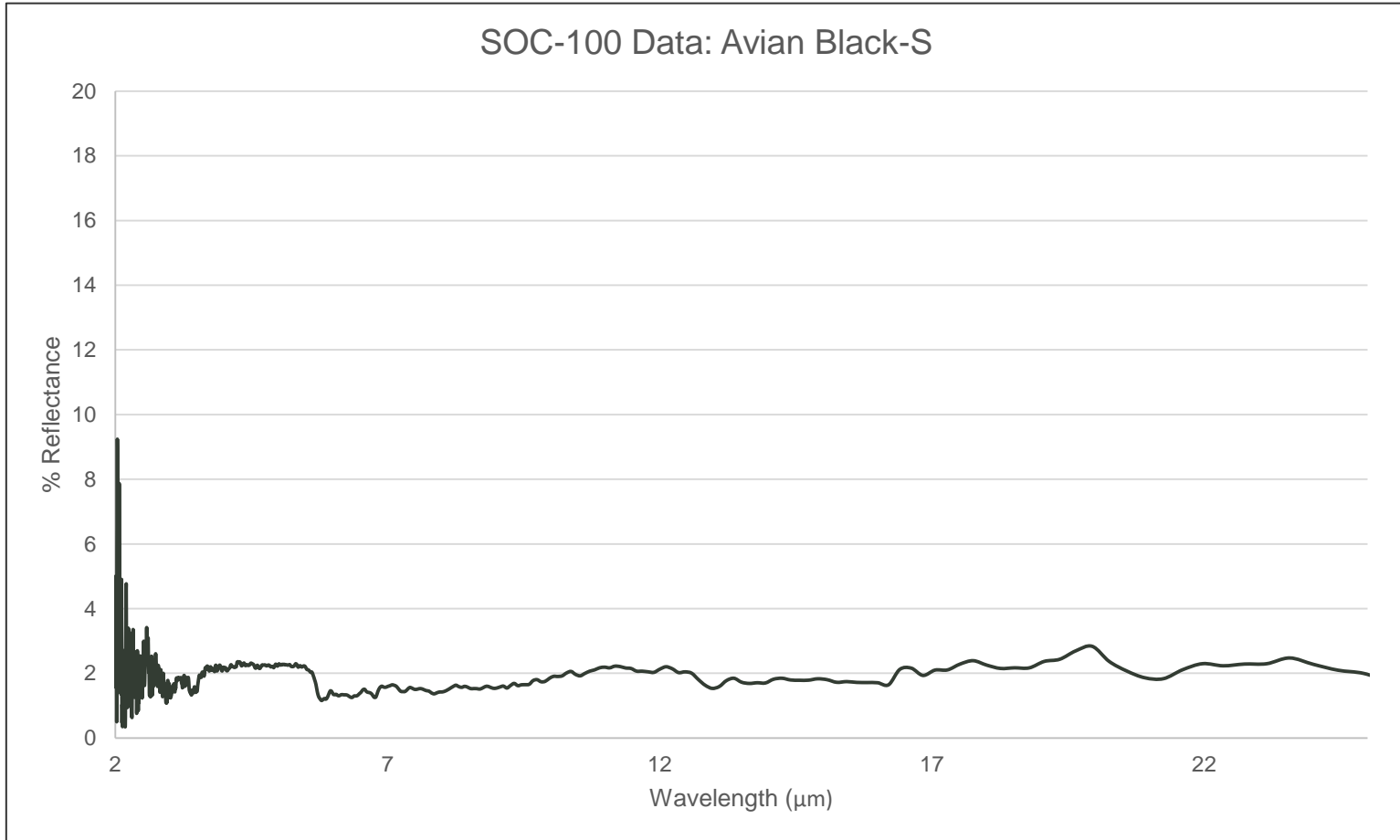


AVIAN BLACK-S





AVIAN BLACK-S

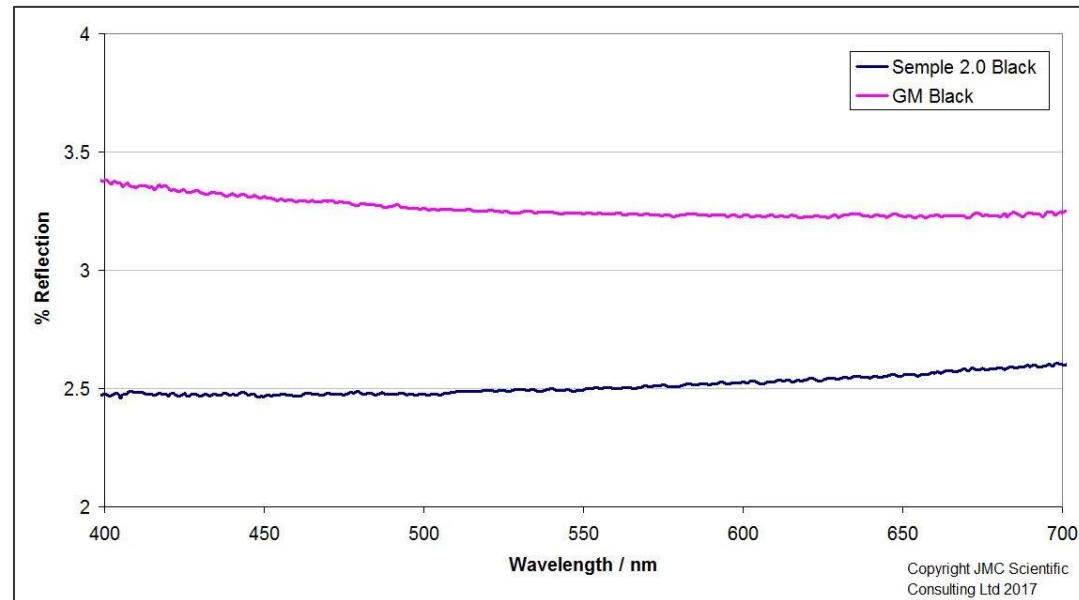
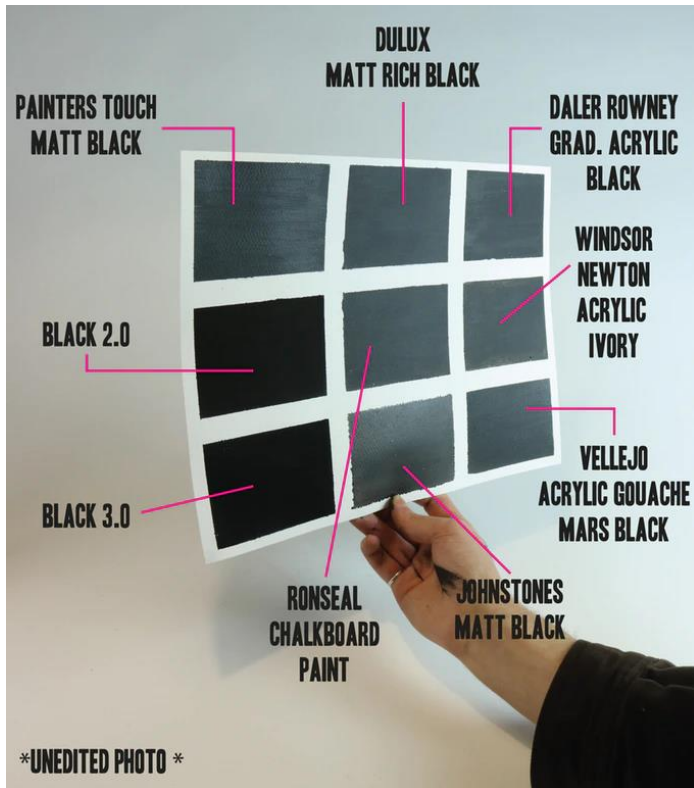




BLACK 3.0

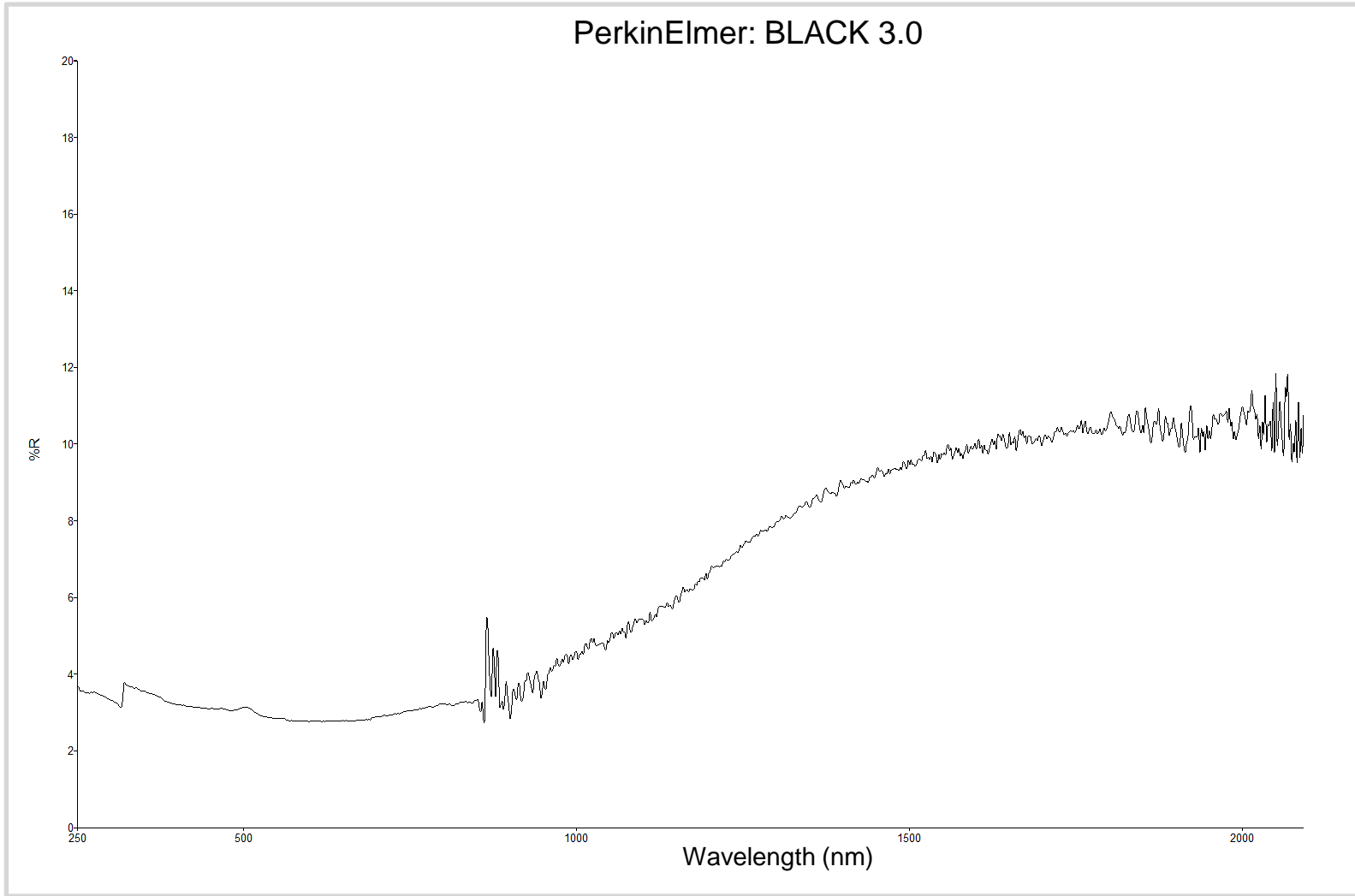


- Acrylic paint
- **Cost & Availability: Kickstarter started by Stuart Semple. Limited number. \$25 pledge gets one bottle.**
- **Details: 10,648 backers pledged £478,923**



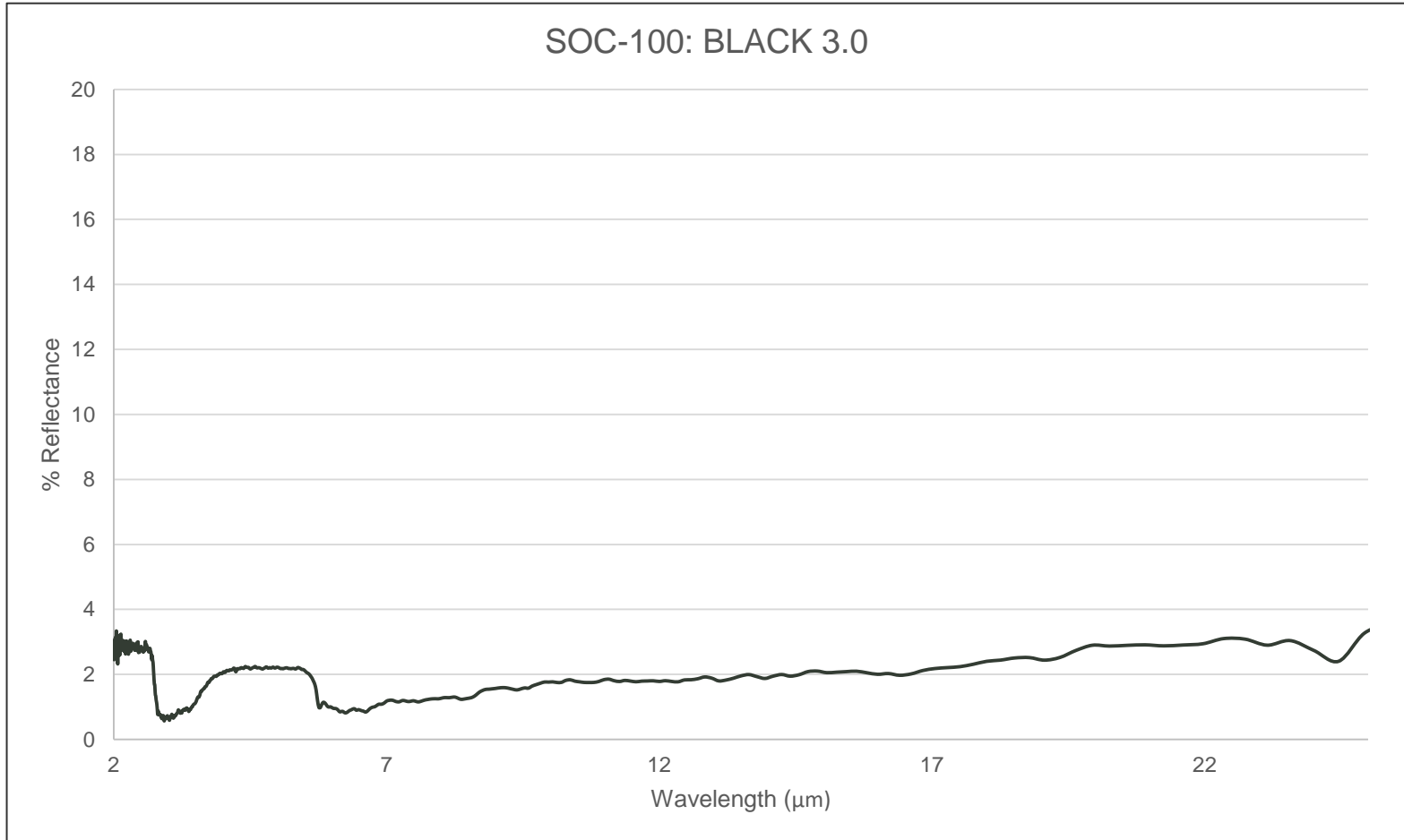


BLACK 3.0





BLACK 3.0





CURRENT US ARMY MILITARY PAINT



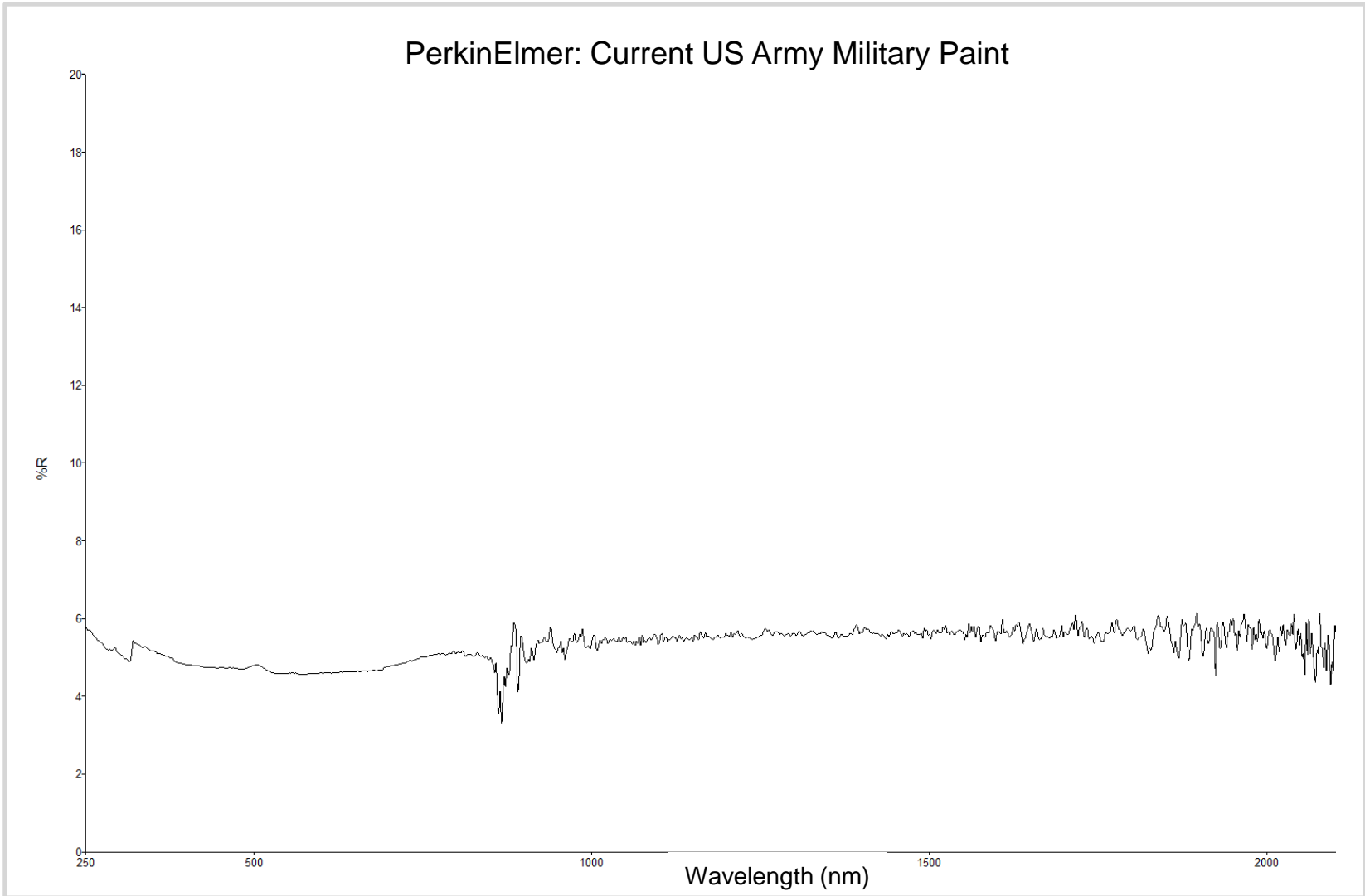
- The most common coating currently utilized by the US Army
- Only reflectance data will be shown. No other information can be disclosed at this briefing.



CURRENT US ARMY MILITARY PAINT

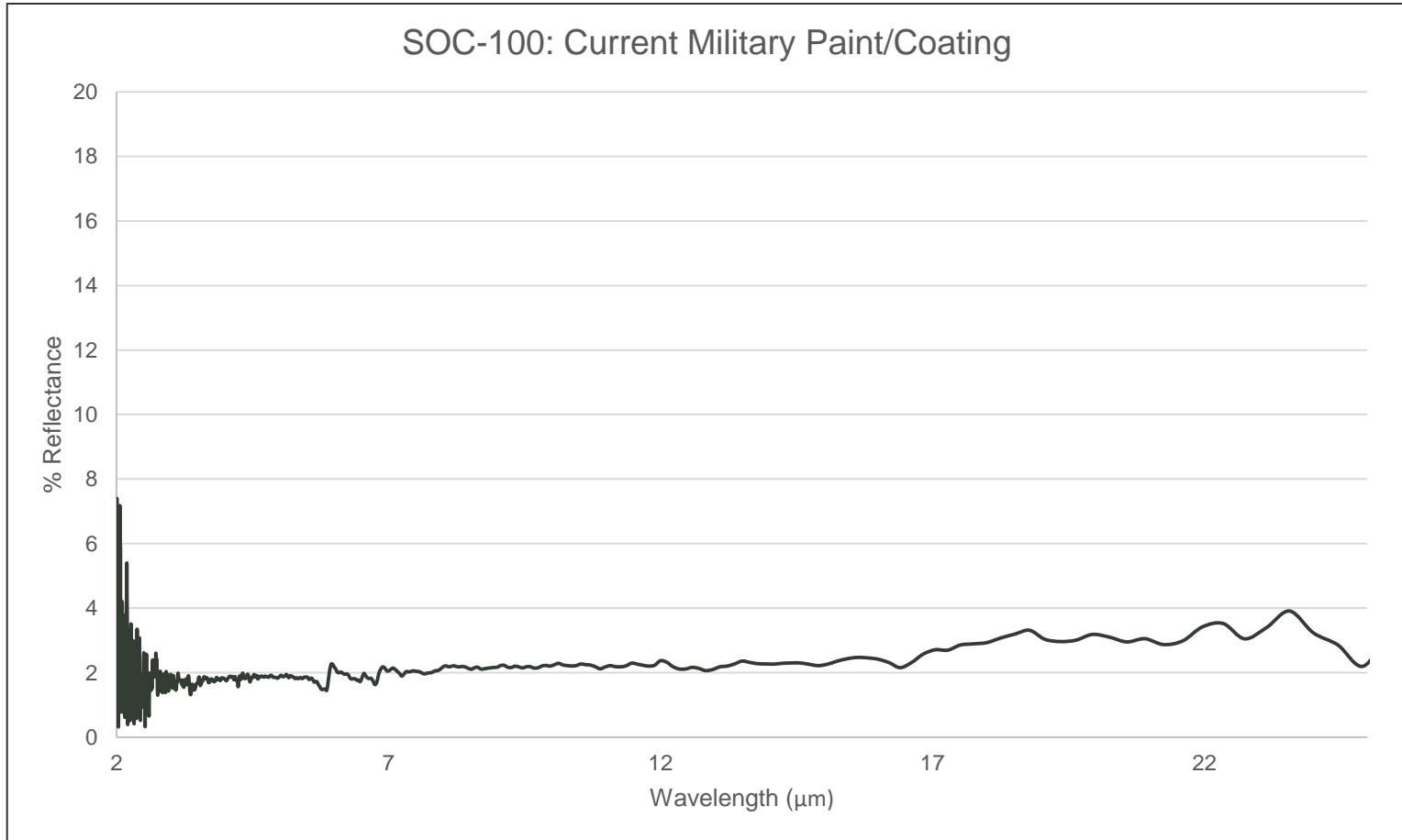


PerkinElmer: Current US Army Military Paint





CURRENT US ARMY MILITARY PAINT



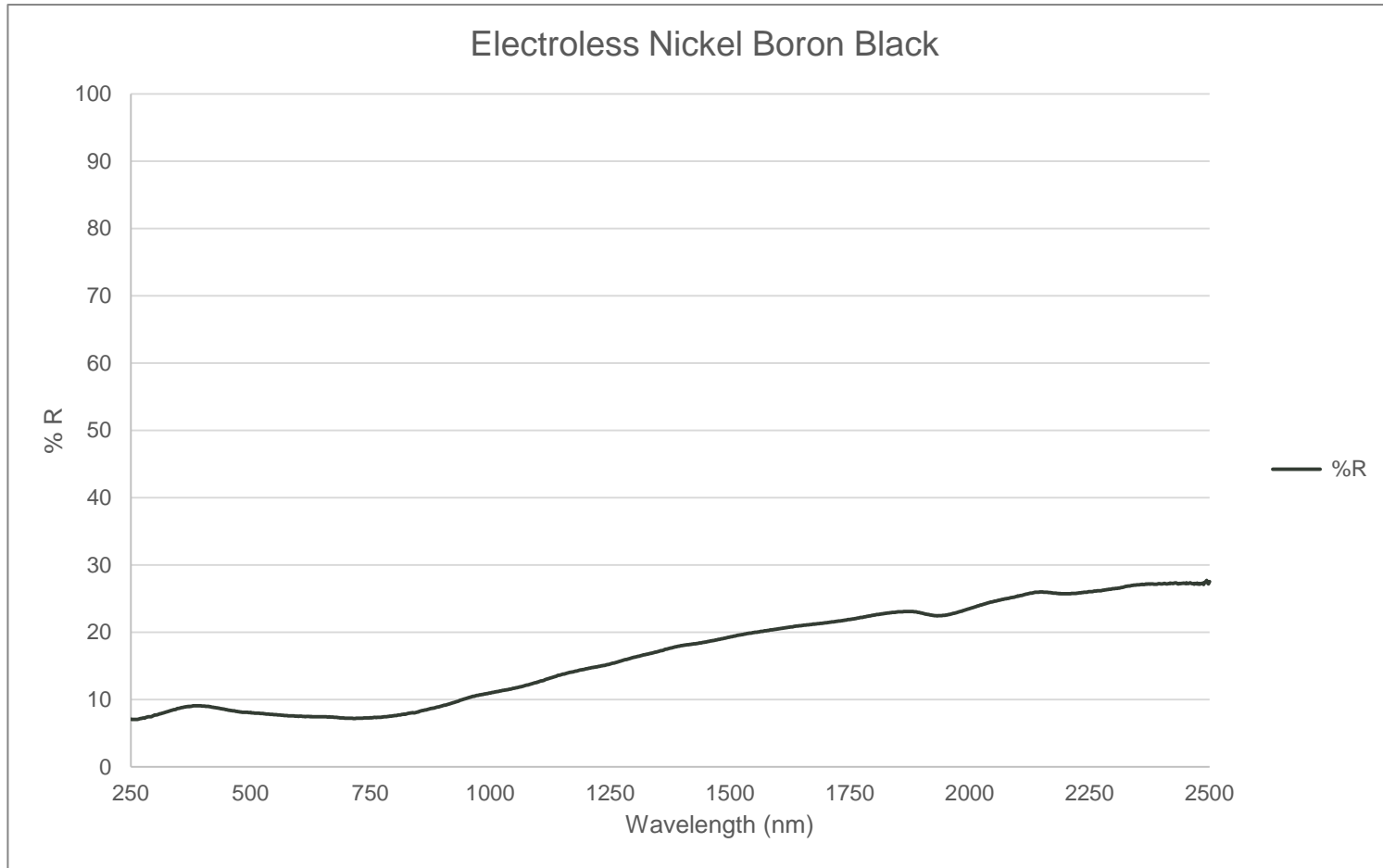


ELECTROLESS NICKEL BORON BLACK

Samples acquired and provided by LLNL. Data collected by NVESD.

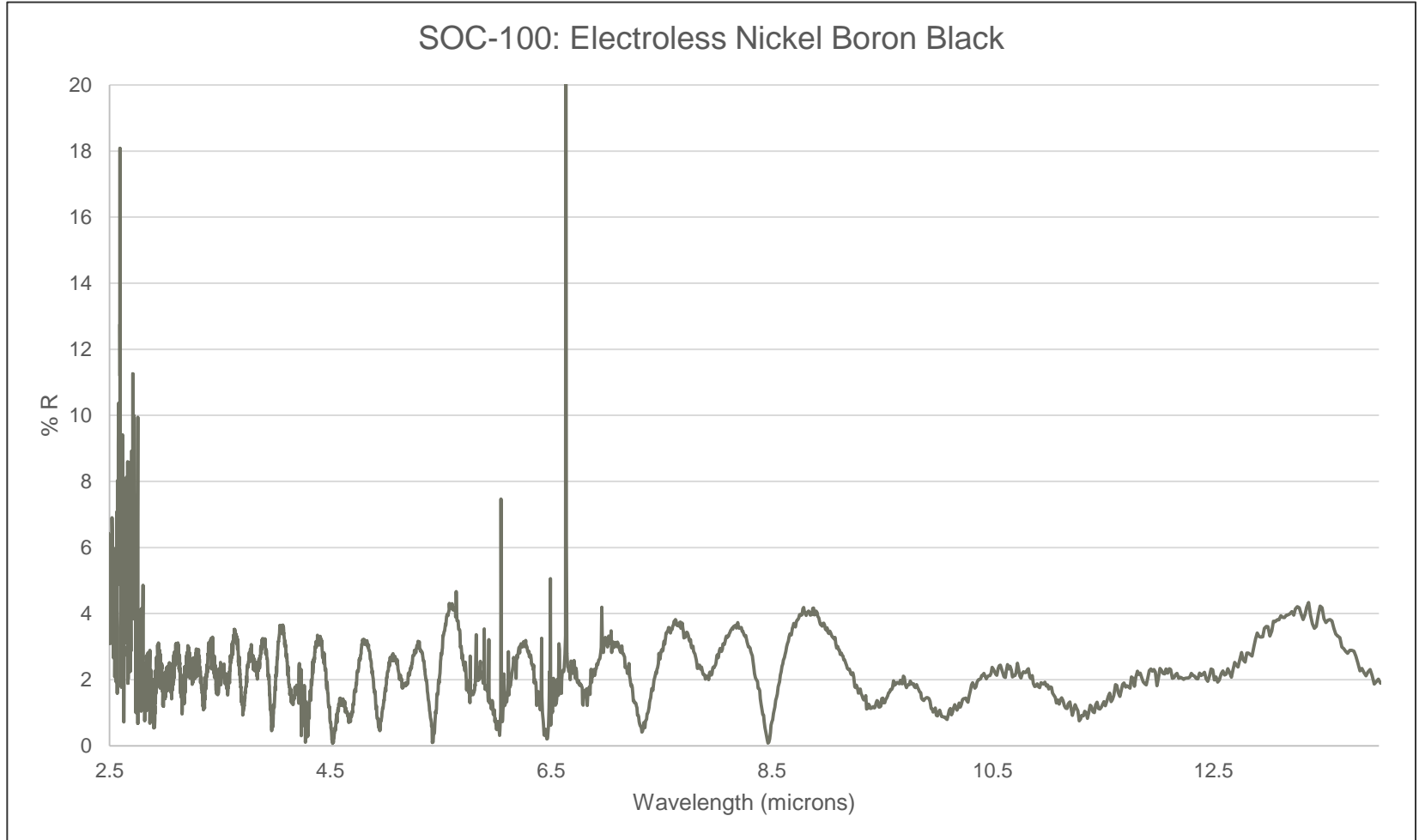


- Black nickel on silica blasted aluminum
- Details N/A





ELECTROLESS NICKEL BORON BLACK



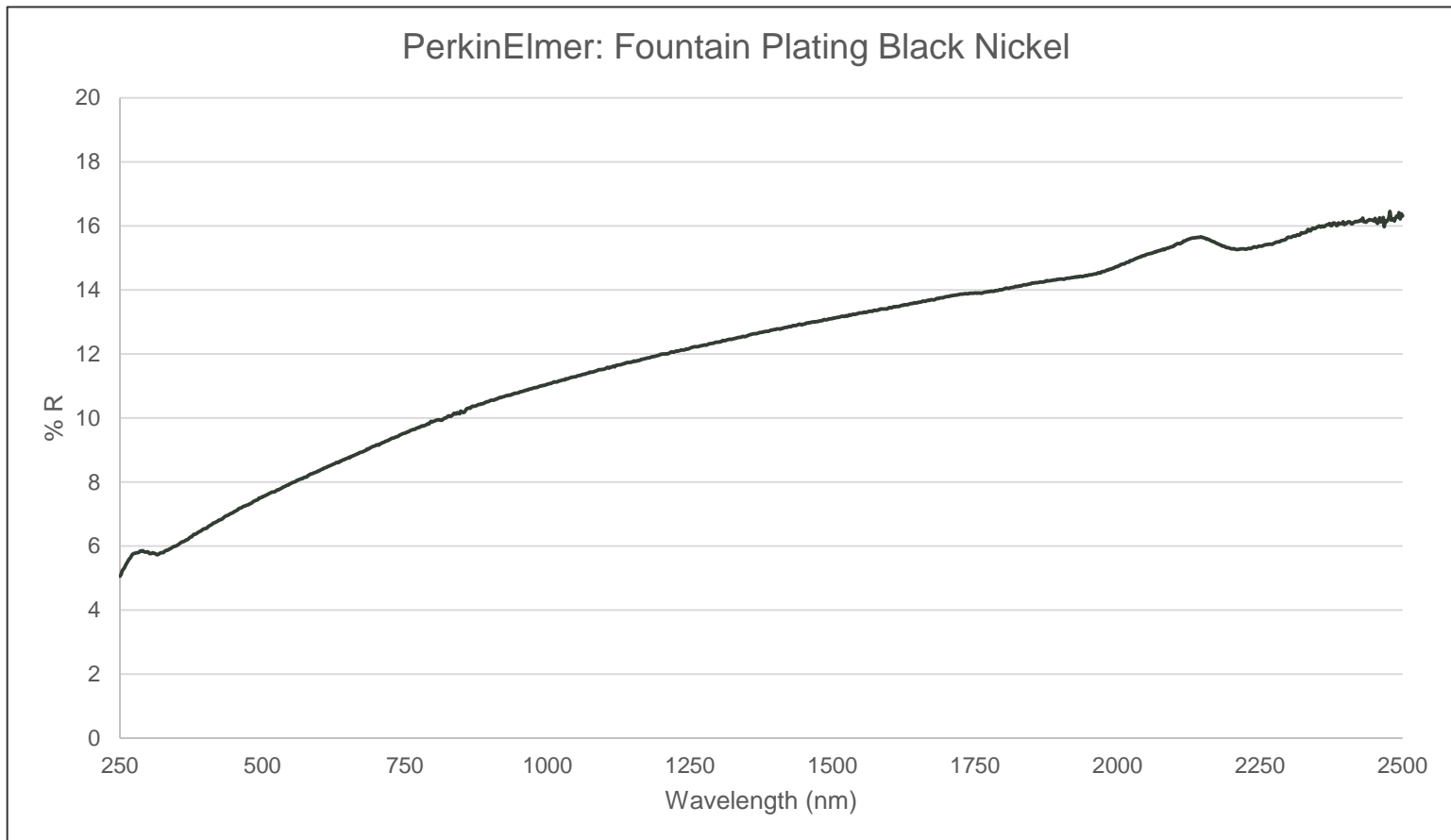


FOUNTAIN PLATING BLACK NICKEL

Samples acquired and provided by LLNL. Data collected by NVESD.



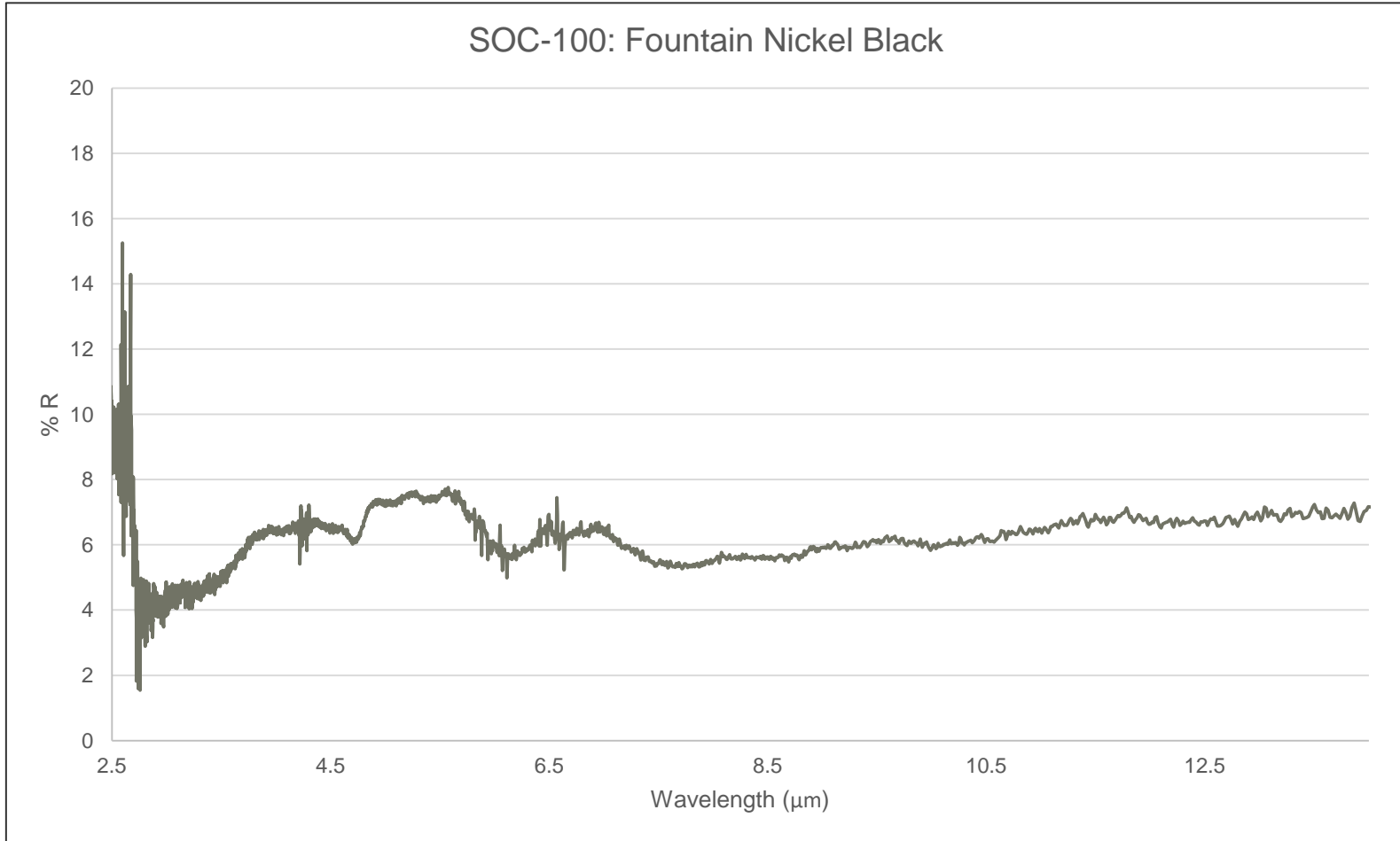
- Black nickel coating on media blasted aluminum by Pioneer Metal Finishing.
- Discontinued. Details N/A.





FOUNTAIN PLATING BLACK NICKEL

Samples acquired and provided by LLNL. Data collected by NVESD.





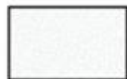
KRYLON ULTRA BLACK



- Commonly in form of spray paint
- Widely available commercially
- Used on fielded targets
- Details: Weather resistant, environmentally friendly



Crystal Clear



Flat White



Glossy White



Bright Silver



Brass



Cherry Red



Glossy Black



Ultra Flat Black



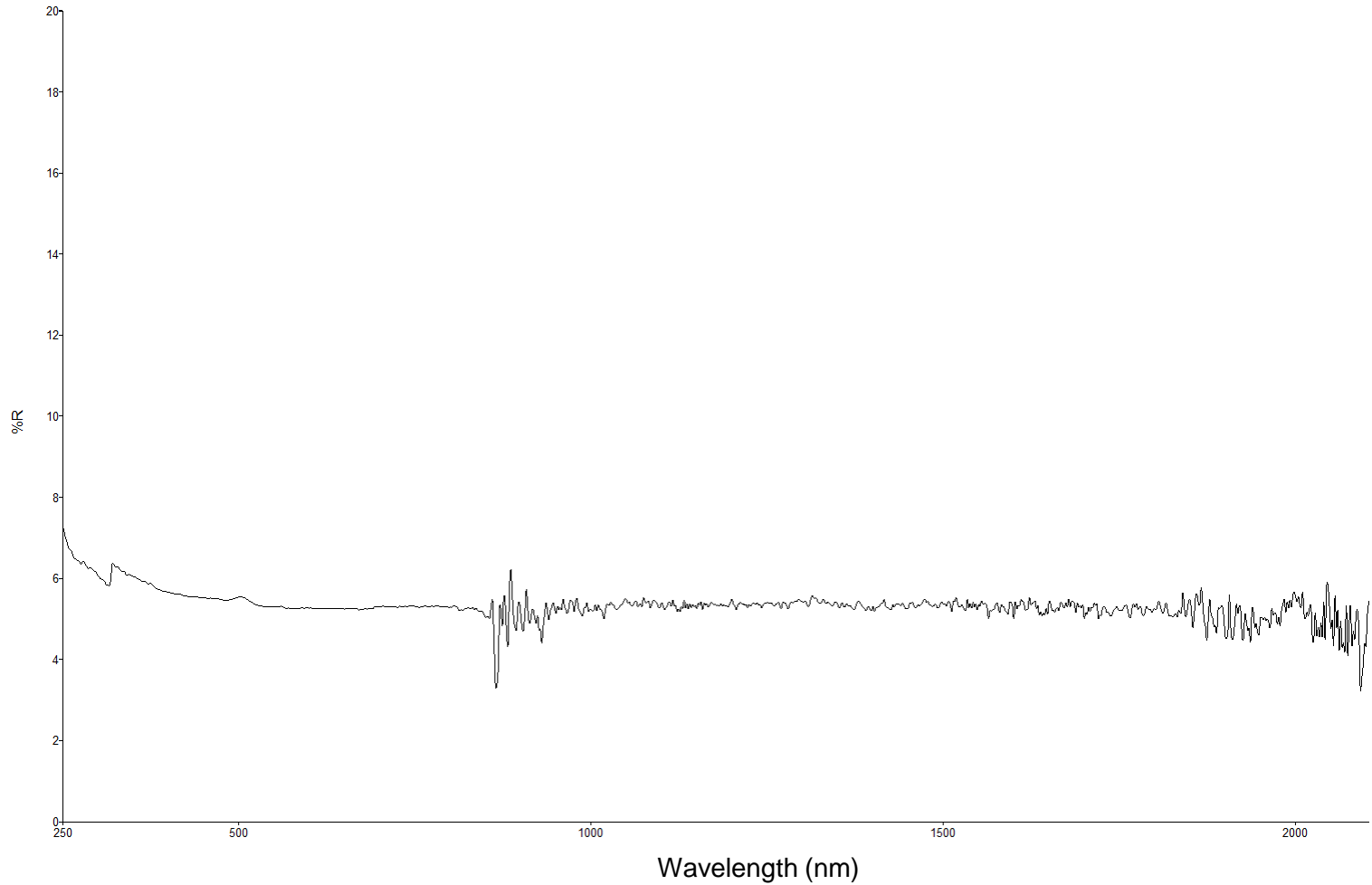
Dull Aluminum



KRYLON ULTRA BLACK

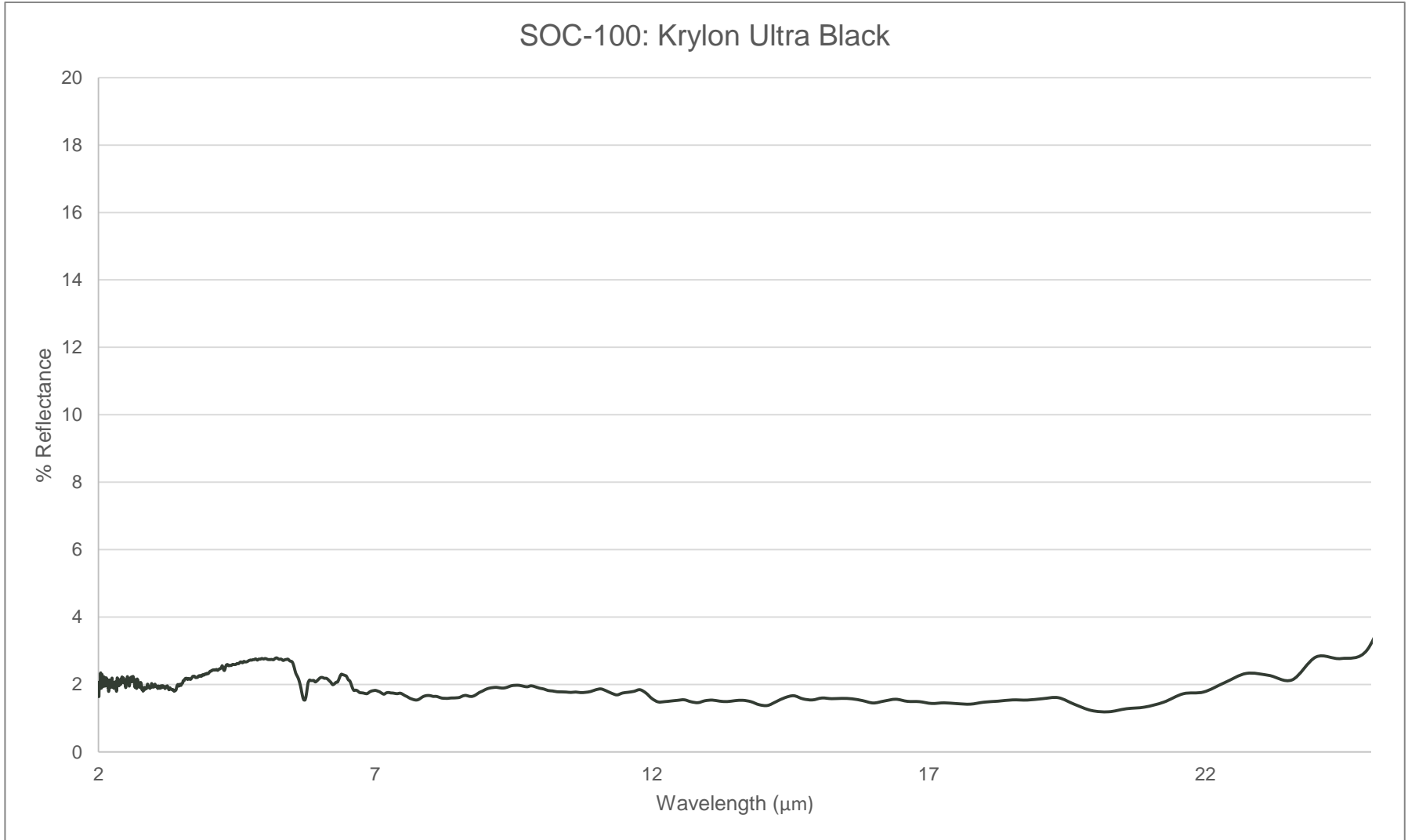


PerkinElmer: Krylon Ultra Black





KRYLON ULTRA BLACK



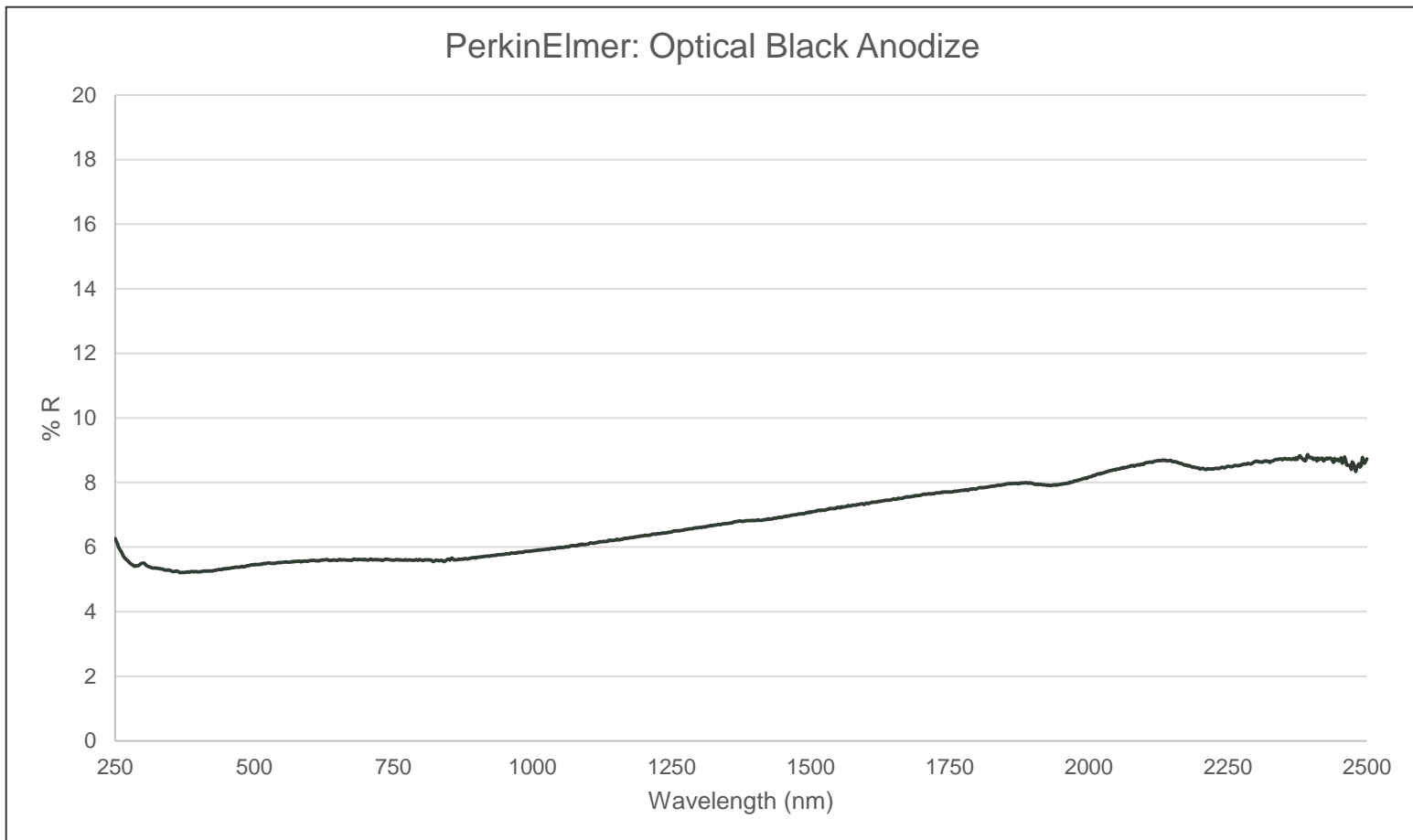


OPTICAL BLACK ANODIZED COATING

Samples acquired and provided by LLNL. Data collected by NVESD.



- Results from an oxide process but no organic dyes are used. Vacuum compatible and should be no outgassing.
- From Pioneer Metal Finishing

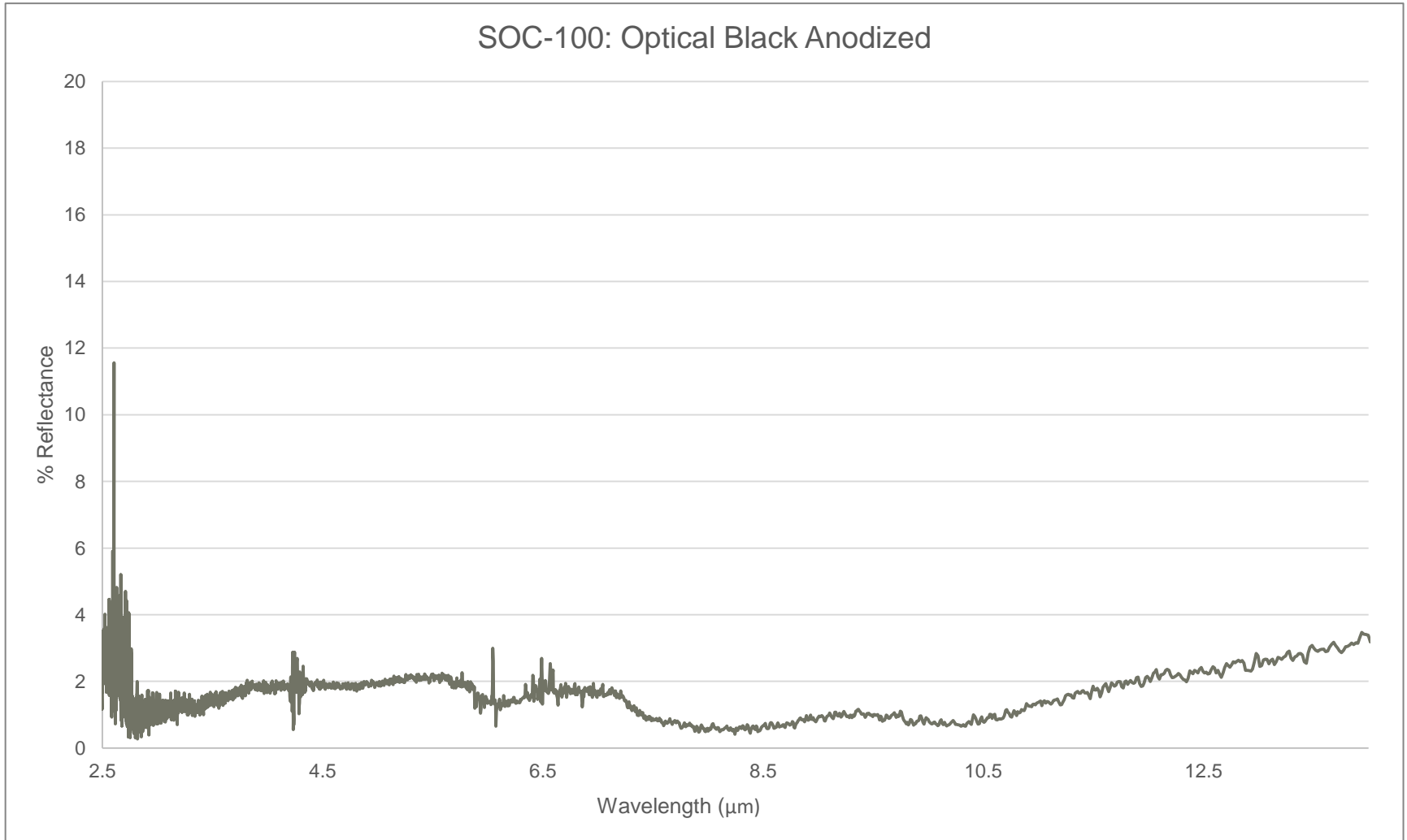




OPTICAL BLACK ANODIZED COATING



SOC-100: Optical Black Anodized





PERMAFLECT 5%

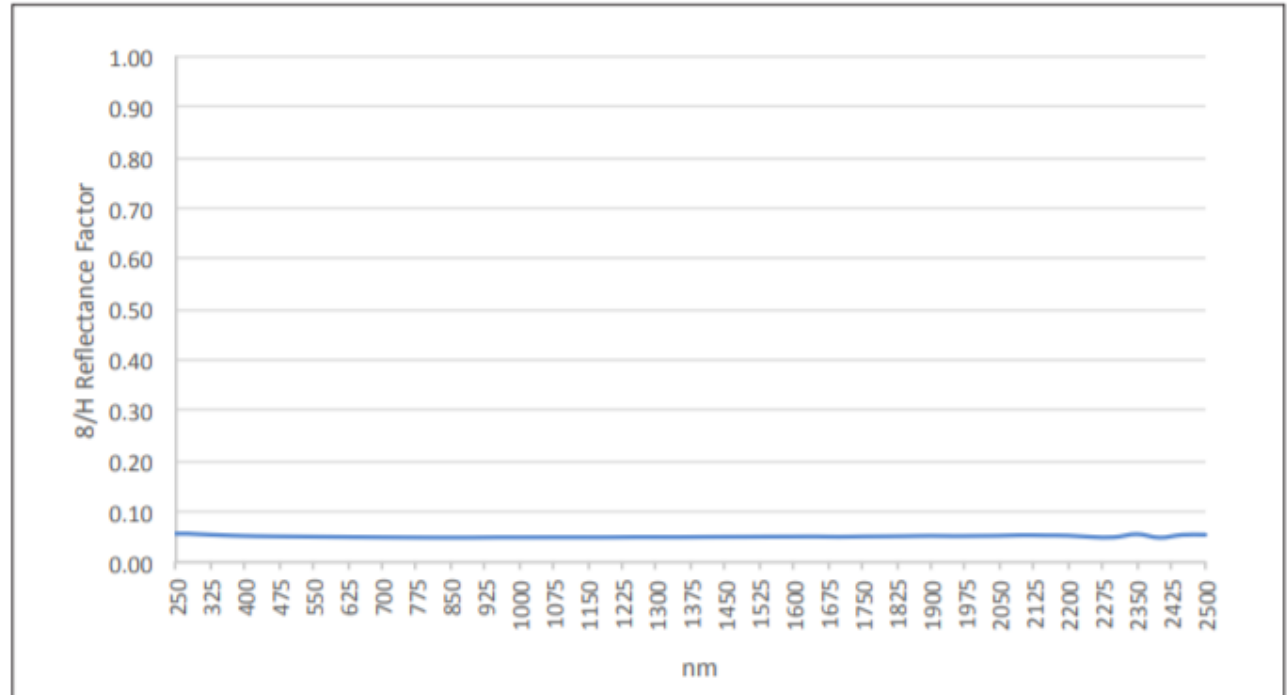


- Optical coating. No details provided by Labsphere.
- Commercially available. 1x1m is \$3,800



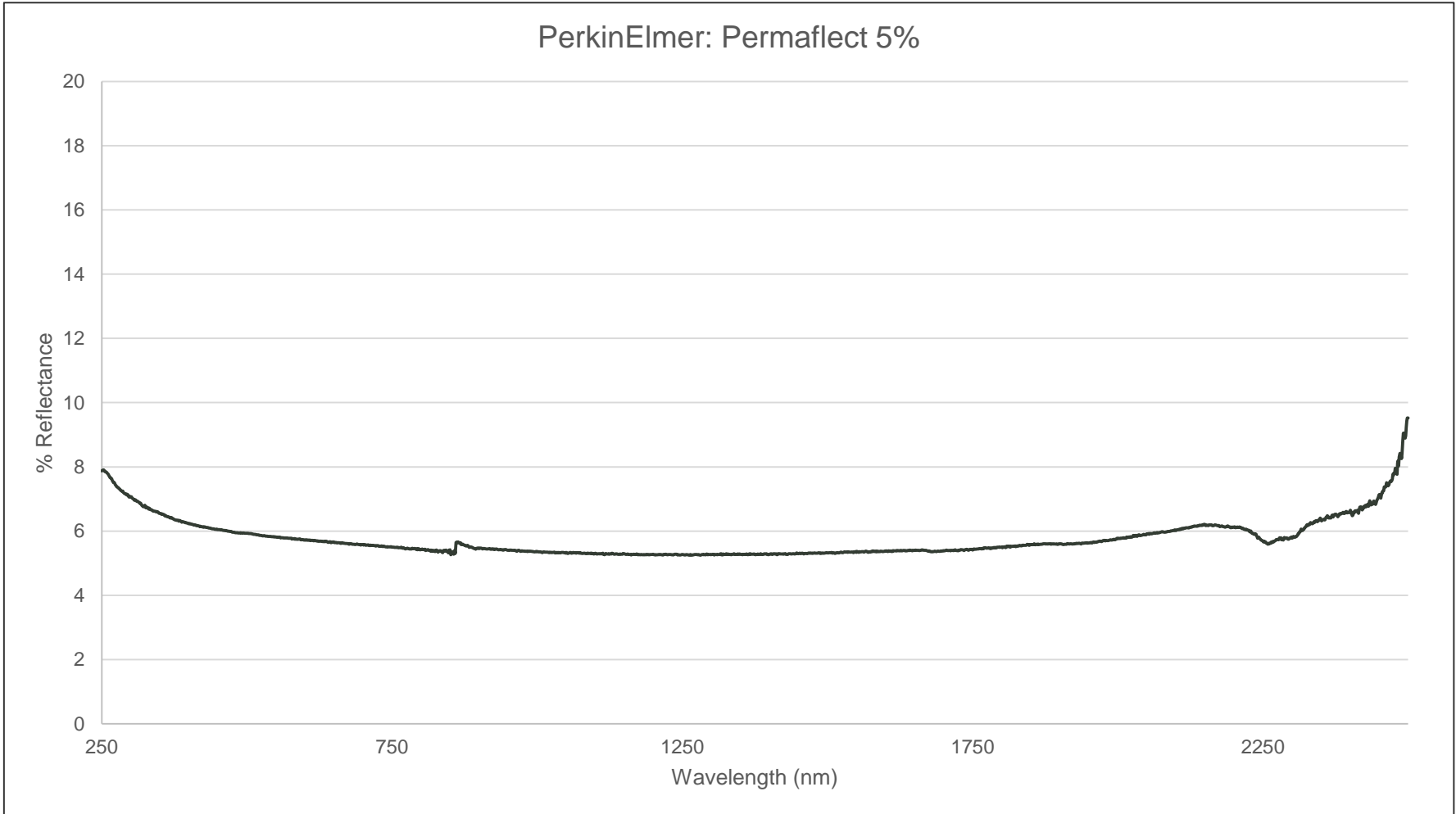
- Durable
- Reproducible
- Versatile
- Diffuse
- Highly Lambertian
- Repeatable

Typical 8/H Spectral Reflectance Factor



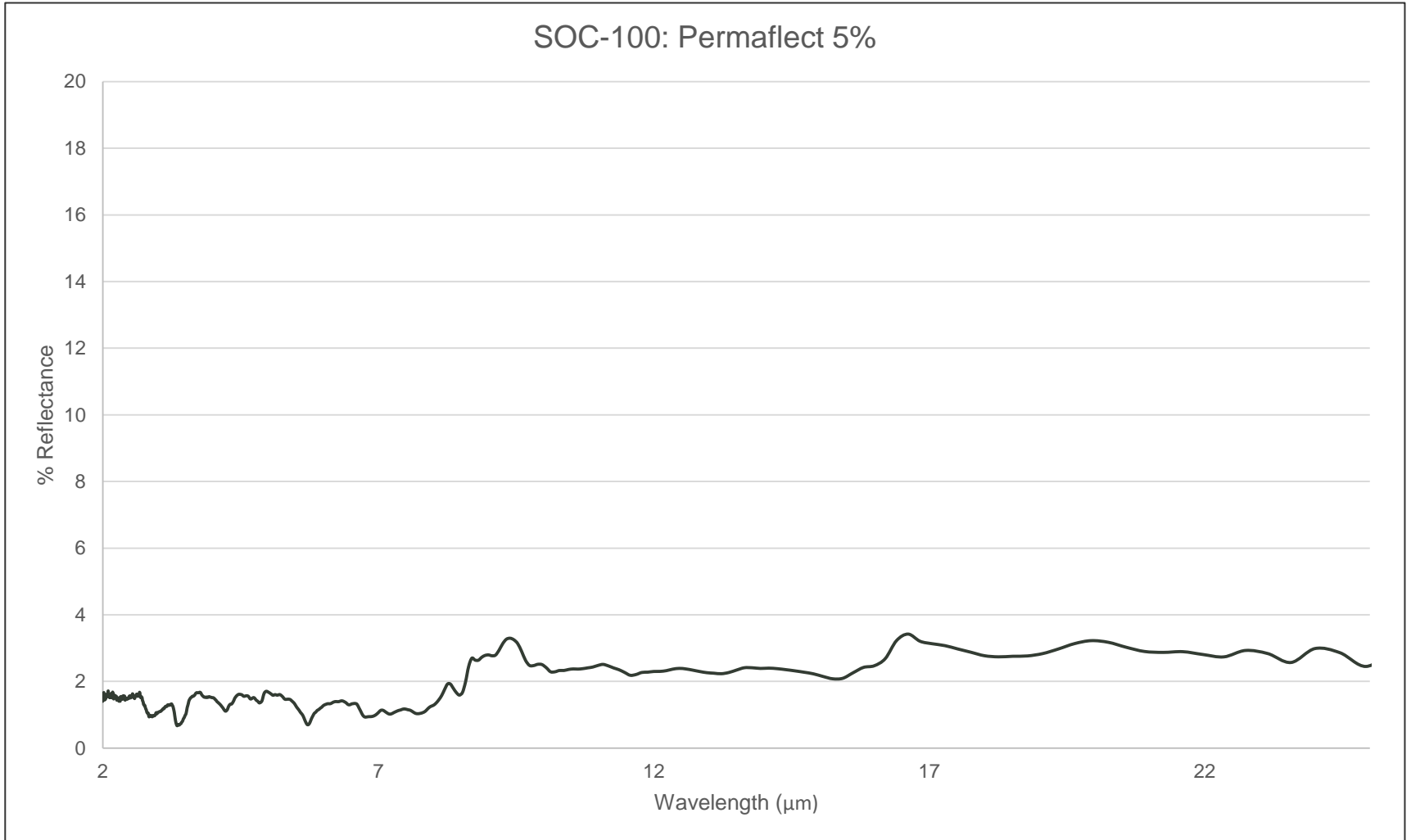


PERMAFLECT 5%





PERMAFLECT 5%

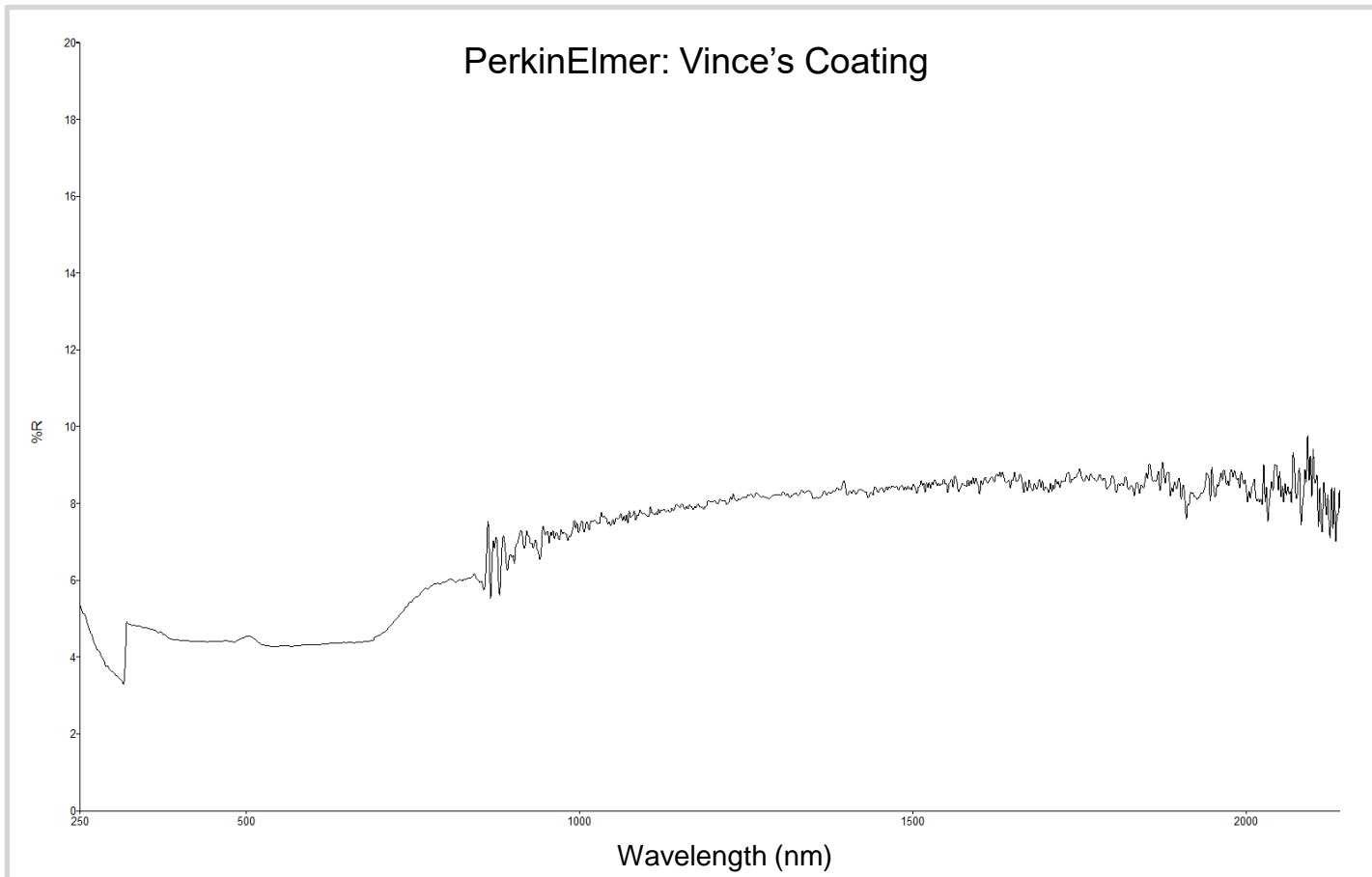




VINCE'S SUPER-SECRET COATING



- Nano Carbon Coating
- Formulated at NVESD
- Not so secret, just hasn't been publically published.

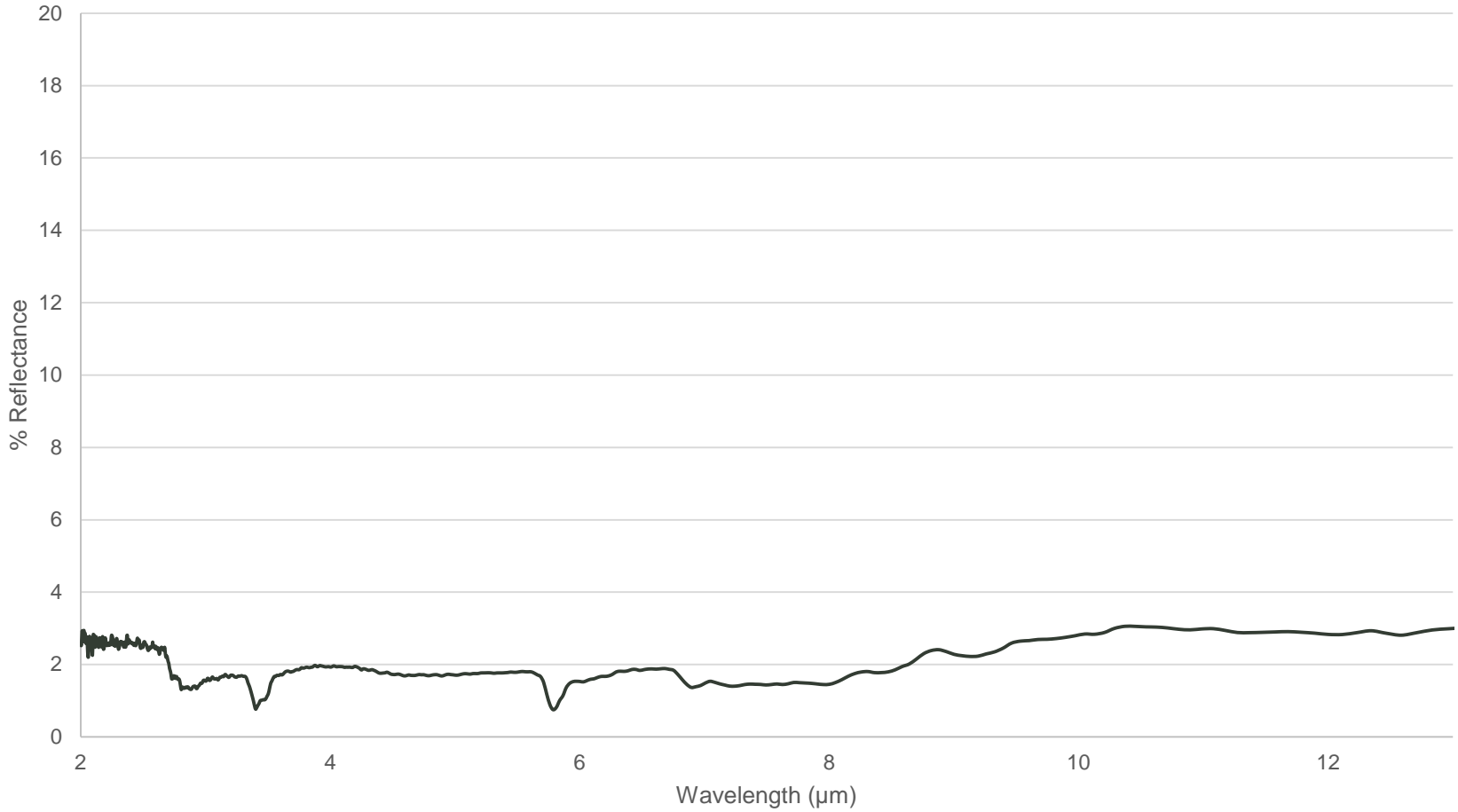




VINCE'S SUPER-SECRET COATING



SOC-100: Vince's Coating





PERKINELMER COMPARISONS



From top to bottom:

Permafect 5%

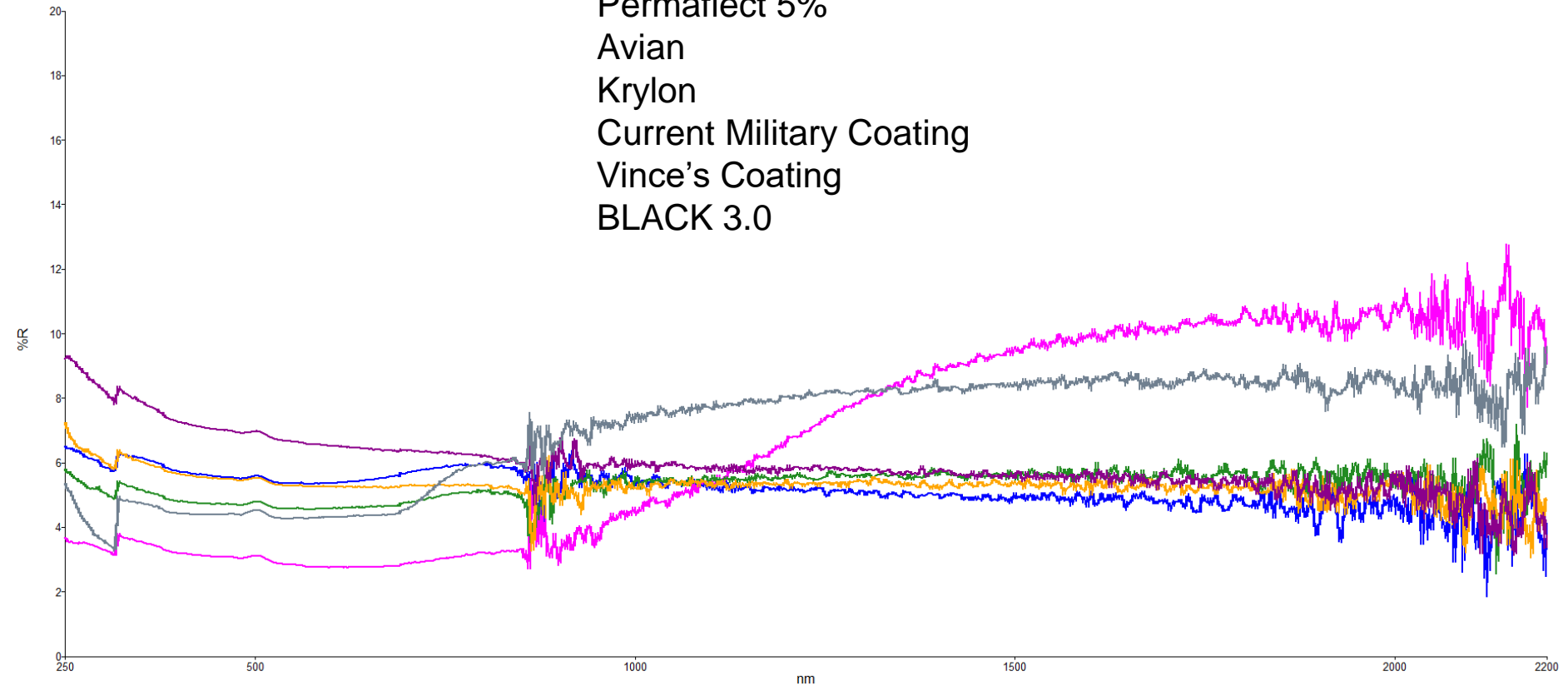
Avian

Krylon

Current Military Coating

Vince's Coating

BLACK 3.0



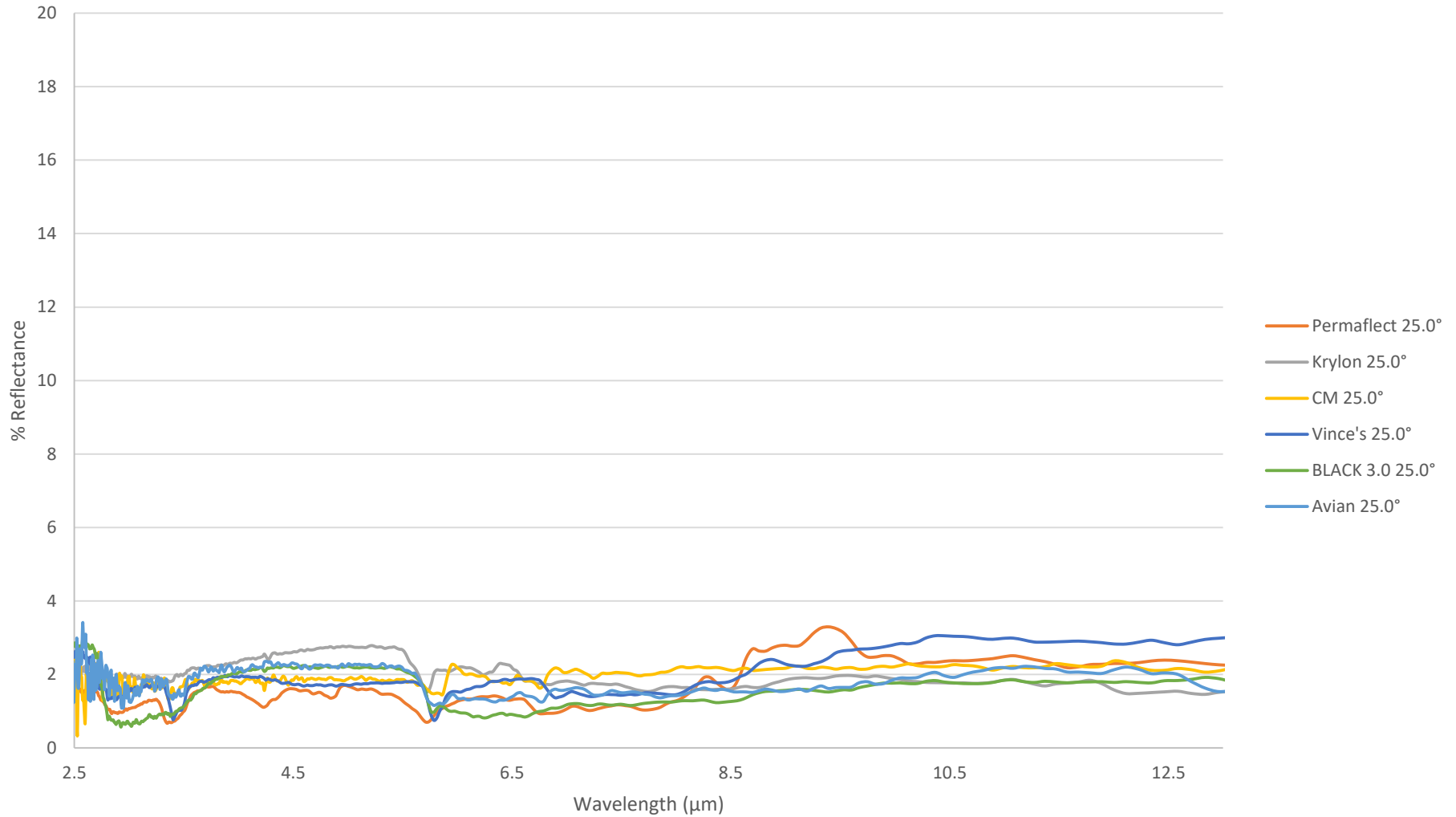
The two darkest paint and coating are both the most fragile (physically) and not weather resistant. Will flake even with touch.



COMPARISONS SOC-100 2.5-13 MICRONS



Comparison of some samples

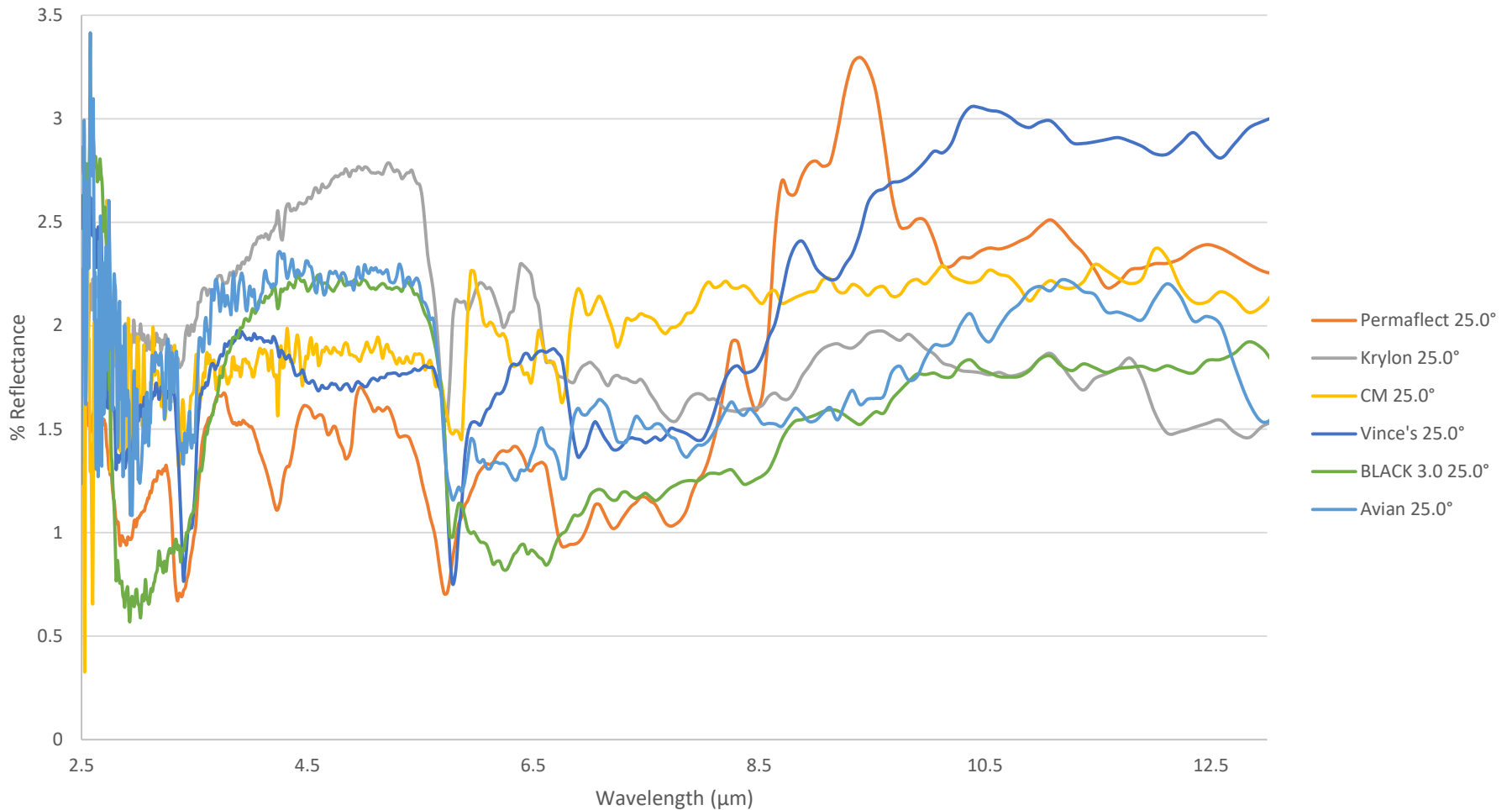




COMPARISONS SOC-100 2.5-13 MICRONS



Comparison of some samples

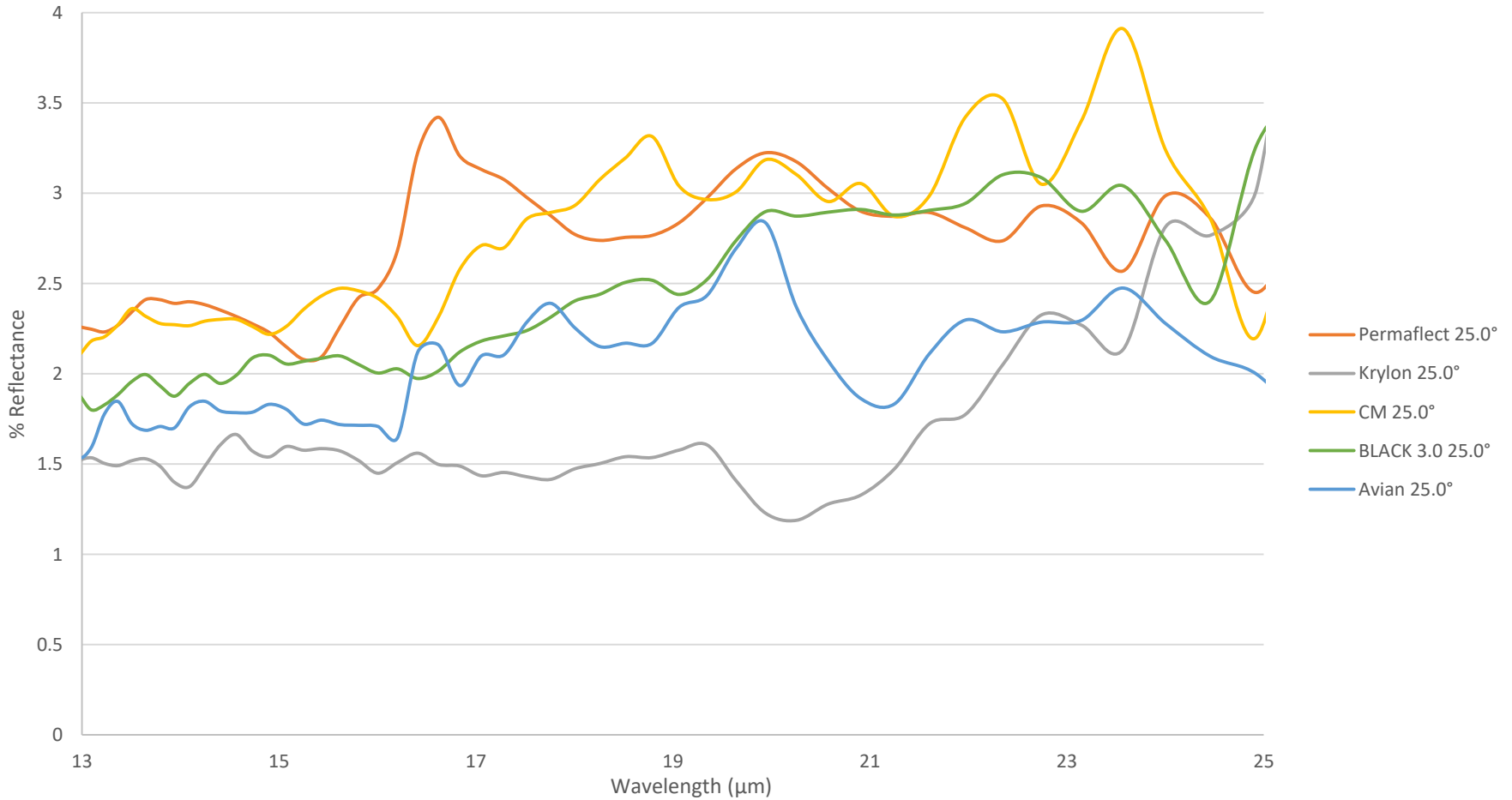




COMPARISONS SOC-100 13-25 MICRONS



Comparison of some samples





CONCLUSION



- Not all black paints are created equally.
- Krylon and Avian have the lowest reflectivity for paints that are durable and weather resistant, ideal for field applications.
- Visibly black but may not all have the same spectral characteristics.
- Maybe the blackest paint or coating is not ideal when weighing application.