



GMK MoDo Light Color Matching

APPROVED // // // 20 OCTOBER 2020

WRITE UP : DIXIE

MEASUREMENTS & EDITING : NEBULANT

Reading Spectrophotometer Data

We send our samples and swatches to Nebulant, who we have partnered with to help us get actual data on color and who has helped with color matching on other sets like GMK Bingsu, to measure with a tool called a spectrophotometer. This device measures the reflectance of the samples across the visible spectrum, and can be used to calculate CIEL*a*b* color values of both the reference colors and GMK samples.

L* stands for *Lightness* where 0 is black and 100 is white.

a* is from green (-) to red (+).

b* is from blue (-) to yellow (+).

We take these three values from one color and compare them to another color to calculate the euclidean distance between them in the CIEL*a*b* color space. The accumulation of all three (L*, a*, & b*) deltas will give us a ΔE^*_{ab} (DeltaE*ab) between the two colors. A $\Delta E^*_{ab} \leq 2.3$ considered to be a “just noticeable difference”; and our goal is to have a difference of less than 2.

Pre Color Matching

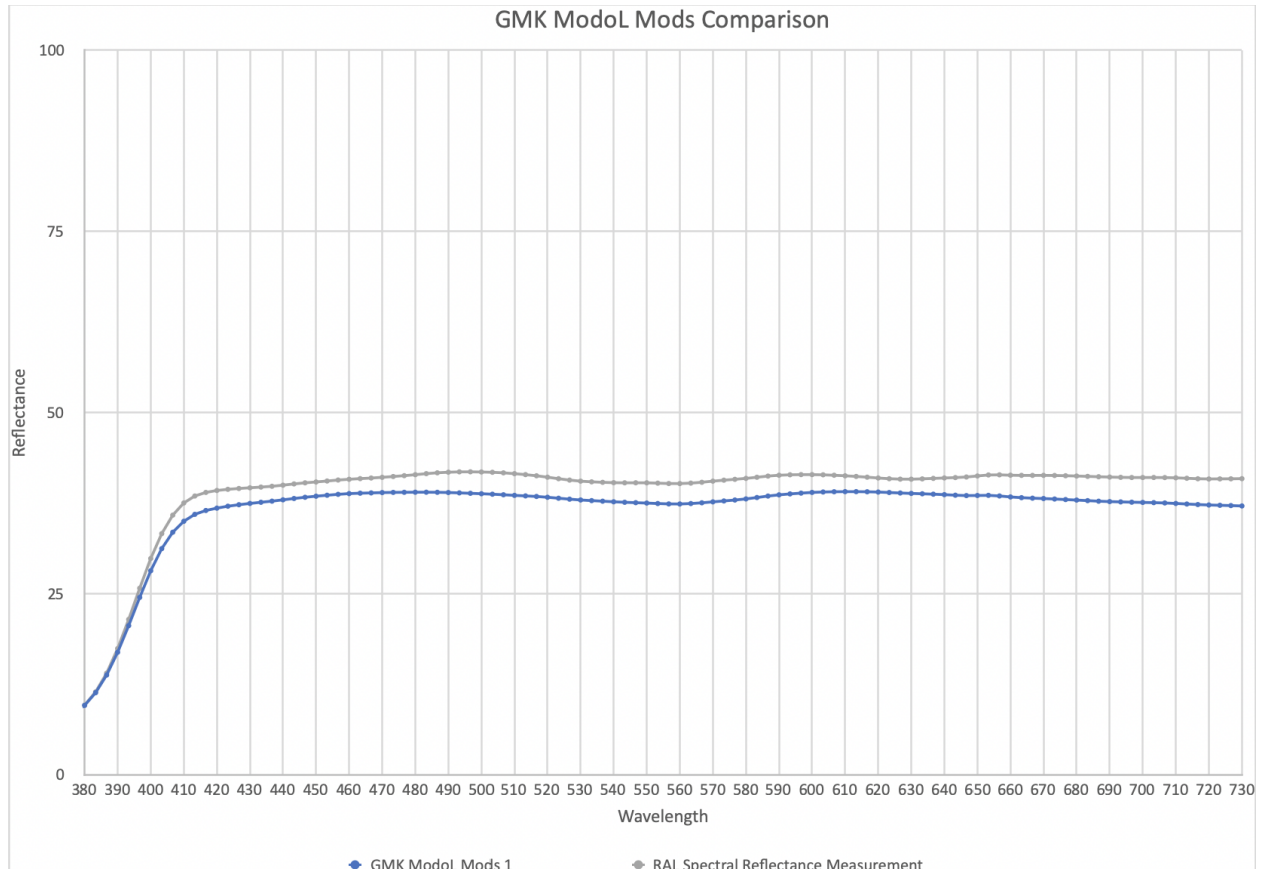
For GMK MoDo Light, I chose RAL values that represented a lighter derivative of GMK Modern Dolch by comparing them side-by-side to GMK MoDo keycaps. We then sent those values to GMK to match.

Round 1 Samples

When we received the color match samples from GMK, we noticed that GMK had sent the incorrect key for the alpha, so we do not have a round 1 sample for the alpha color.

Modifiers - NOT APPROVED ❌

Below is a graph comparing the measurements of the keycap sample from GMK and the RAL swatch for the Modifier color. The majority of the difference with the GMK sample vs the RAL is almost exclusively in brightness, the color shifts are small. The GMK Sample has a lift in the blue area (450-480) and the red area (600-620) that the RAL does not have. This means the GMK sample has a slight purple / cool feel. We sent in for another round of samples to try to get the sample more neutral.



Below is the final comparison data from the sample from GMK and the RAL swatch.

ΔL^* : -1.9 Very close match with only a slight decrease in lightness.

Δa^* : .61 Virtually perfect with only .61 Delta.

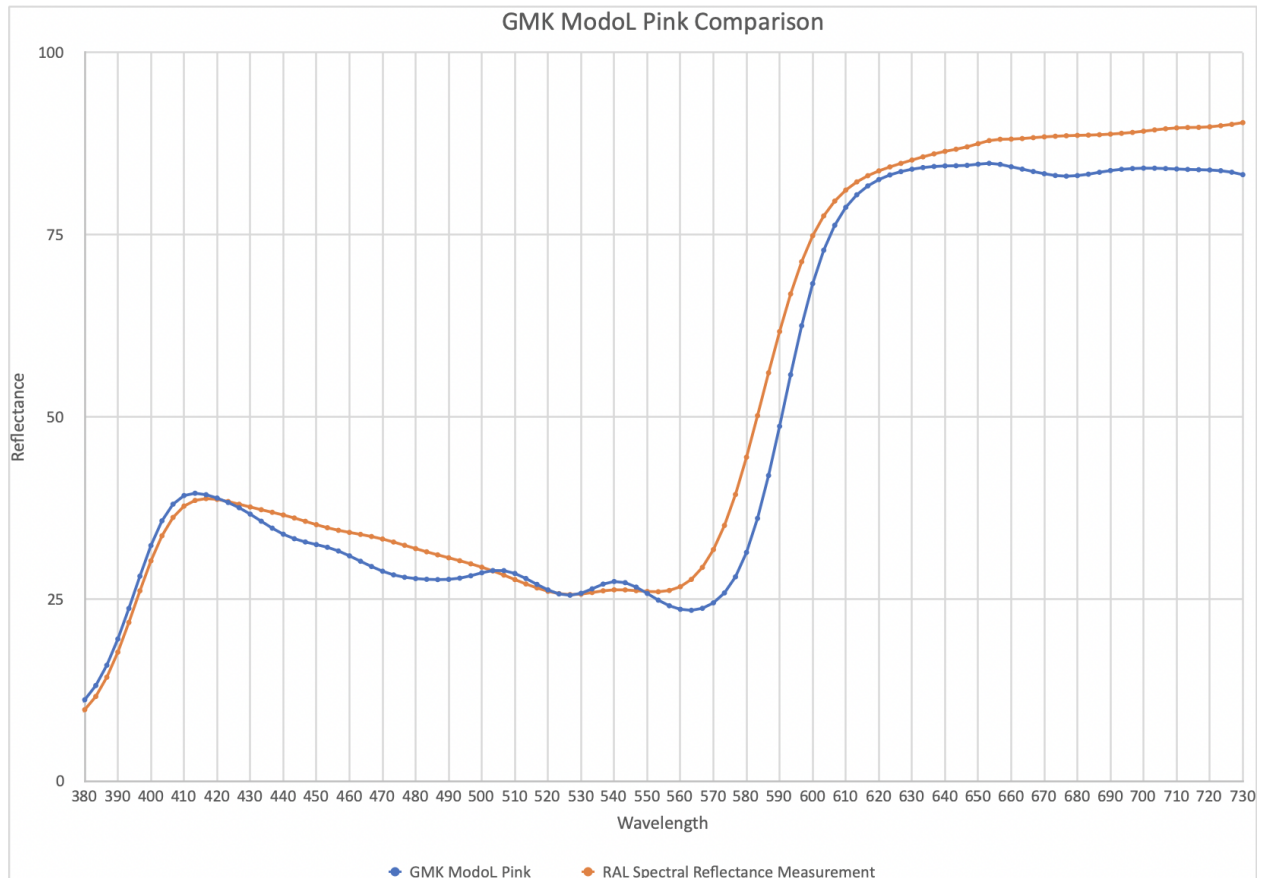
Δb^* : -.57 Virtually perfect with only .57 Delta

ΔE^*_{ab} : 2.08 This value is well under the standard threshold of a close match and virtually spot on to the 2.00 threshold we are attempting to achieve. While the majority of the difference is coming from the slight decrease in lightness, the combination of the increased red and blue made for a slight purple hue shift on the sample. Because of this, we decided to get a second sample.

	L^*	a^*	b^*
RAL Spectral Reflectance Measurement	70.0701176	0.0769966	0.3961388
GMK Modol Mods 1	68.1620522	0.6949011	-0.1826677
DELTA	-1.9080654	0.6179045	-0.5788065
DeltaEab	2.08747131		

Pink Accent - NOT APPROVED ✖

Below is a graph comparing the measurements of the keycap sample from GMK and the RAL swatch for the Pink Accent color. The graph below shows that the GMK sample is a little darker than the RAL, as well as higher levels of green and blue in the 540 and 500 ranges.



Below is the final comparison data from the sample from GMK and the RAL swatch.

ΔL^* : -2.56 Too dark

Δa^* : -0.93 Towards green but is far under 2, so we are well within the target range.

Δb^* : -0.76 Very close match.

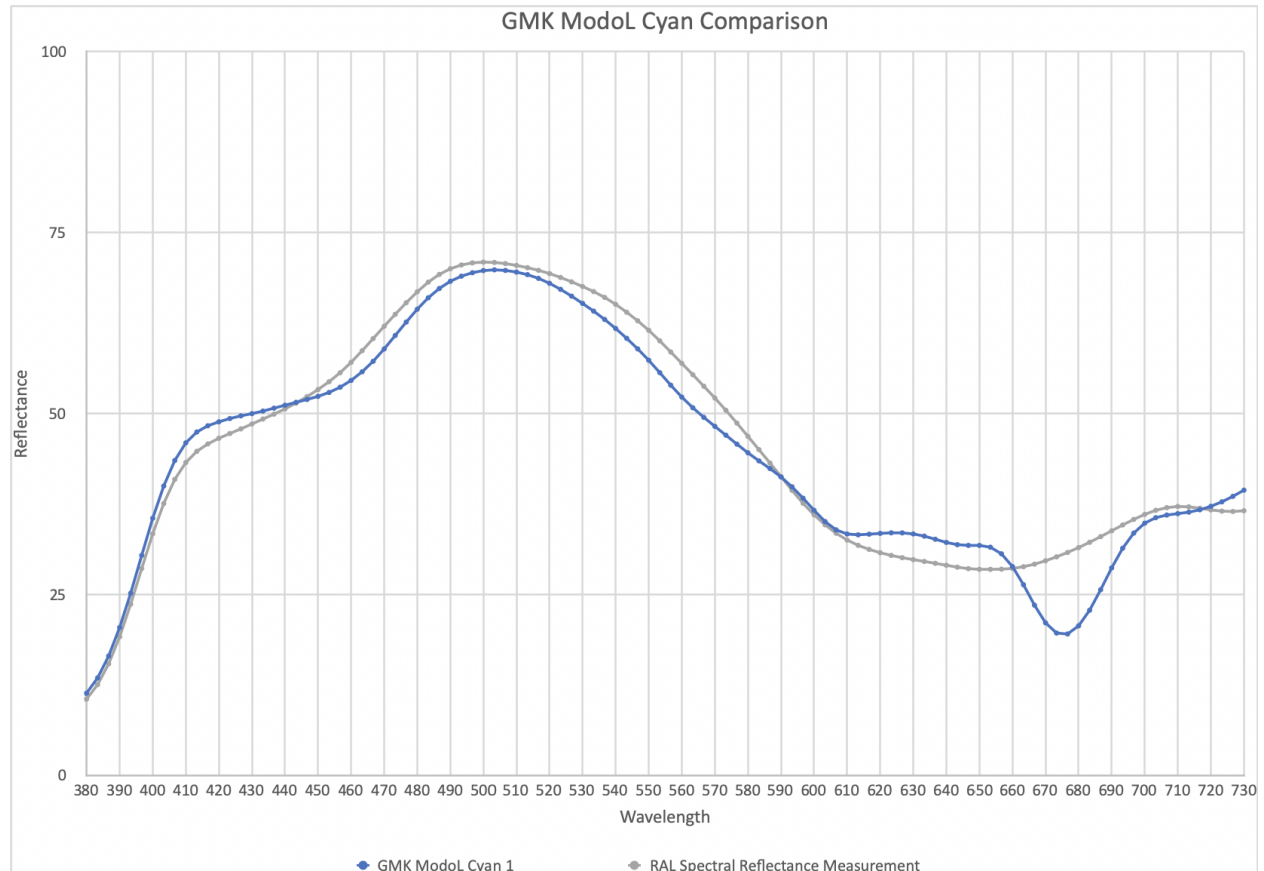
ΔE^*_{ab} : 2.83 Difference is over 2 and even over the standard 2.3, with the majority of change being a decrease in lightness from the RAL swatch.

Initially, we thought we were okay with this sample from a visual judgement and didn't ask for a second round of samples with the Modifier and the Cyan. However we will be getting a second round after this data has highlighted that the sample is too dark / saturated.

	L*	a*	b*
RAL Spectral Reflectance Measurement	71.109164	41.5038383	10.0655914
GMK Modol Pink	68.5491089	40.5720372	9.2991928
DELTA	-2.5600551	-0.9318011	-0.7663986
DeltaEab	2.830106397		

Cyan Accent - NOT APPROVED ✖

Below is a graph comparing the measurements of the keycap sample from GMK and the RAL swatch for the Cyan Accent color. The graph below shows that the GMK sample follows the RAL pretty closely until it gets to the yellow and red ranges (610-730). You can see the sample is actually lighter in the yellow / the high red areas and much darker in the mid red areas. This resulted in the cap looking a little washed out and dusty.



Below is the final comparison data from the sample from GMK and the RAL swatch.

ΔL^* : -1.09 Great match on the lightness.

Δa^* : 3.16 Much redder than it should be.

Δb^* : -0.84 Very close match.

ΔE^*_{ab} : 3.45 Difference is over 3, with the majority of change being the a^* value tipping far towards red from the RAL swatch.

We will be getting another round to attempt to get a closer match to the RAL swatch.

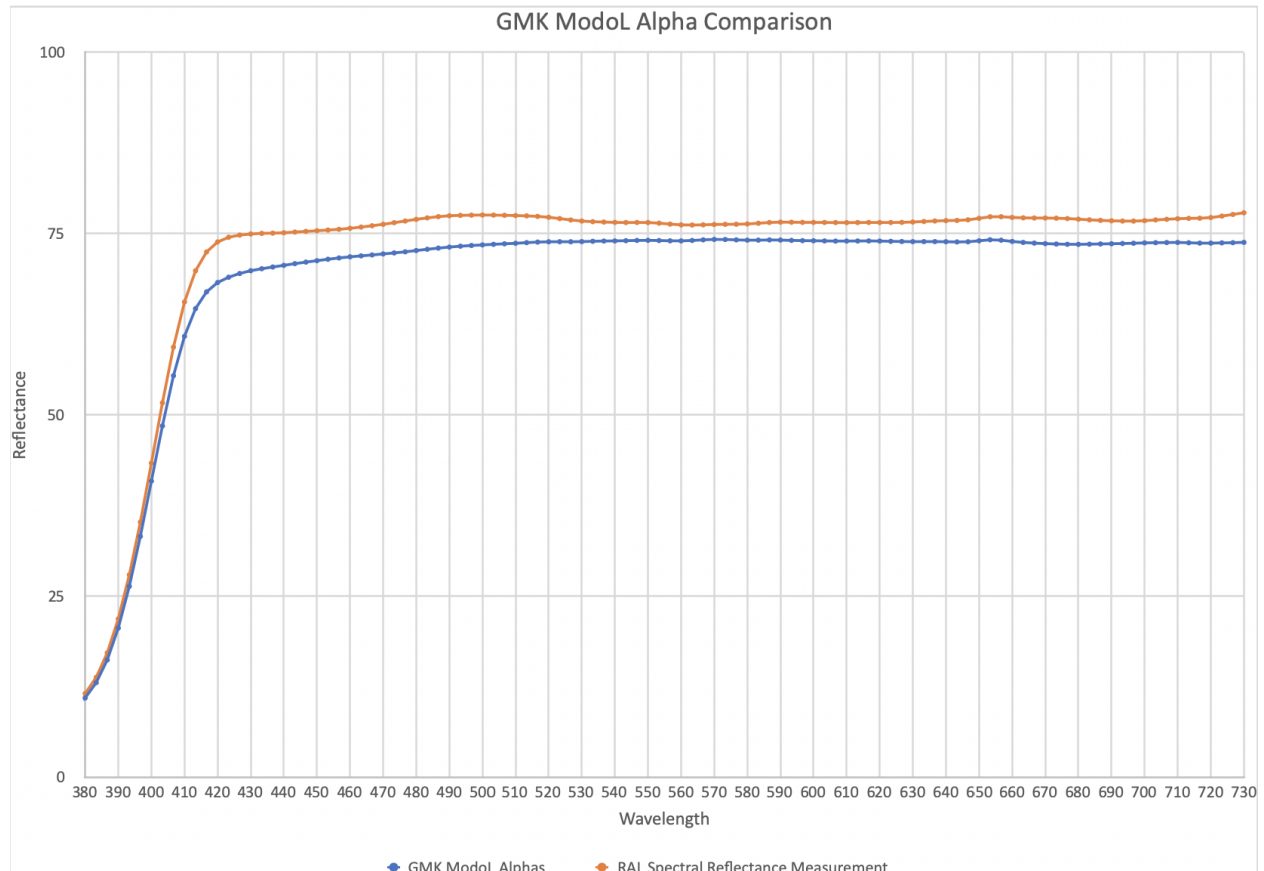
	L^*	a^*	b^*
RAL Spectral Reflectance Measurement	78.400495	-28.5064693	-2.9556943
GMK Modol Cyan 1	77.3098912	-25.3411116	-3.803306
DELTA	-1.0906038	3.1653577	-0.8476117
DeltaEab	3.453599804		

Round 2 Samples

We got in the correct sample for the Alphas and a second round of the Modifier and the Cyan samples.

Alphas - APPROVED ✓

Below is a graph comparing the measurements of the keycap sample from GMK and the RAL swatch for the Modifier color. This sample follows a similar path as the RAL swatch with the main difference coming in the lightness.



Below is the final comparison data from the sample from GMK and the RAL swatch.

ΔL^* : -1.2 Very close match. Difference not really noticeable to the human eye.

Δa^* : -.13 A nearly exact match.

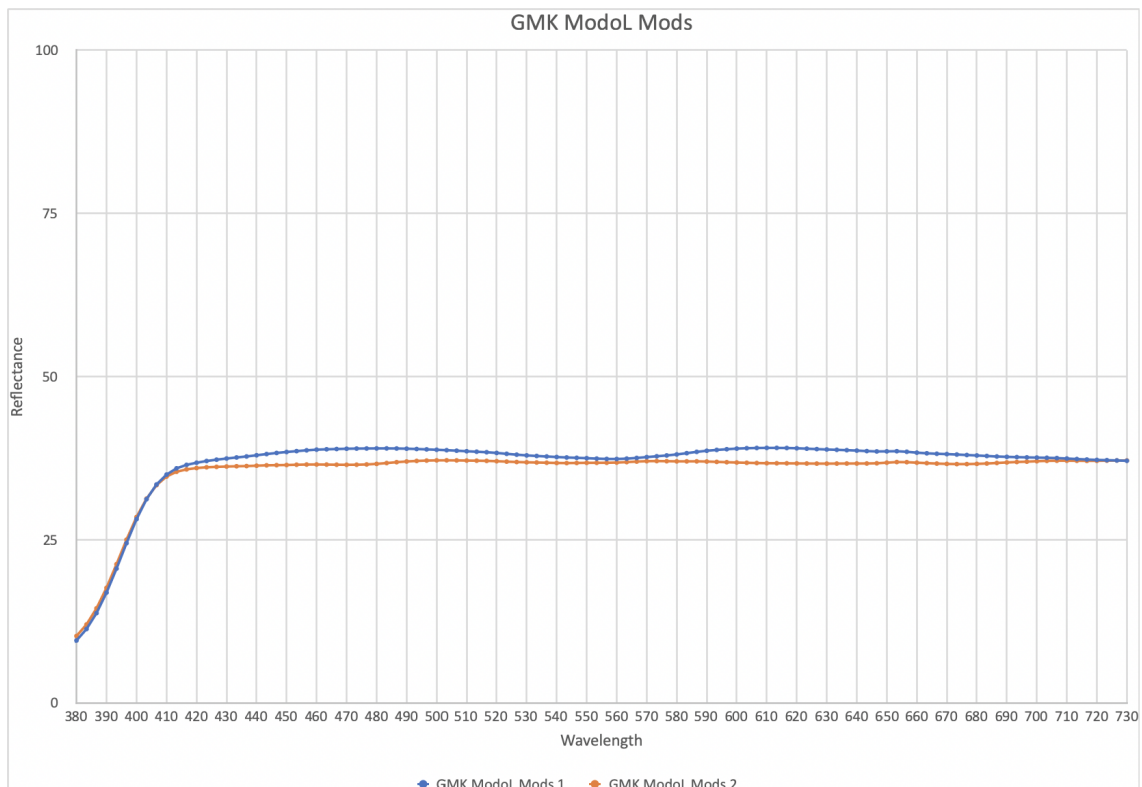
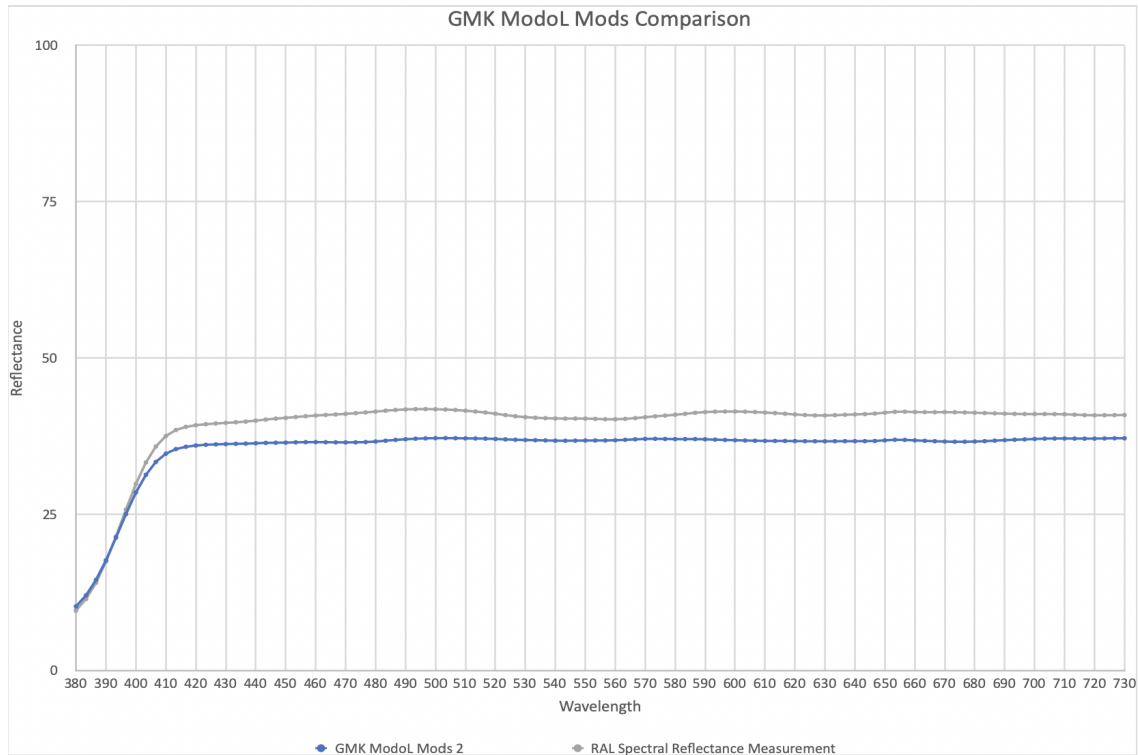
Δb^* : 1.32 Barely yellower (warmer), but still well under the target of a 2.00 Δ

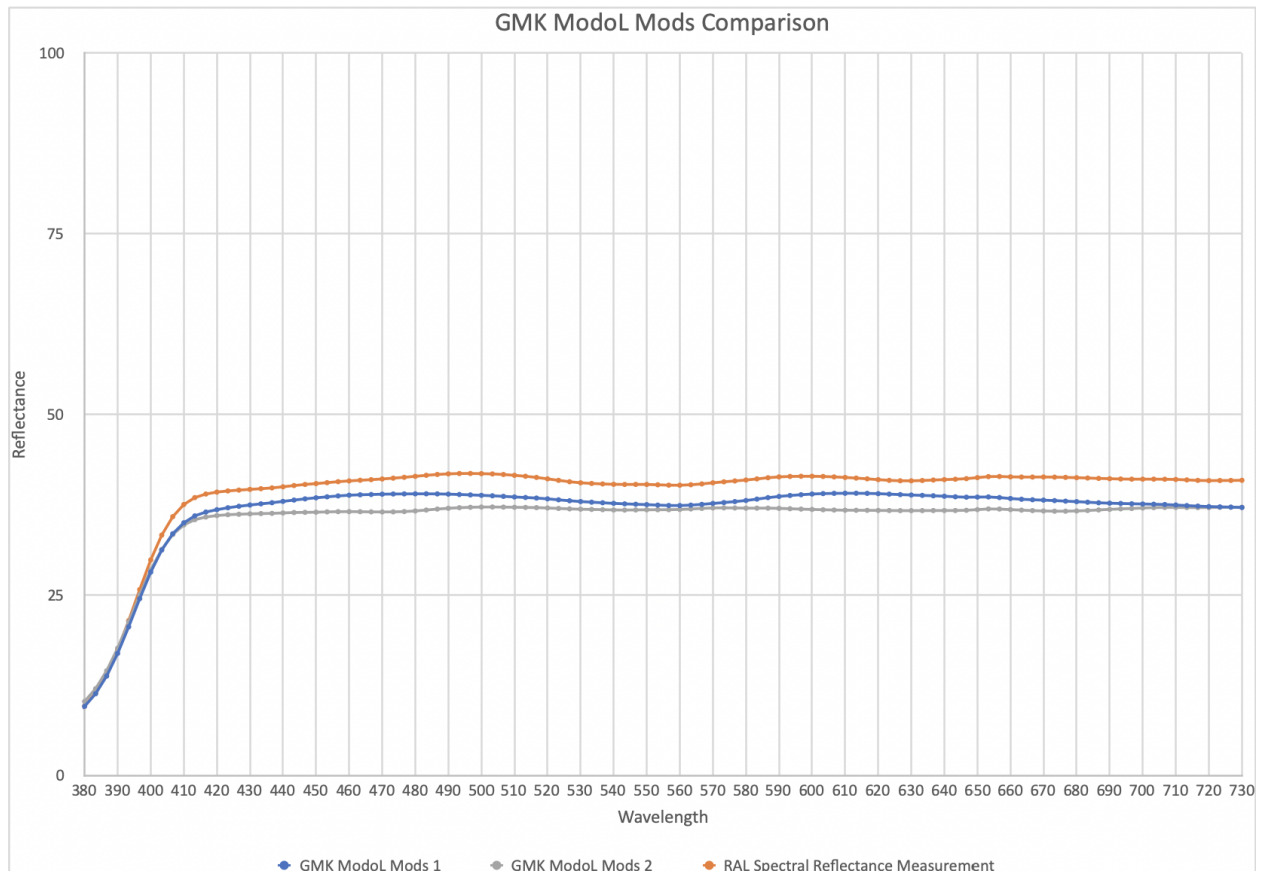
ΔE^*_{ab} : 1.84 This color is under our target ΔE^*_{ab} of 2.00, with most of the difference coming from the small increase in yellow. **This color is approved!**

RAL Spectral Reflectance Measurement	90.1367794	-0.5576033	0.8957059
GMK ModoL Alphas	88.8636178	-0.6896111	2.223356
DELTA	-1.2731616	-0.1320078	1.3276501
DeltaEab	1.844185811		

Modifiers - APPROVED ✓

Below is a graph comparing the measurements of the second keycap sample from GMK and the RAL swatch for the Modifier color. As you can see, the new sample has nearly a straight line across without any lifts like the first round, resulting in a much more neutral color. Second graph is comparing the first and second round samples. Third graph is comparing both samples to the RAL, all together.





Below is the final comparison data from the sample from GMK and the RAL swatch.

ΔL^* : -2.8 Slightly darker than the RAL when held up against each other .

Δa^* : -.44 Virtually perfect with only .44 Delta.

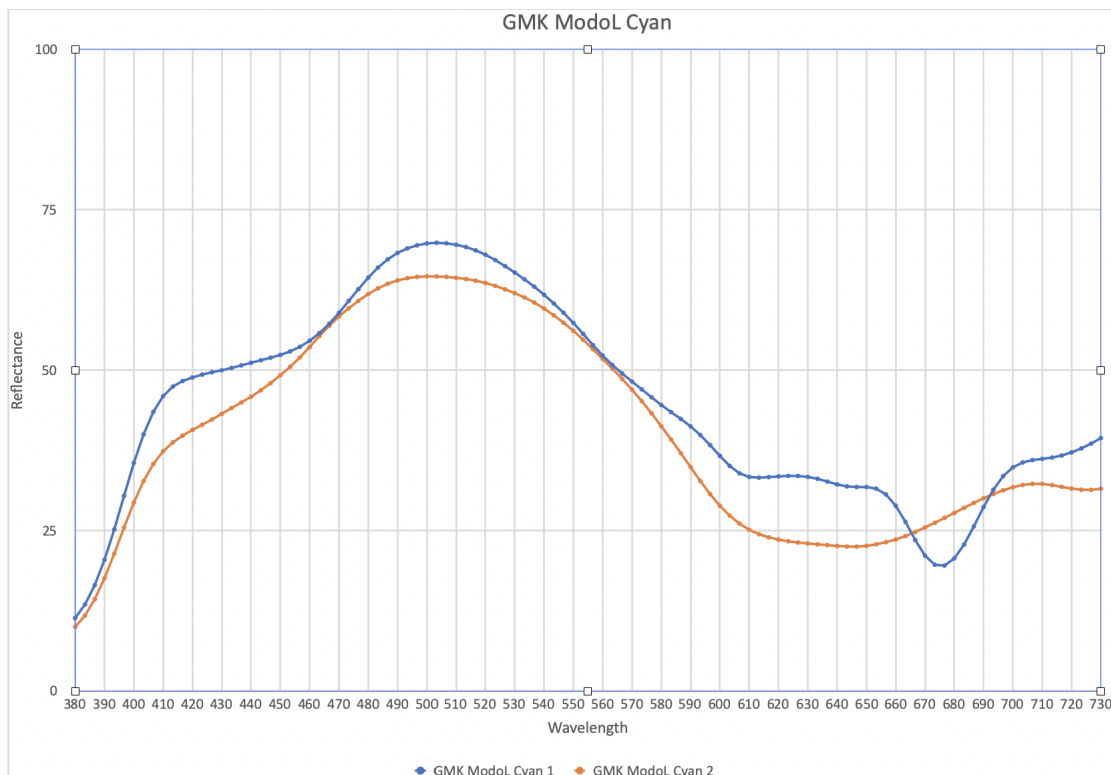
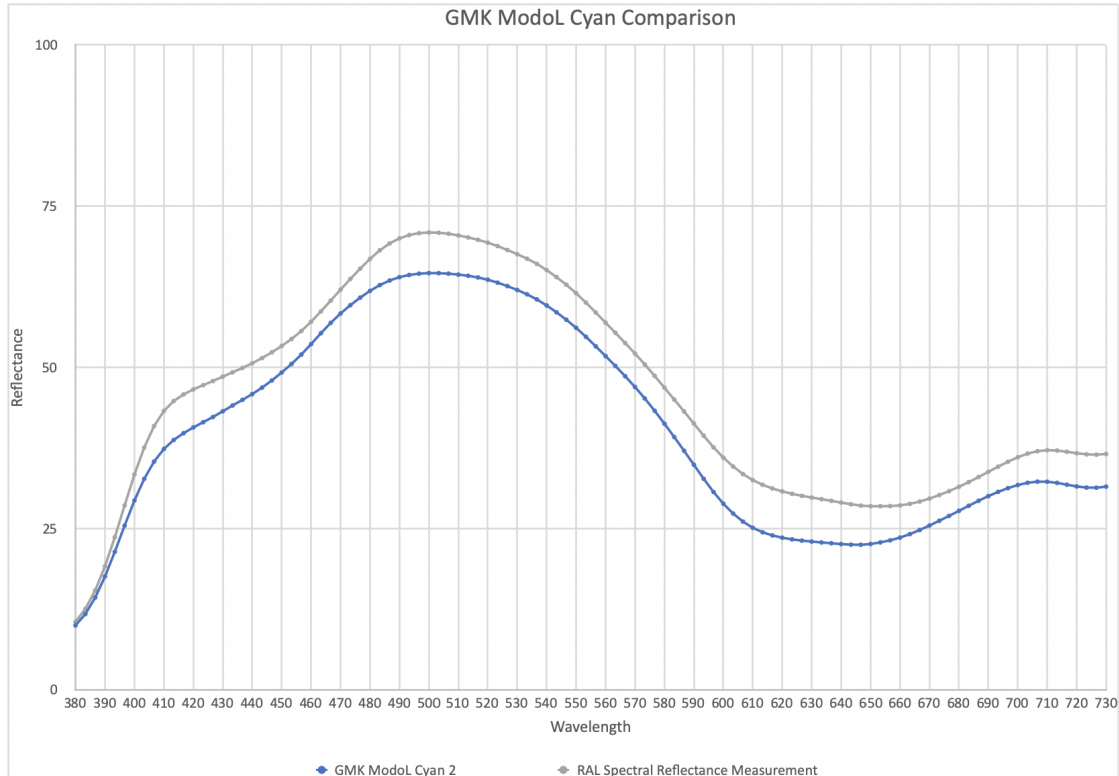
Δb^* : .18 A nearly exact match.

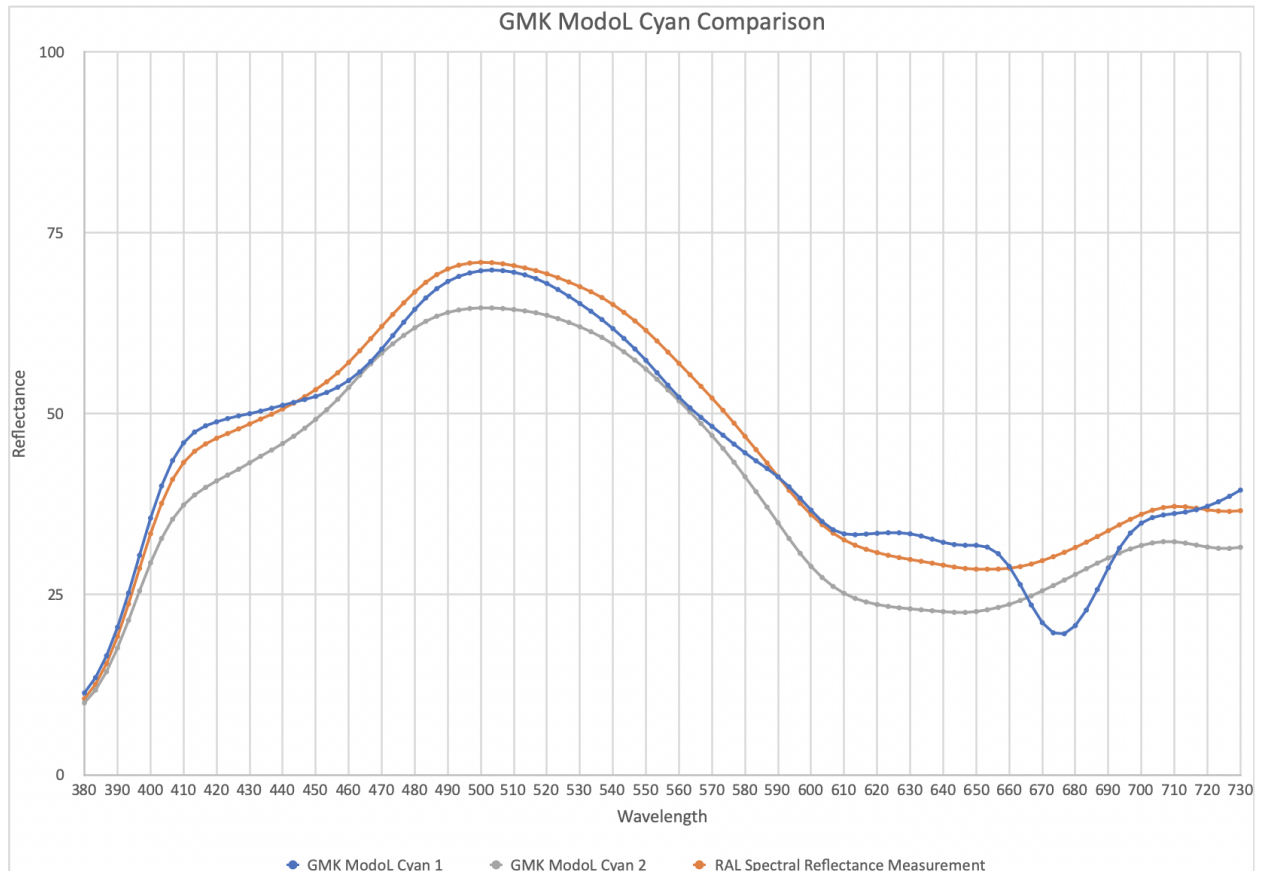
ΔE^*_{ab} : 2.90 While this value is actually higher than the previous sample, it is nearly all in the lightness category. The correction from a purple / cooler hue to a neutral hue is more important than the difference in lightness. **This color is approved!**

	L^*	a^*	b^*
RAL Spectral Reflectance Measurement	70.0701176	0.0769966	0.3961388
GMK ModoL Mods 2	67.2065619	-0.3687648	0.5800856
DELTA	-2.8635557	-0.4457614	0.1839468
DeltaEab	2.903875151		

Cyan Accent - NOT APPROVED ✖

Below is a graph comparing the measurements of the second keycap sample from GMK and the RAL swatch for the Cyan Accent color. The graph below shows that the new GMK sample corrected the dip red issue from R1, but they over corrected and made the sample too dark. Second graph is comparing the first and second round samples. Third graph is comparing both samples to the RAL, all together.





Below is the final comparison data from the sample from GMK and the RAL swatch.

ΔL^* : -3.5 Much darker than the RAL.

Δa^* : -3.06 Much greener than the RAL.

Δb^* : -1.58 Close match tipping slightly to the blue.

ΔE^*_{ab} : 4.9 Difference is nearly 5. This sample is actually worse than the first round. It is too saturated and too dark. It seems to be an over correction from the first sample being a little too light and desaturated.

We will be getting another round to attempt to get a closer match to the RAL swatch.

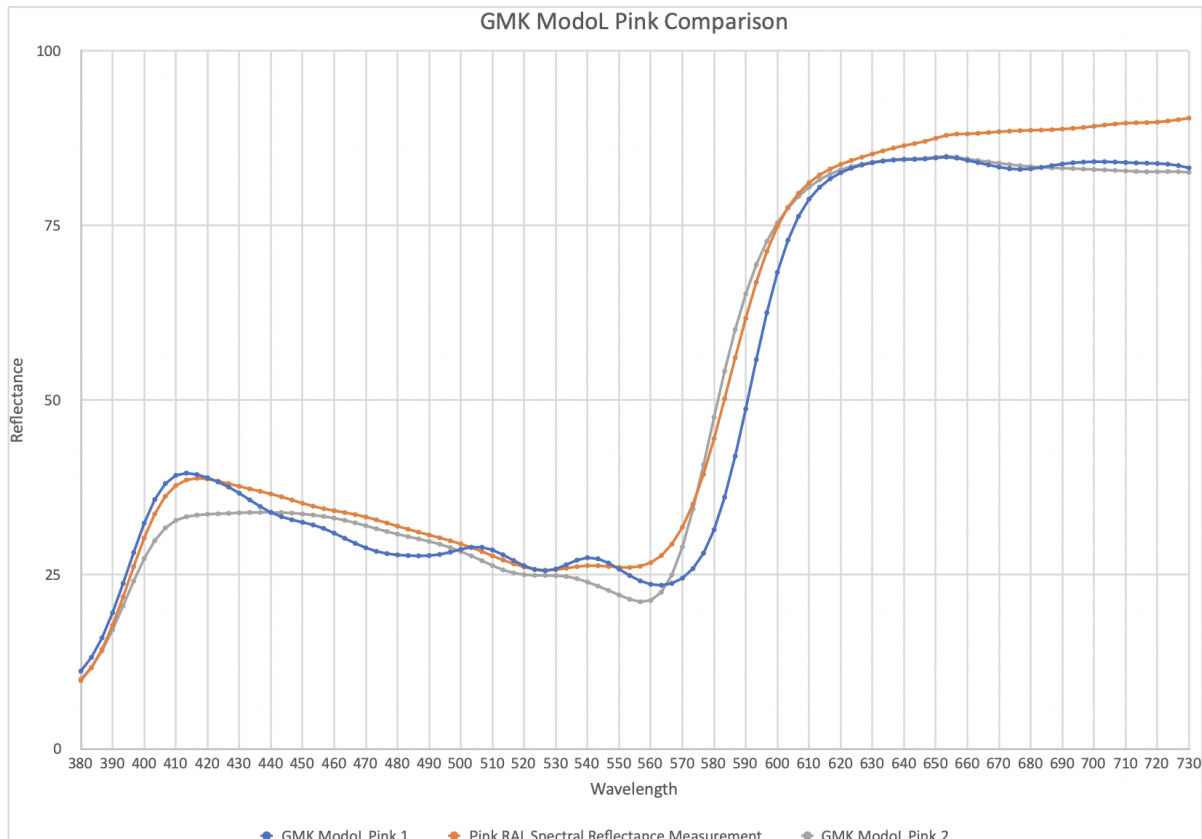
RAL Spectral Reflectance Measurem	78.400495	-28.5064693	-2.9556943
GMK Modol Cyan 2	74.8722844	-31.5993509	-4.4865888
DELTA	-3.5282106	-3.0928816	-1.5308945
DeltaEab	4.935364687		

Round 3 Samples

We got in the second round of the pink accent and the third round of the cyan accent.

Pink Accent - APPROVED ✓

Below is a graph comparing the measurements of the keycap sample from GMK and the RAL swatch for the Pink Accent color. The graph below shows that the GMK sample is more consistent to the intended color than the previous sample and matches the overall theme well.



Below is the final comparison data from the sample from GMK and the RAL swatch.

ΔL^* : -0.92 Nearly spot on. This was a major improvement from the previous rounds -2.56.

Δa^* : 1.77 Within our 2.00 target.

Δb^* : 1.05 Half of our 2.00 target.

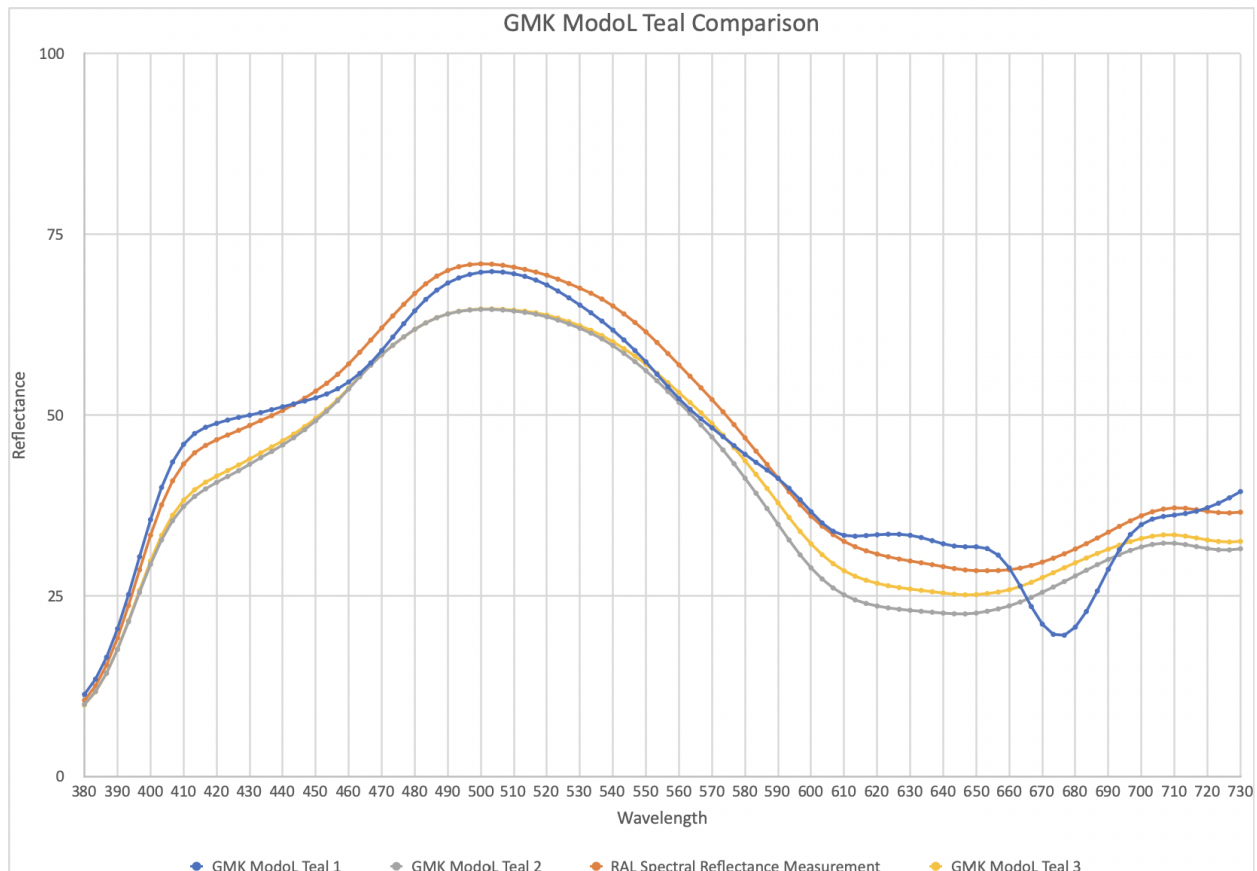
ΔE^*_{ab} : 2.26 Difference is just barely over our target of 2.00 and below the standard of 2.5 ΔE^*_{ab}

This color is approved!

	L*	a*	b*
RAL Spectral Reflectance Measurement	71.109164	41.5038383	10.0655914
GMK ModoL Pink 2	70.1821722	43.2761296	11.1243715
DELTA	-0.9269918	1.7722913	1.0587801
DeltaEab	2.263039007		

Cyan Accent -APPROVED ✓

Below is a graph comparing the measurements of the keycap sample from GMK and the RAL swatch for the Cyan Accent color. The graph below shows that the newest GMK sample is in line with our vision of the set, closely matching the RAL curve shape, with only a slight decrease in brightness.



Below is the final comparison data from the sample from GMK and the RAL swatch.

ΔL^* : -2.58 A little dark, but not very noticeable in person.

Δa^* : -0.26 Nearly perfect.

Δb^* : -0.21 Nearly perfect.

ΔE^*_{ab} : 2.60 This is slightly over our standard of 2.5, with nearly all of the difference in lightness.

The color accuracy is nearly as perfect as it could be.

This color is approved!

	L^*	a^*	b^*
RAL Spectral Reflectance Measurement	78.400495	-28.5064693	-2.9556943
GMK Modol Teal 3	75.8159309	-28.7706839	-3.1687435
DELTA	-2.5845641	-0.2642146	-0.2130492
DeltaEab	2.606754860		

[Link to Photos](#)