ChromaPure³

# Video Calibration Report

| | | | |
|---|---|---|---|
| **Company:** | Display Calibrations LLC | **Email:** | tom@chromapure.com |
| **URL:** | www.chromapure.com | **Test Pattern Source:** | Murideo4k |
| **Color Analyzer:** | None | **Reference Gamut:** | Rec. 709 |
| **Calibration Date:** | 7/12/2022 6:08 PM | **Target Gamma:** | 2.22 |
| | | **Color Intensity:** | 100% |

## Client Information

**Name:**

**Display:**

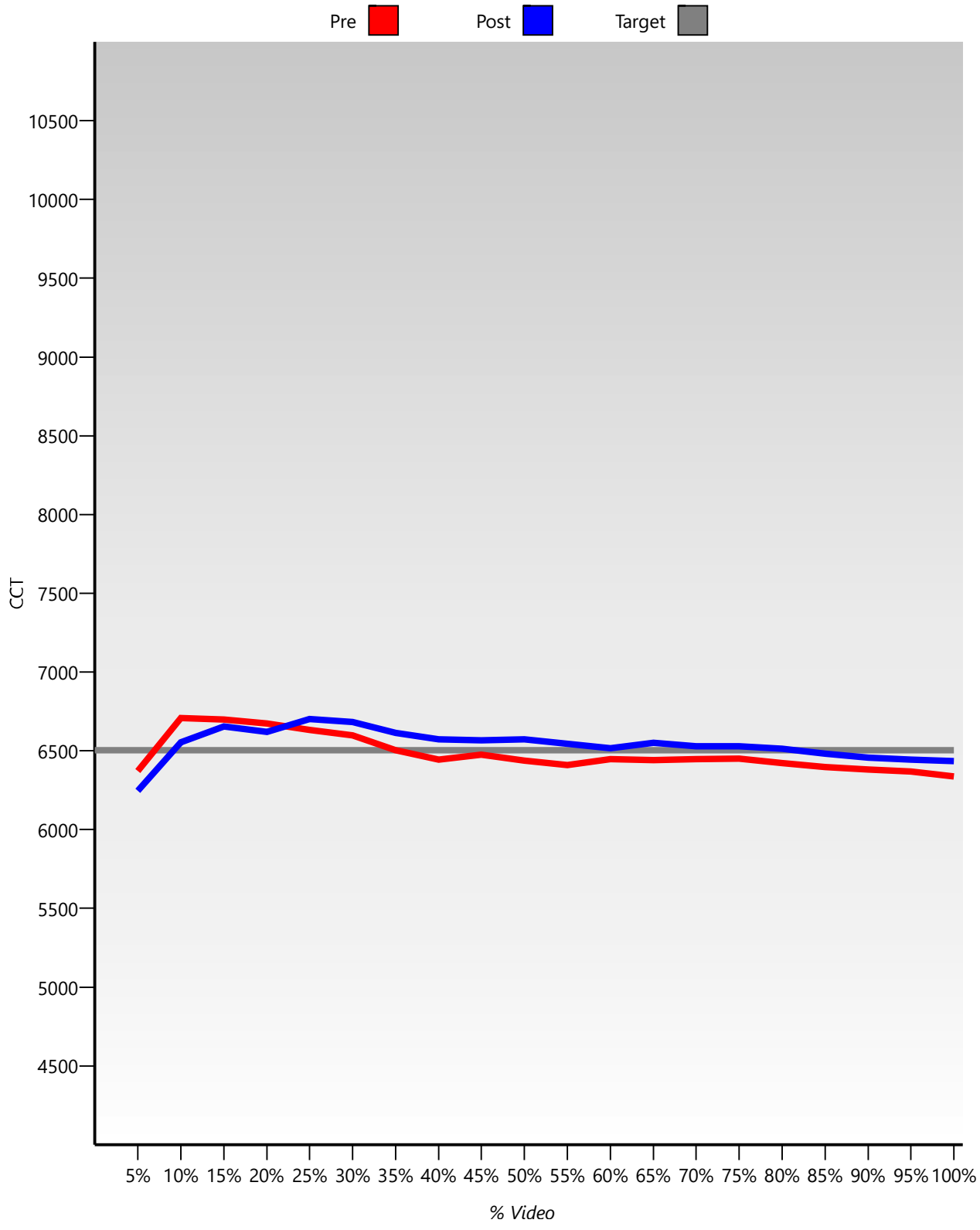
**Address:**

**Phone:**

**Email:**

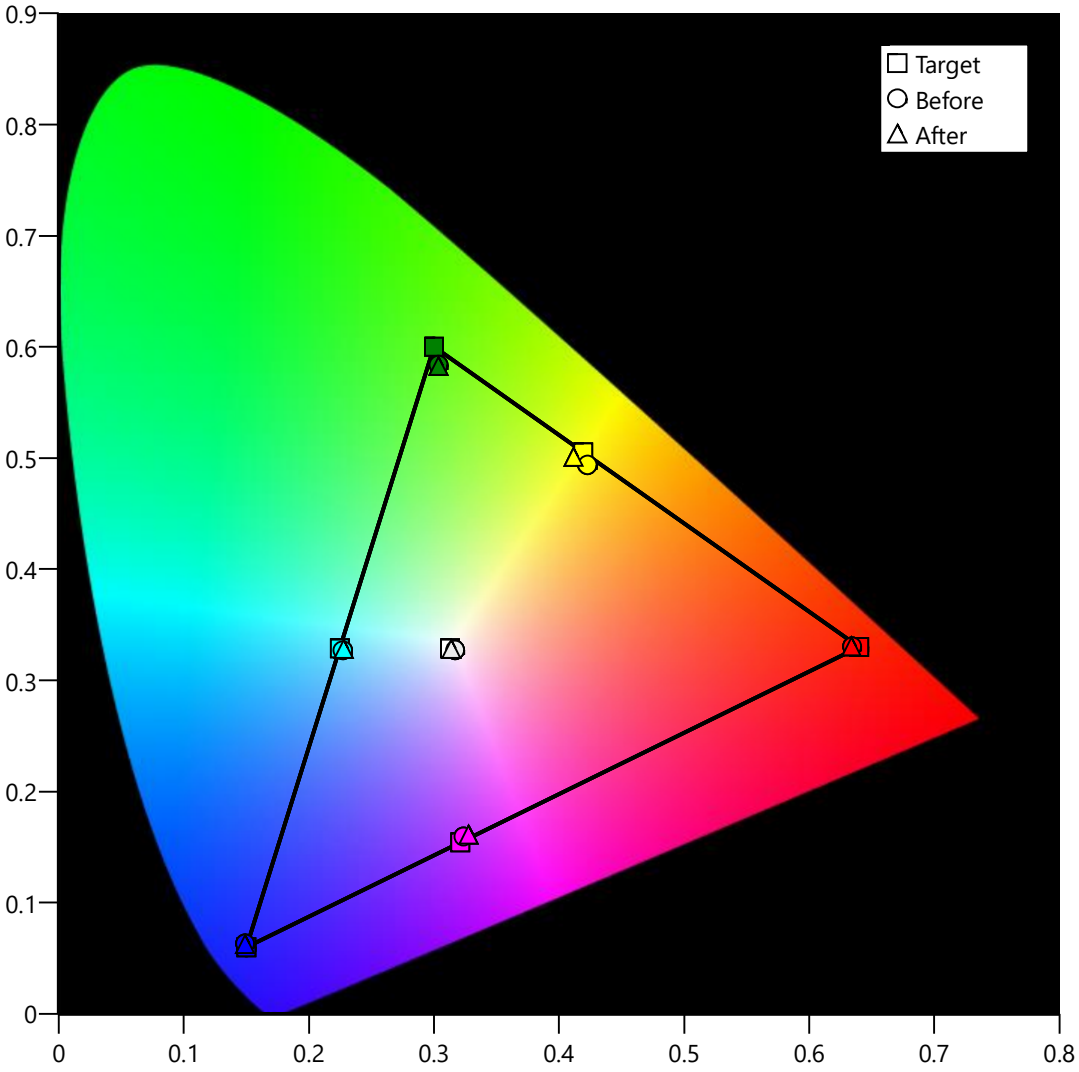
## Correlated Color Temperature

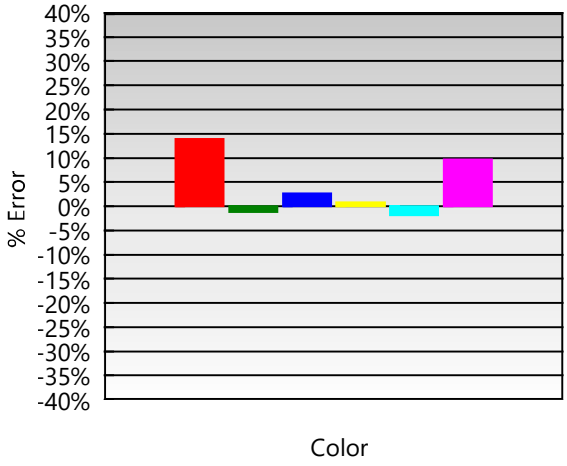
Correlated Color Temperature (CCT) is a less precise measurement of the color of white. The target is 6505.  Higher than 6505 is too blue. Lower is too red.

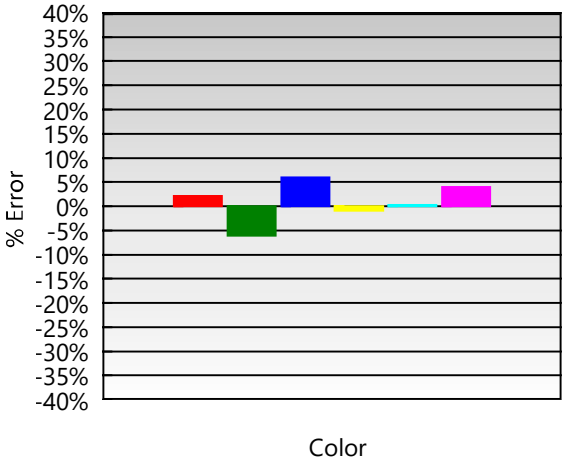


## CIE Charts

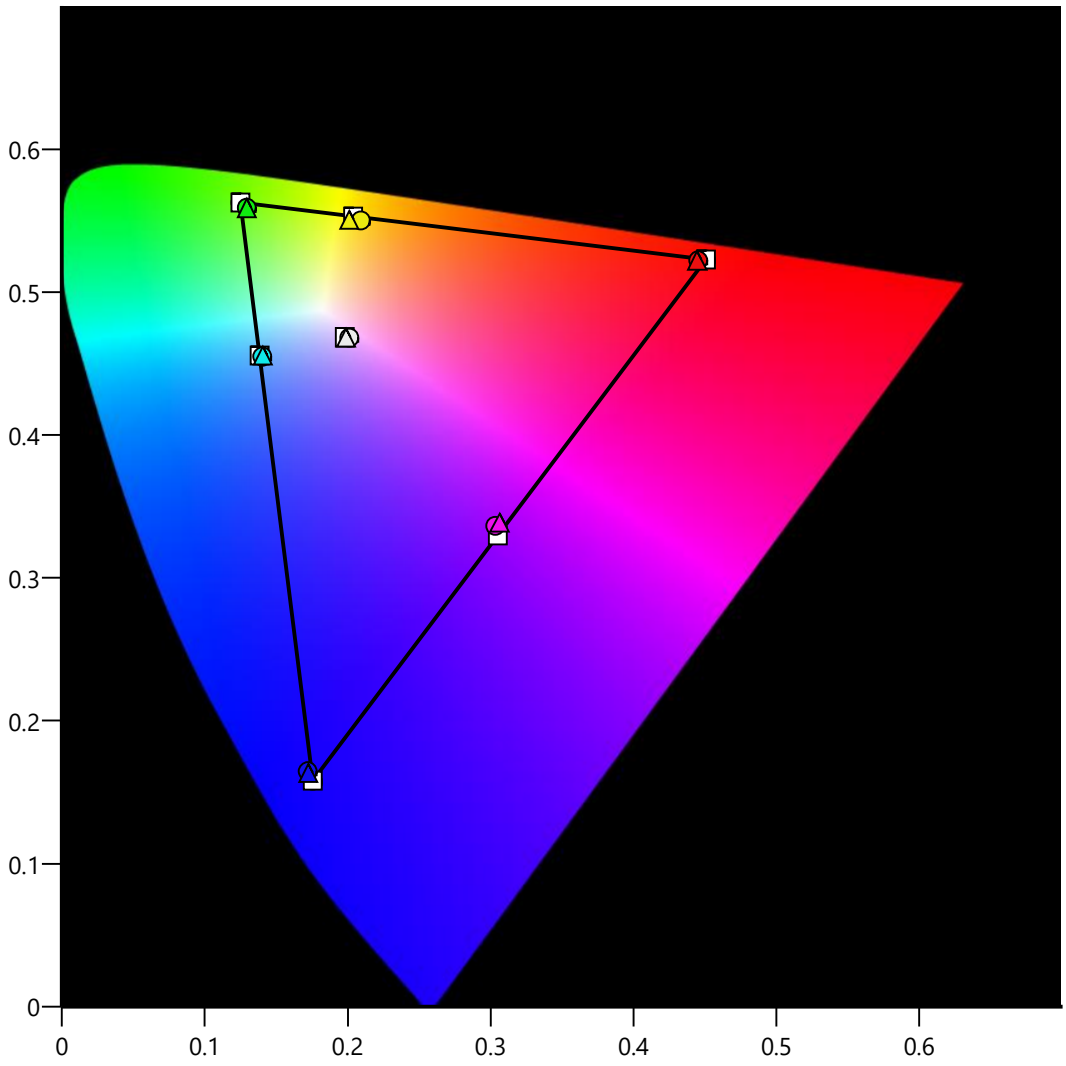
These charts graphically map the accuracy of the display's color saturation and hue relative to the chosen standard The closer the 'After' symbols are to the reference points, the more accurate the color. There are 2 chromaticity charts, one showing before/after performance based on the 1931 xy system and another based on the 1976 u'v' system, which is less well known, but more perceptually uniform.

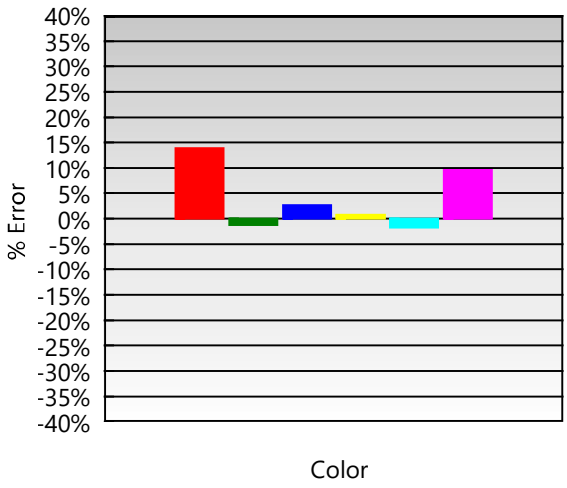


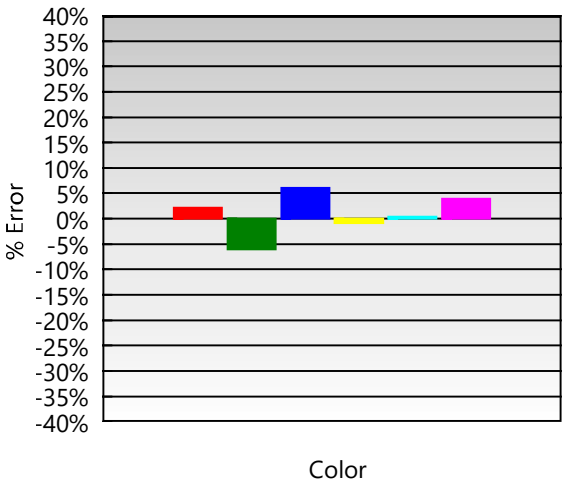



## CIE 1976

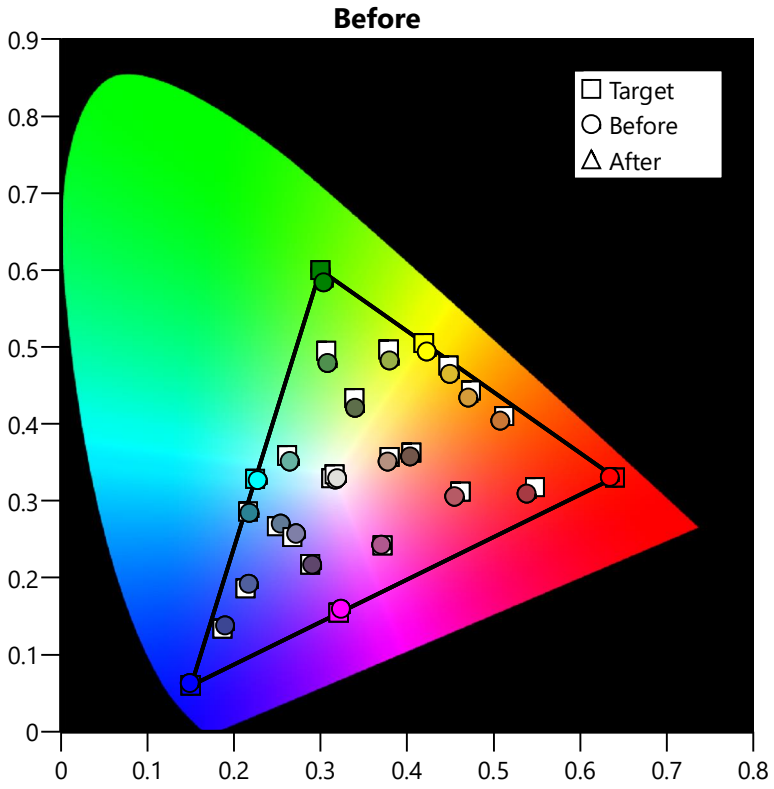

0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
0.6

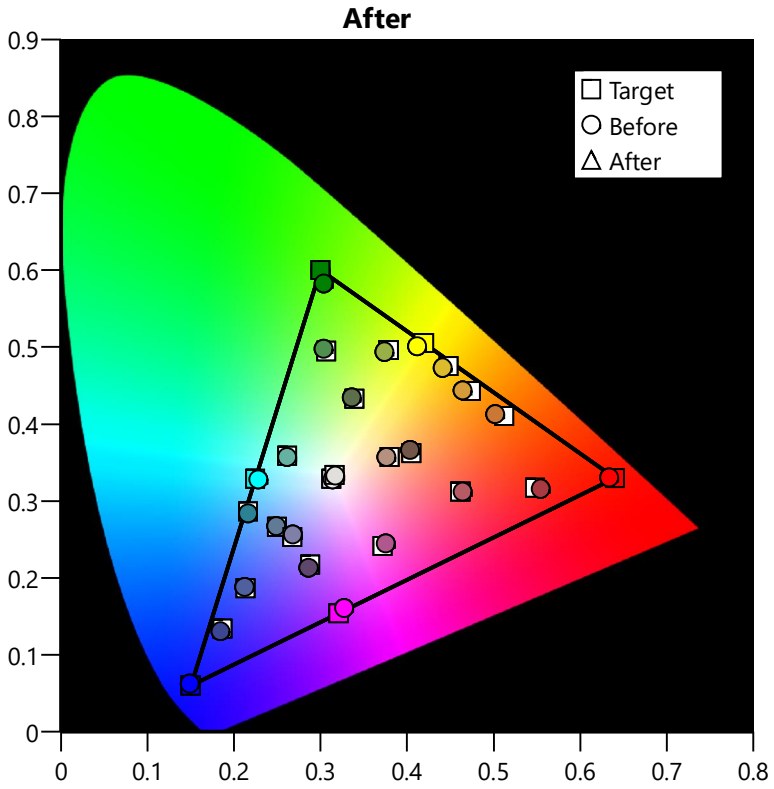

40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
-30%
-35%
-40%
% Error
Color


40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
-30%
-35%
-40%
% Error
Color

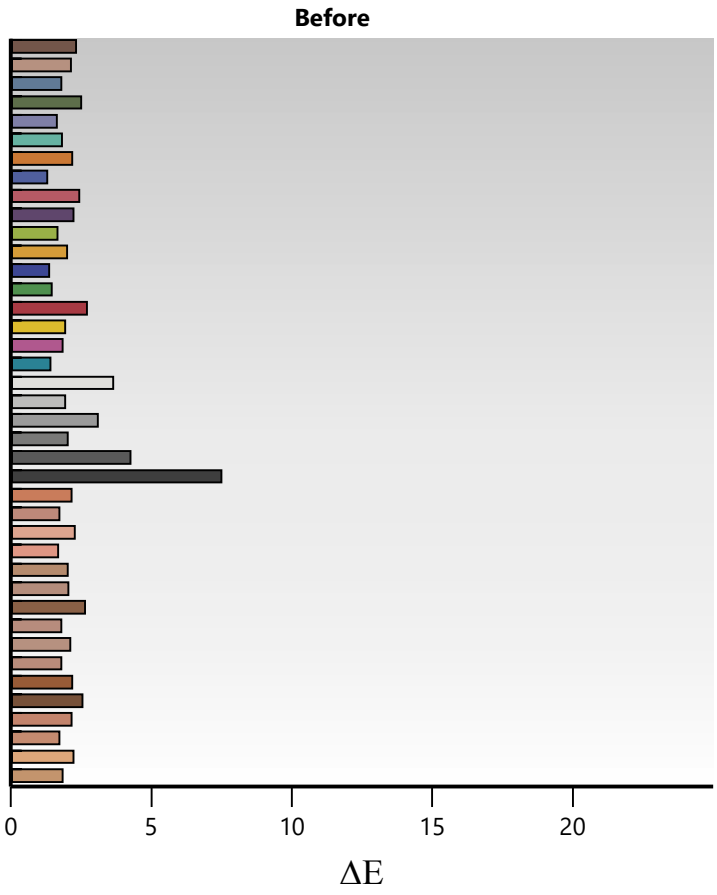
## ColorChecker

The ColorChecker evaluates the real-world color performance of the display by measuring the accuracy of ordinary colors found in the natural world. It includes 24 natural colors plus 16 extra colors that sample a variety of human skin tones. These are important because human vision is especially sensitive to inaccurate skin tone reproduction.



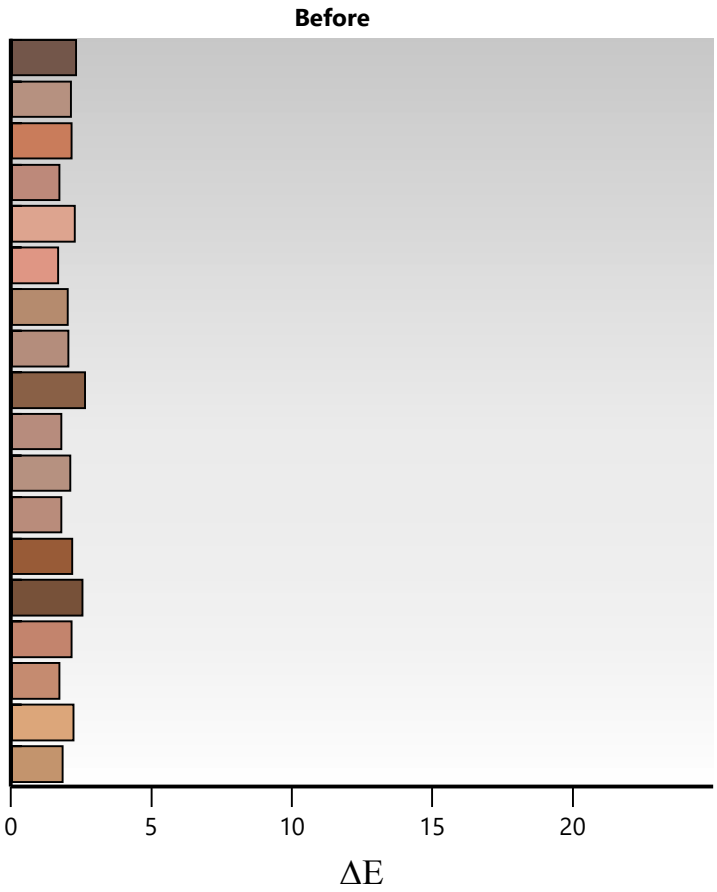



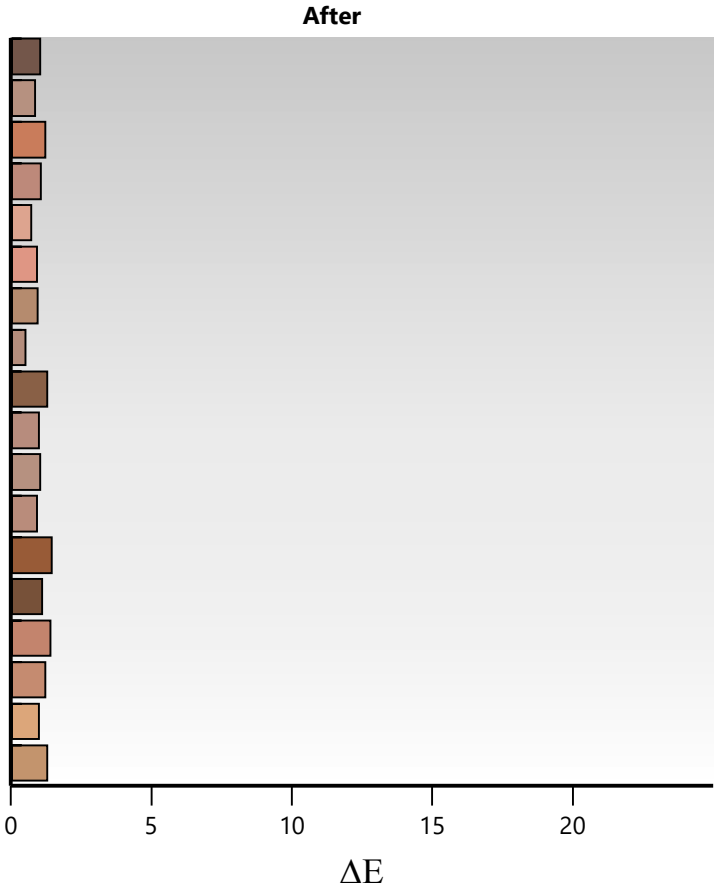
## ColorChecker ΔE Performance




| Color | ΔE Before | ΔE After |
|---|---|---|
| Dark skin | 2.4 | 1.1 |
| Light skin | 2.2 | 0.9 |
| Blue sky | 1.8 | 0.7 |
| Foliage | 2.5 | 1.0 |
| Blue flower | 1.7 | 1.0 |
| Bluish green | 1.9 | 0.5 |
| Orange | 2.2 | 1.8 |
| Purplish blue | 1.3 | 0.7 |
| Moderate red | 2.5 | 0.3 |
| Purple | 2.3 | 0.7 |
| Yellow green | 1.7 | 0.9 |
| Orange yellow | 2.0 | 1.9 |
| Blue* | 1.4 | 0.5 |
| Green* | 1.5 | 0.7 |
| Red* | 2.7 | 0.6 |
| Yellow* | 2.0 | 2.2 |
| Magenta* | 1.9 | 0.7 |
| Cyan* | 1.4 | 1.1 |
| White* | 3.7 | 1.1 |
| Neutral 8 | 2.0 | 0.8 |
| Neutral 6.5 | 3.1 | 0.2 |
| Neutral 5 | 2.1 | 0.8 |
| Neutral 3.5 | 4.3 | 1.6 |
| Black | 7.5 | 1.4 |
| D7 | 2.2 | 1.3 |
| D8 | 1.8 | 1.1 |
| E7 | 2.3 | 0.8 |
| E8 | 1.7 | 1.0 |
| F7 | 2.1 | 1.0 |
| F8 | 2.1 | 0.6 |
| G7 | 2.7 | 1.3 |
| G8 | 1.8 | 1.0 |
| H7 | 2.2 | 1.1 |
| H8 | 1.8 | 1.0 |
| I7 | 2.2 | 1.5 |
| I8 | 2.6 | 1.2 |
| J7 | 2.2 | 1.4 |
| J8 | 1.8 | 1.3 |
| CP-Light | 2.3 | 1.0 |
| CP-Dark | 1.9 | 1.3 |
| **Mean** | **2.3** | **1.0** |

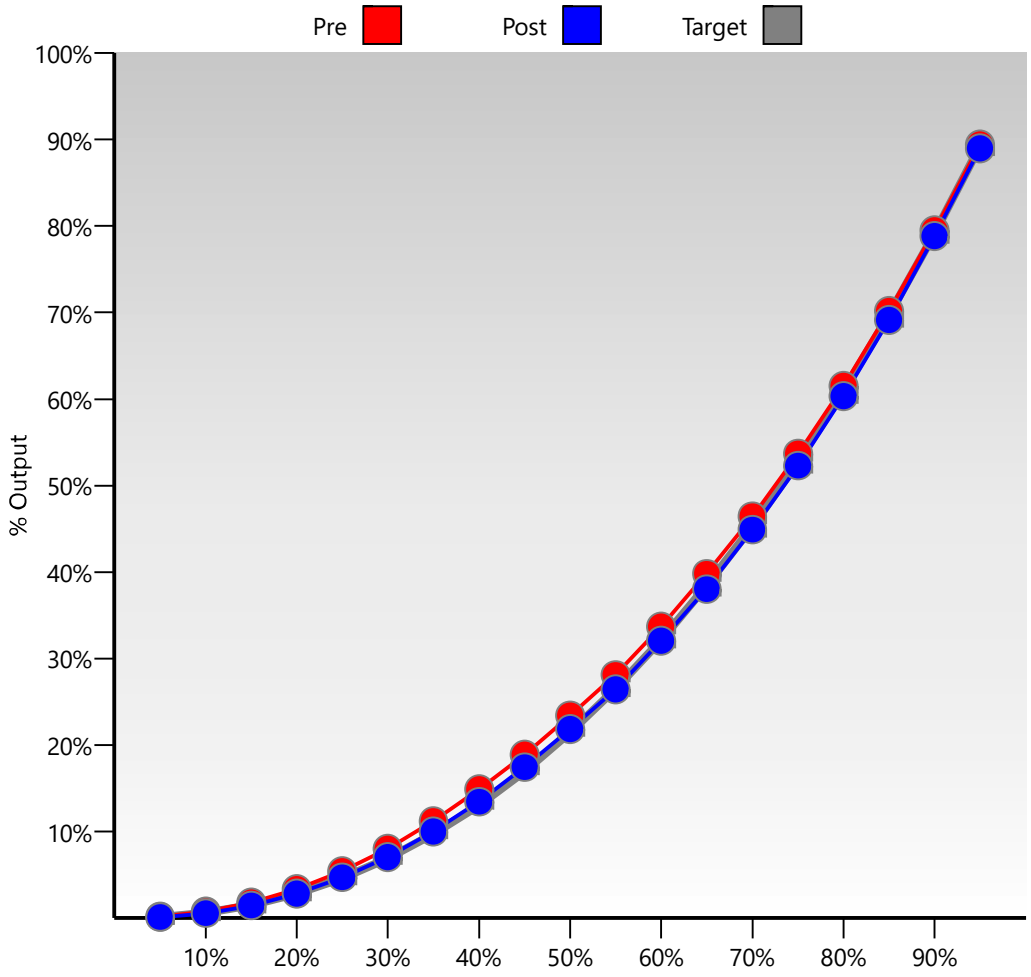
## ColorChecker Skin Tones ΔE Performance




| Color | ΔE Before | ΔE After |
|---|---|---|
| Dark skin | 2.4 | 1.1 |
| Light skin | 2.2 | 0.9 |
| D7 | 2.2 | 1.3 |
| D8 | 1.8 | 1.1 |
| E7 | 2.3 | 0.8 |
| E8 | 1.7 | 1.0 |
| F7 | 2.1 | 1.0 |
| F8 | 2.1 | 0.6 |
| G7 | 2.7 | 1.3 |
| G8 | 1.8 | 1.0 |
| H7 | 2.2 | 1.1 |
| H8 | 1.8 | 1.0 |
| I7 | 2.2 | 1.5 |
| I8 | 2.6 | 1.2 |
| J7 | 2.2 | 1.4 |
| J8 | 1.8 | 1.3 |
| CP-Light | 2.3 | 1.0 |
| CP-Dark | 1.9 | 1.3 |
| **Mean** | **2.1** | **1.1** |

## Gamma Output

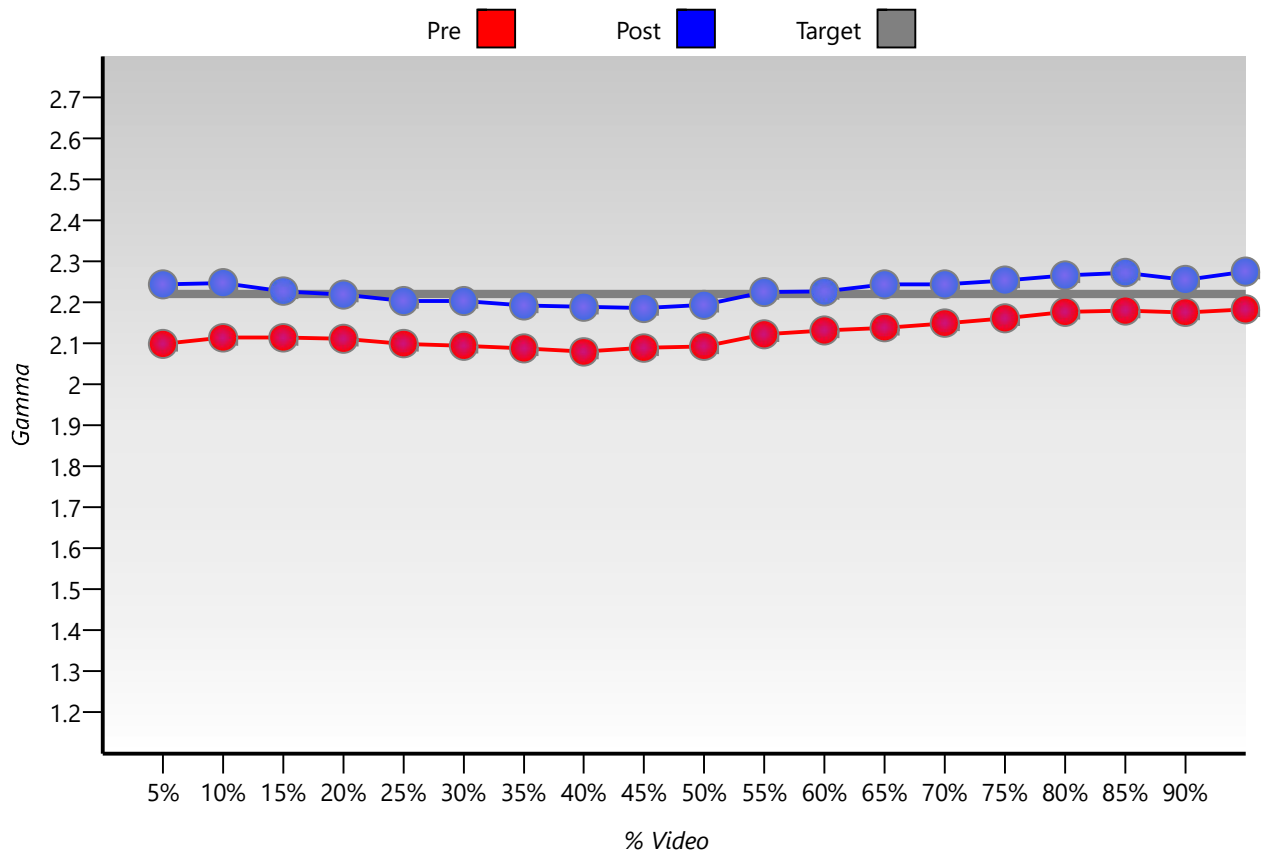



| | Before | | | After | | |
|---|---|---|---|---|---|---|
| | **Output** | **Gamma** | **Video** | **Output** | **Gamma** | **Video** |
| **0%** | | | 0.0119 | | | 0.0133 |
| **5%** | 0.12 (0.2%) | 2.10 | | 0.07 (0.1%) | 2.24 | |
| **10%** | 0.48 (0.8%) | 2.11 | | 0.33 (0.6%) | 2.25 | |
| **20%** | 2.09 (3.3%) | 2.11 | | 1.66 (2.8%) | 2.22 | |
| **30%** | 5.03 (8.0%) | 2.09 | | 4.15 (7.0%) | 2.20 | |
| **40%** | 9.30 (14.9%) | 2.08 | | 7.92 (13.5%) | 2.19 | |
| **50%** | 14.66 (23.4%) | 2.09 | | 12.87 (21.9%) | 2.19 | |
| **60%** | 21.05 (33.7%) | 2.13 | | 18.88 (32.1%) | 2.23 | |
| **70%** | 29.05 (46.5%) | 2.15 | | 26.44 (44.9%) | 2.24 | |
| **80%** | 38.47 (61.5%) | 2.18 | | 35.51 (60.3%) | 2.27 | |
| **90%** | 49.72 (79.5%) | 2.18 | | 46.42 (78.8%) | 2.26 | |
| **100%** | 62.54 (100.0%) | 0 | 62.5 | 58.88 (100.0%) | 0 | 58.9 |
| | **Mean:** | **2.13** | | **2.23** | | |
| | **Contrast:** | | **5236** | | | **4430** |

## Gamma

Gamma describes the rate at which video output increases with signal input. This is not a a one-to-one relationship. If gamma is too high, the image will darken and shadow detail will suffer. If gamma is too low, contrast and depth suffer.

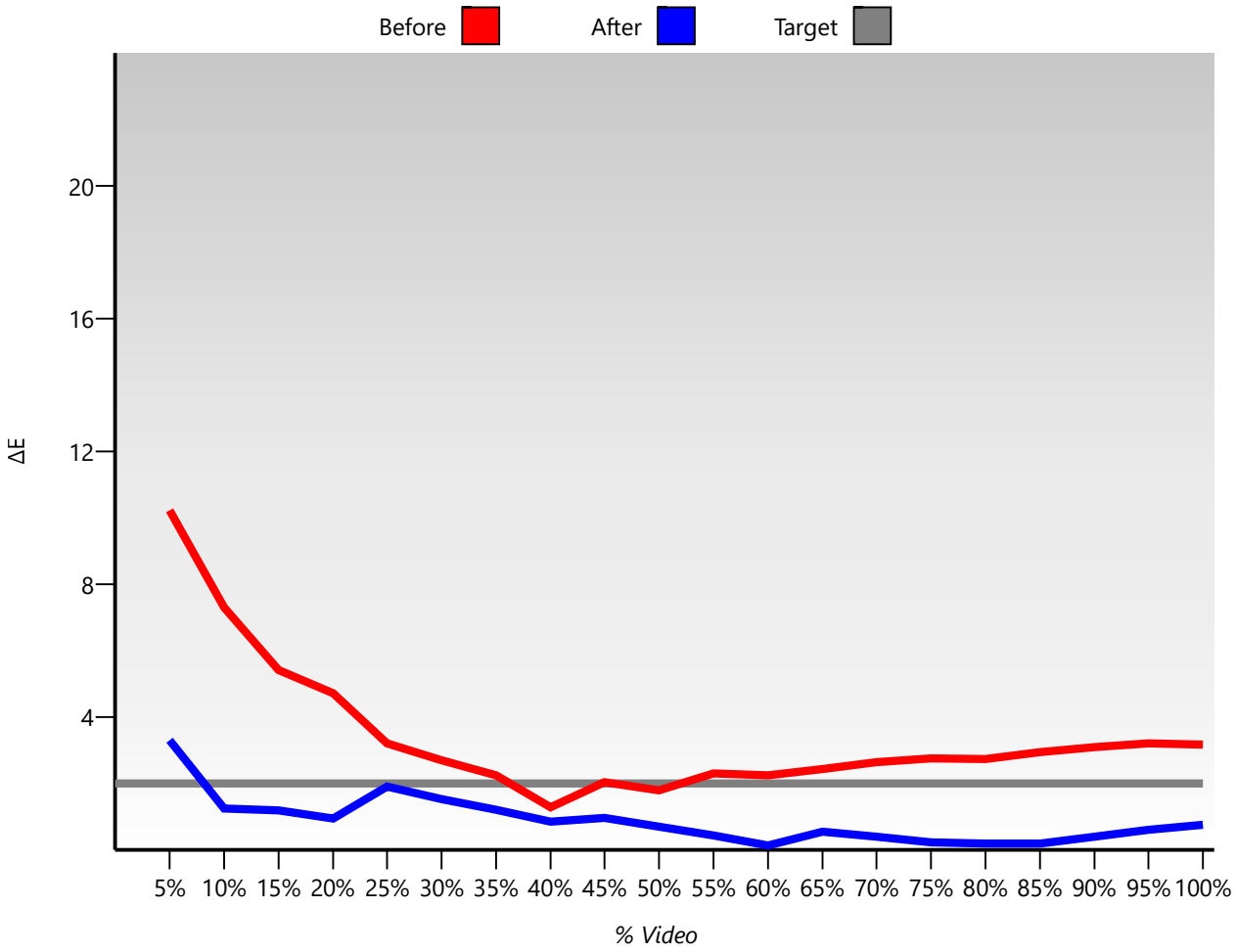
Luminance: cdm2 Target Gamma: 2.22




| | Before | | | After | | |
|---|---|---|---|---|---|---|
| | **Output** | **Gamma** | **Video** | **Output** | **Gamma** | **Video** |
| **0%** | | | 0.0119 | | | 0.0133 |
| **10%** | 0.48 (0.8%) | 2.11 | | 0.33 (0.6%) | 2.25 | |
| **20%** | 2.09 (3.3%) | 2.11 | | 1.66 (2.8%) | 2.22 | |
| **30%** | 5.03 (8.0%) | 2.09 | | 4.15 (7.0%) | 2.20 | |
| **40%** | 9.30 (14.9%) | 2.08 | | 7.92 (13.5%) | 2.19 | |
| **50%** | 14.66 (23.4%) | 2.09 | | 12.87 (21.9%) | 2.19 | |
| **60%** | 21.05 (33.7%) | 2.13 | | 18.88 (32.1%) | 2.23 | |
| **70%** | 29.05 (46.5%) | 2.15 | | 26.44 (44.9%) | 2.24 | |
| **80%** | 38.47 (61.5%) | 2.18 | | 35.51 (60.3%) | 2.27 | |
| **90%** | 49.72 (79.5%) | 2.18 | | 46.42 (78.8%) | 2.26 | |
| **100%** | 62.54 (100.0%) | 0 | 62.5 | 58.88 (100.0%) | 0 | 58.9 |
| | **Mean:** | **2.13** | | **2.23** | | |
| | **Contrast:** | | **5236** | | | **4430** |

## Grayscale ΔE Chart

This chart displays the color of white across the entire grayscale in raw xy data and Delta-E. White is defined as x0.3127, y0.3290. Delta E (dE or ΔE) measures deviation from a color standard. The smaller the number, the less the deviation from the standard and the more accurate the color. Ideally, ΔE for white should not rise above 2.

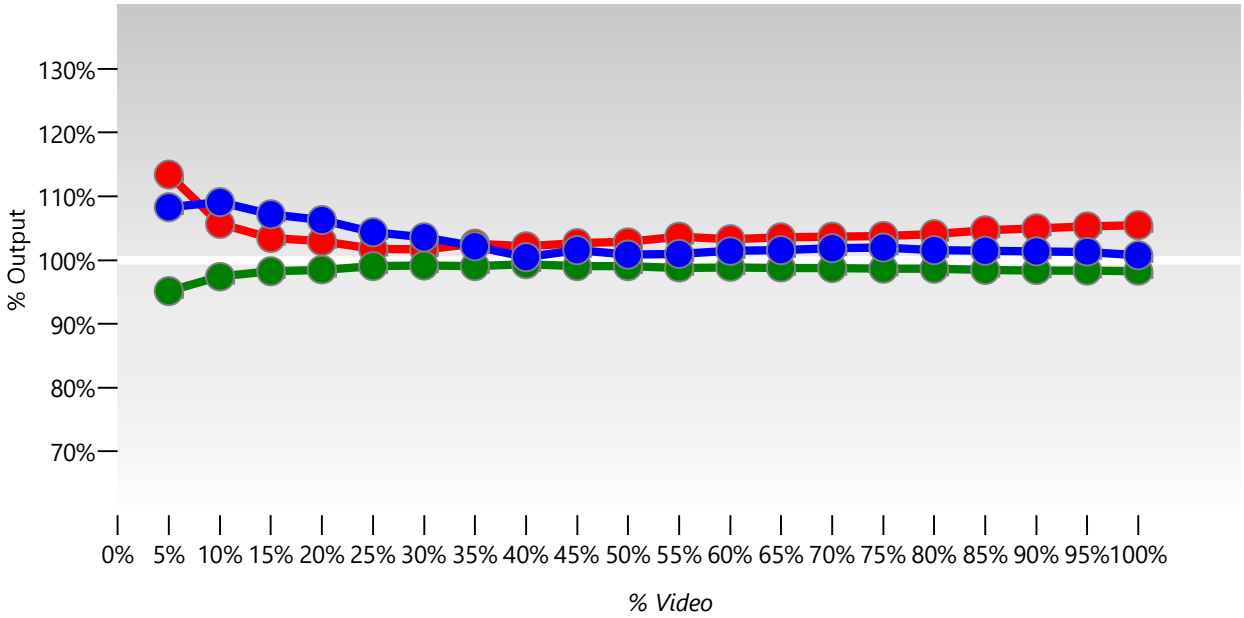



| | Before | | | After | | |
|---|---|---|---|---|---|---|
| | x, y | ΔE | CCT | x, y | ΔE | CCT |
| **5%** | 0.317, 0.316 | 10.2 | 6,370 | 0.317, 0.335 | 3.3 | 6,247 |
| **10%** | 0.311, 0.317 | 7.3 | 6,707 | 0.312, 0.327 | 1.2 | 6,554 |
| **20%** | 0.311, 0.321 | 4.7 | 6,675 | 0.311, 0.328 | 0.9 | 6,621 |
| **30%** | 0.312, 0.324 | 2.7 | 6,599 | 0.310, 0.328 | 1.5 | 6,683 |
| **40%** | 0.314, 0.328 | 1.3 | 6,445 | 0.311, 0.329 | 0.8 | 6,572 |
| **50%** | 0.314, 0.327 | 1.8 | 6,438 | 0.311, 0.329 | 0.7 | 6,572 |
| **60%** | 0.314, 0.326 | 2.2 | 6,446 | 0.312, 0.329 | 0.1 | 6,518 |
| **70%** | 0.314, 0.326 | 2.6 | 6,448 | 0.312, 0.328 | 0.4 | 6,529 |
| **80%** | 0.315, 0.326 | 2.7 | 6,423 | 0.313, 0.329 | 0.2 | 6,514 |
| **90%** | 0.315, 0.326 | 3.1 | 6,383 | 0.314, 0.329 | 0.4 | 6,458 |
| **100%** | 0.316, 0.326 | 3.2 | 6,337 | 0.314, 0.329 | 0.7 | 6,434 |
| **Mean:** | | **3.8** | **6,479** | | **0.9** | **6,518** |

## RGB Line Chart

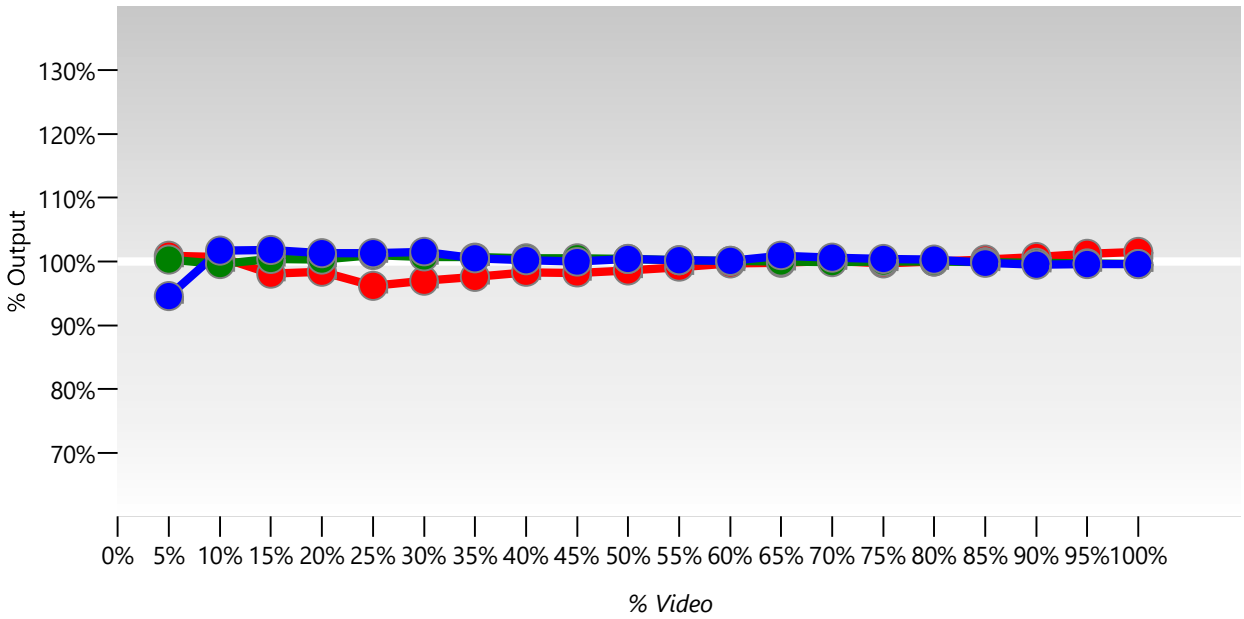
This chart also displays gray scale performance, but breaks out the contributions of red, green, and blue. Ideally, all three colors should be within +- 4% from 100% across the entire range.

**Before**




| | 5% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R** | 113.4% | 105.6% | 103.0% | 101.7% | 102.1% | 102.8% | 103.3% | 103.7% | 104.1% | 105.0% | 105.5% | 104.6% |
| **G** | 95.2% | 97.4% | 98.5% | 99.1% | 99.3% | 99.1% | 98.9% | 98.7% | 98.6% | 98.4% | 98.3% | 103.2% |
| **B** | 108.3% | 109.1% | 106.3% | 103.6% | 100.4% | 100.9% | 101.4% | 101.8% | 101.6% | 101.4% | 100.8% | 103.2% |

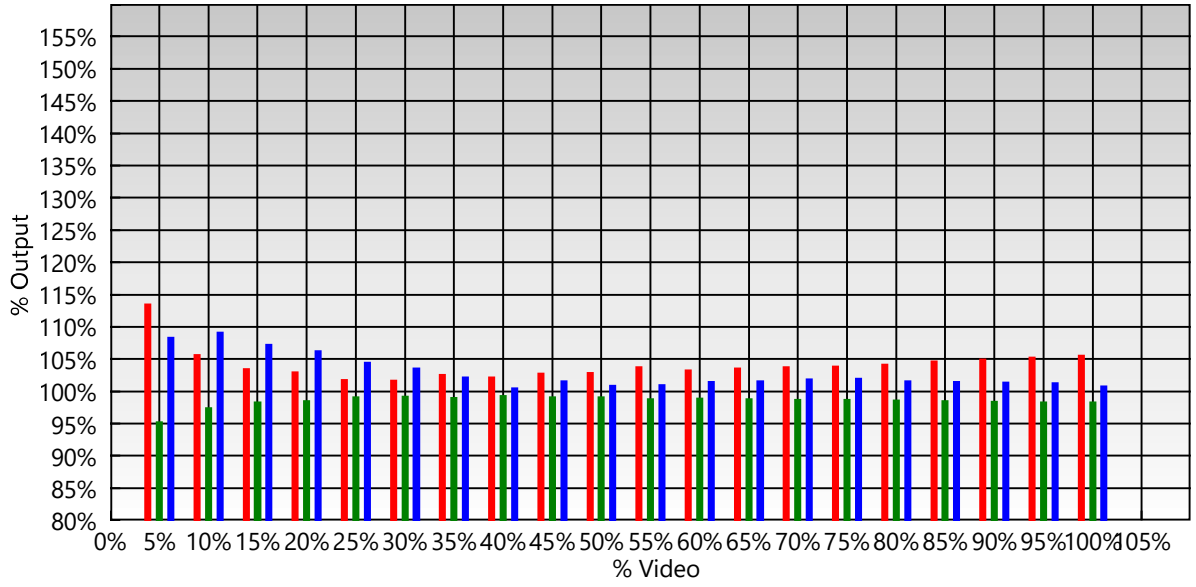
**After**



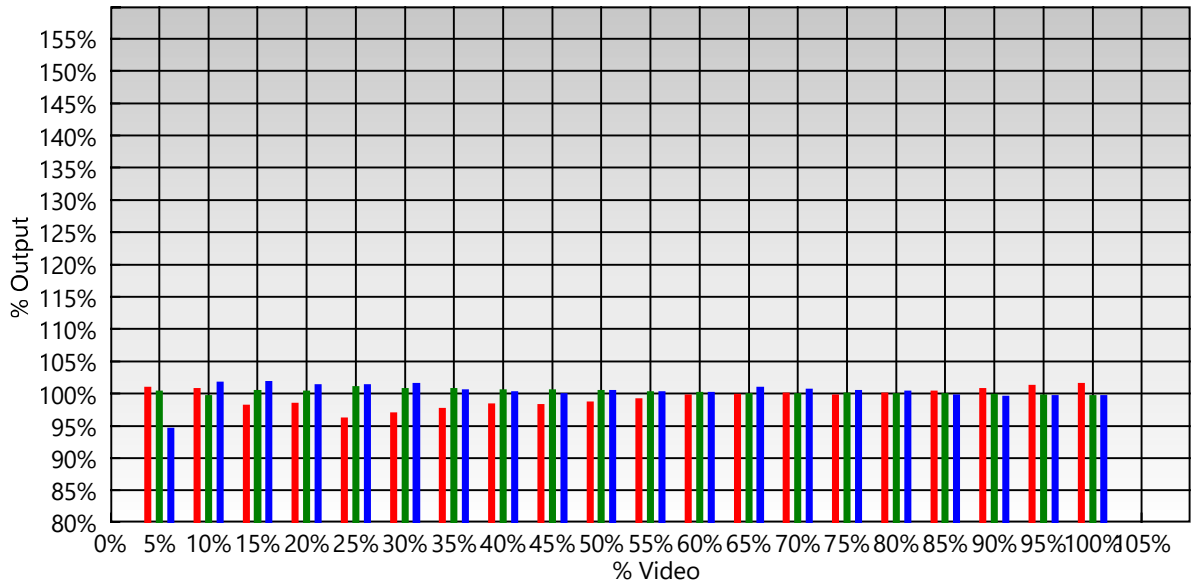

| | 5% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R** | 100.9% | 100.7% | 98.4% | 97.0% | 98.3% | 98.6% | 99.7% | 100.1% | 100.0% | 100.7% | 101.5% | 99.6% |
| **G** | 100.3% | 99.6% | 100.3% | 100.7% | 100.5% | 100.4% | 100.1% | 99.9% | 100.0% | 99.8% | 99.6% | 100.0% |
| **B** | 94.6% | 101.7% | 101.3% | 101.5% | 100.2% | 100.4% | 100.1% | 100.6% | 100.3% | 99.5% | 99.6% | 100.0% |

## RGB Bar Chart

This chart also displays gray scale performance, but breaks out the contributions of red, green, and blue. Ideally, all three colors should equal at 100% + - 4% across the entire range.



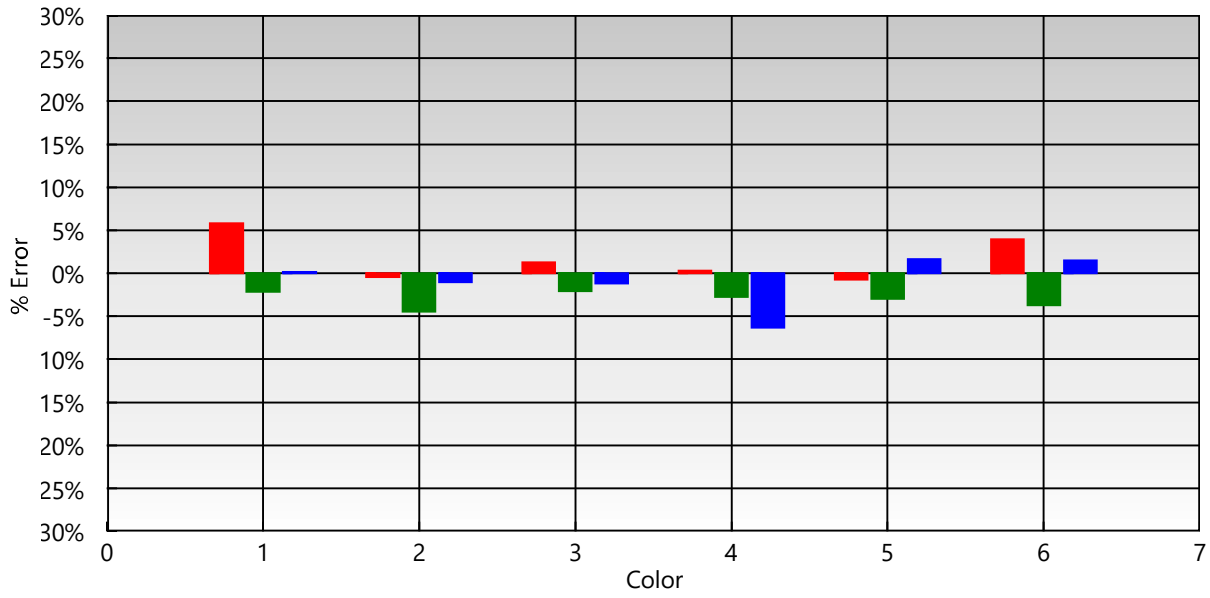

| | 5% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R** | 113.4% | 105.6% | 103.0% | 101.7% | 102.1% | 102.8% | 103.3% | 103.7% | 104.1% | 105.0% | 105.5% | 104.6% |
| **G** | 95.2% | 97.4% | 98.5% | 99.1% | 99.3% | 99.1% | 98.9% | 98.7% | 98.6% | 98.4% | 98.3% | 103.2% |
| **B** | 108.3% | 109.1% | 106.3% | 103.6% | 100.4% | 100.9% | 101.4% | 101.8% | 101.6% | 101.4% | 100.8% | 103.2% |



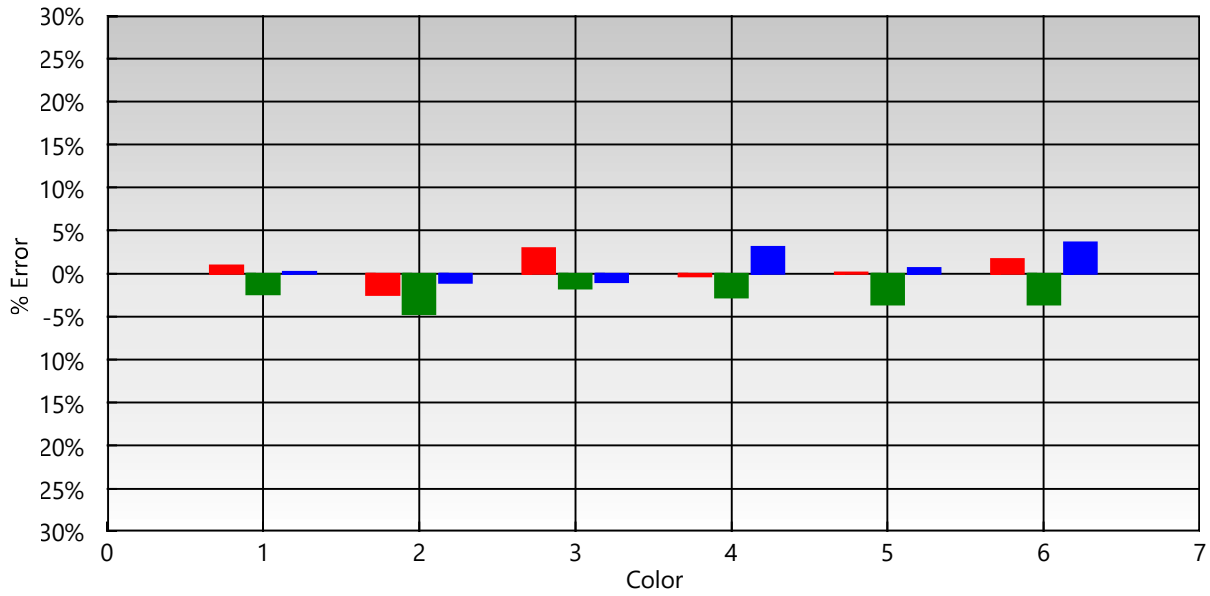

| | 5% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R** | 100.9% | 100.7% | 98.4% | 97.0% | 98.3% | 98.6% | 99.7% | 100.1% | 100.0% | 100.7% | 101.5% | 99.6% |
| **G** | 100.3% | 99.6% | 100.3% | 100.7% | 100.5% | 100.4% | 100.1% | 99.9% | 100.0% | 99.8% | 99.6% | 100.0% |
| **B** | 94.6% | 101.7% | 101.3% | 101.5% | 100.2% | 100.4% | 100.1% | 100.6% | 100.3% | 99.5% | 99.6% | 100.0% |

## Primary/Secondary Colors Hue, Saturation, and Lightness Error

These charts display the before/after color errors of the primary/secondary colors in terms of the three visible components of color: Hue, Saturation, and Lightness (HSL). Ideally, all primary and secondary colors should have no more than 2% error in any component.



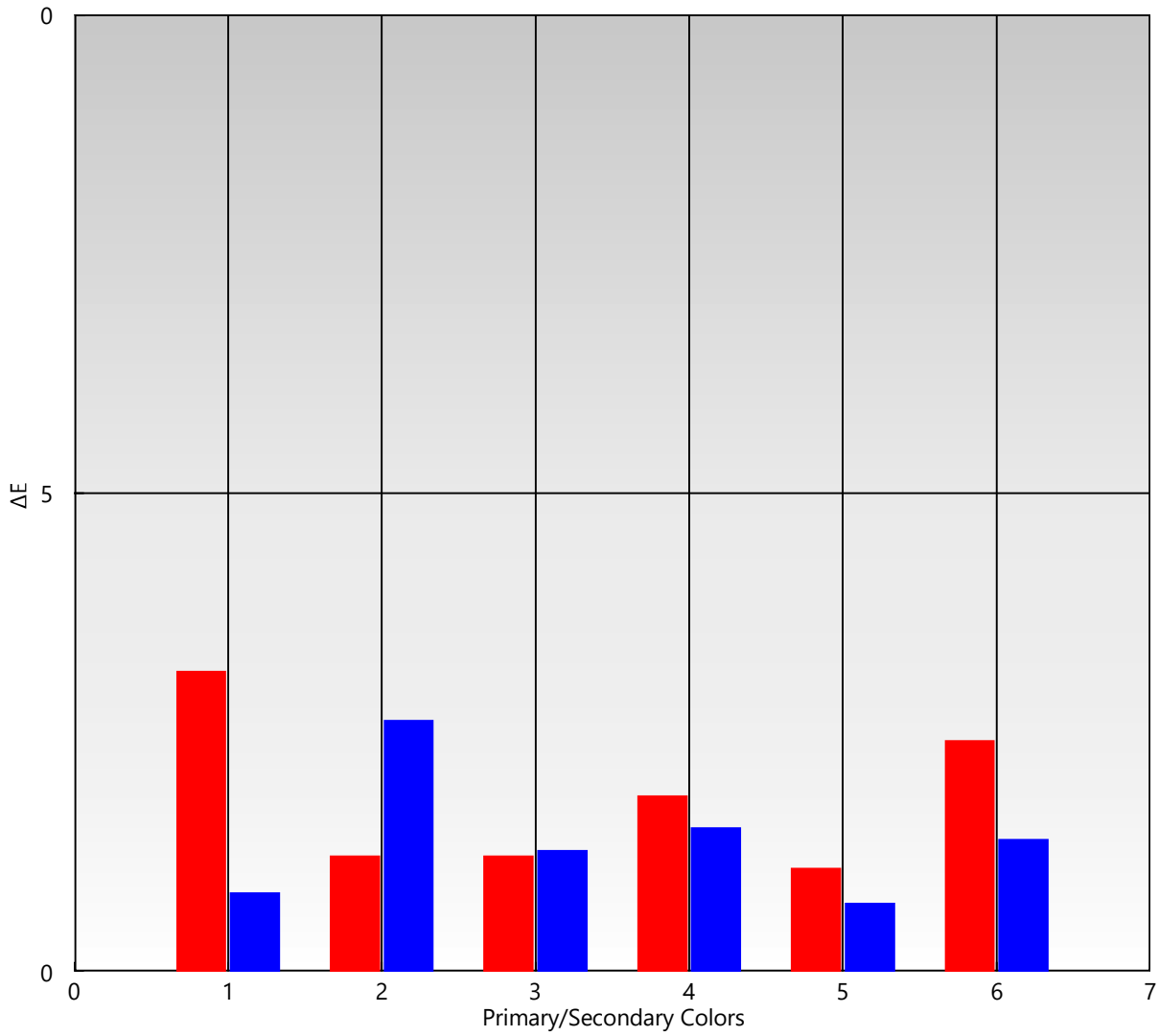

| | Red | Green | Blue | Yellow | Cyan | Magenta |
|---|---|---|---|---|---|---|
| **Lightness** | 5.8% | -0.5% | 1.3% | 0.3% | -0.7% | 4.0% |
| **Saturation** | -2.2% | -4.5% | -2.1% | -2.7% | -3.0% | -3.7% |
| **Hue** | 0.2% | -1.1% | -1.2% | -6.3% | 1.6% | 1.5% |




| | Red | Green | Blue | Yellow | Cyan | Magenta |
|---|---|---|---|---|---|---|
| **Lightness** | 0.9% | -2.5% | 2.9% | -0.3% | 0.1% | 1.6% |
| **Saturation** | -2.4% | -4.7% | -1.7% | -2.8% | -3.6% | -3.6% |
| **Hue** | 0.2% | -1.1% | -1.0% | 3.1% | 0.7% | 3.6% |

## Primary/Secondary Colors dE Performance

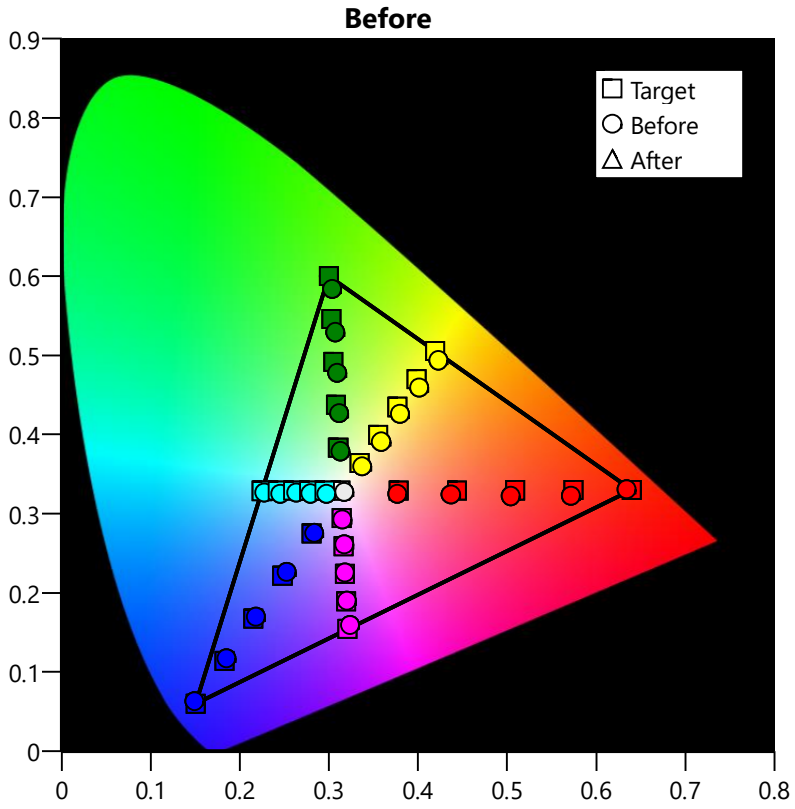
The data below below shows the display's ability to accurately reproduce color as defined by the selected color difference model in ΔE units. CIE94 or CIEDE2000 should be 1.5 or less.

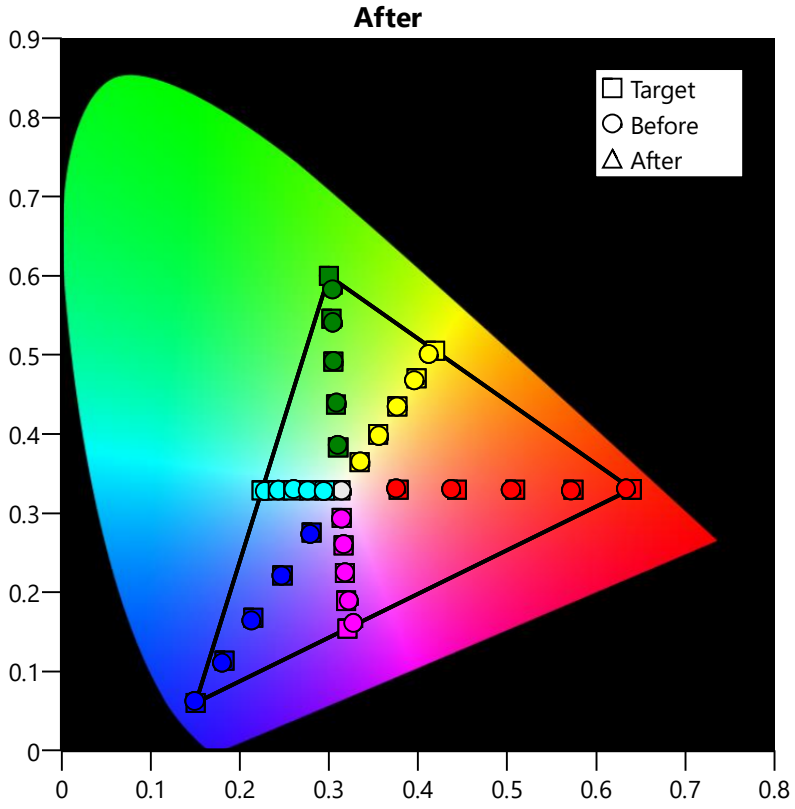



| | Reference | Before | | After | |
|---|---|---|---|---|---|
| | xyY | xyY | ΔE | xyY | ΔE |
| **Red** | 0.6400, 0.3300, 0.2127 | 0.6342, 0.3306, 0.2423 | 3.1 | 0.6337, 0.3308, 0.2172 | 0.8 |
| **Green** | 0.3000, 0.6000, 0.7152 | 0.3037, 0.5838, 0.7066 | 1.2 | 0.3038, 0.5828, 0.6715 | 2.6 |
| **Blue** | 0.1500, 0.0600, 0.0722 | 0.1490, 0.0633, 0.0741 | 1.2 | 0.1491, 0.0628, 0.0765 | 1.3 |
| **Yellow** | 0.4193, 0.5052, 0.9278 | 0.4226, 0.4938, 0.9348 | 1.8 | 0.4117, 0.5011, 0.9198 | 1.5 |
| **Cyan** | 0.2247, 0.3288, 0.7873 | 0.2270, 0.3271, 0.7731 | 1.1 | 0.2278, 0.3281, 0.7900 | 0.7 |
| **Magenta** | 0.3209, 0.1542, 0.2848 | 0.3235, 0.1596, 0.3124 | 2.4 | 0.3274, 0.1610, 0.2961 | 1.4 |
| **White** | 0.3127, 0.3290, 1.0000 | 0.3167, 0.3274, 63.0430 | 3.0 | 0.3138, 0.3284, 58.8854 | 0.9 |
| | | **Mean:** | **2.0** | **Mean:** | **1.3** |

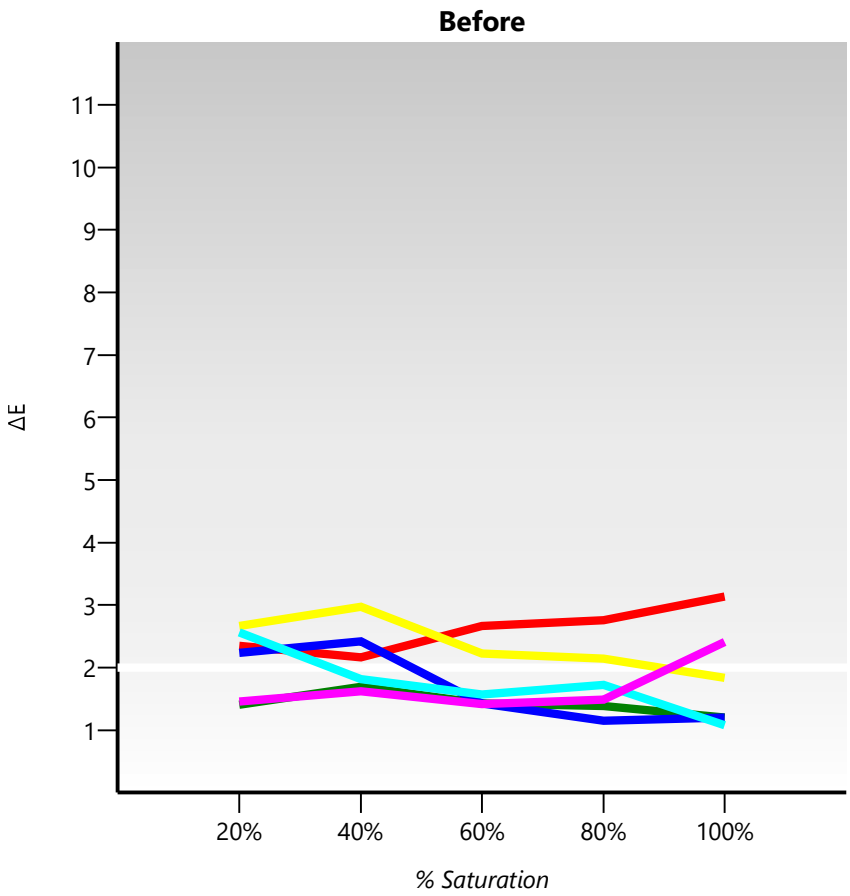
## Color Saturations

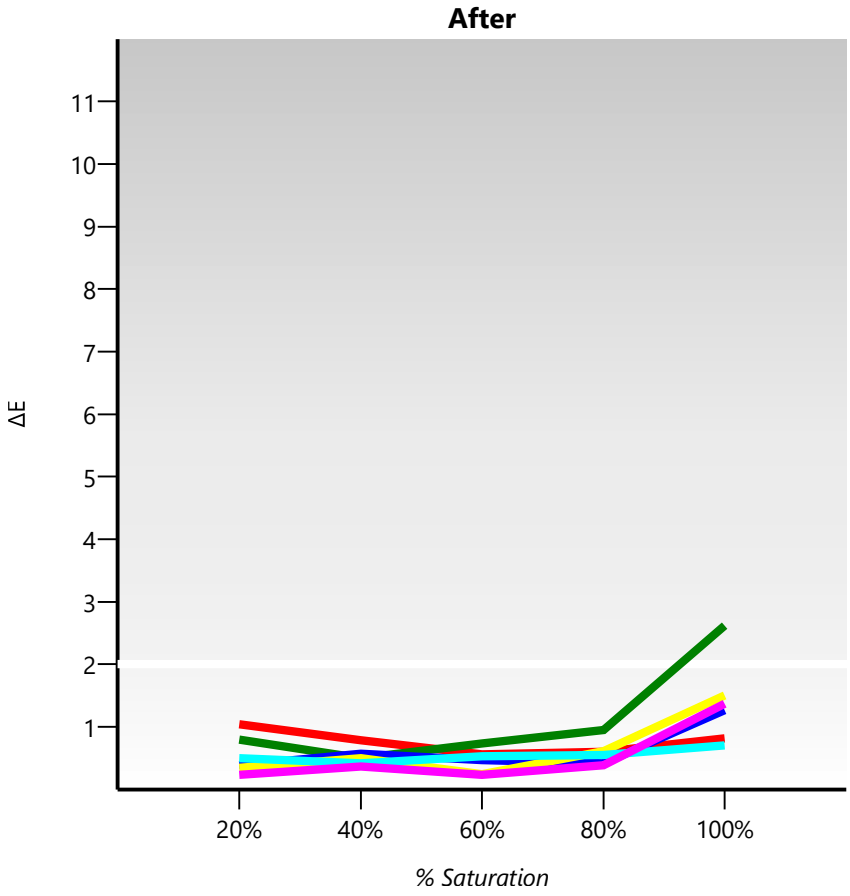
This shows the ability of the display to reproduce color accurately throughout the entire gamut, rather than just at the gamut boundary.



## Saturations ΔE




| Color | ΔE Before | ΔE After |
|---|---|---|
| Red | 3.1 | 0.8 |
| Green | 1.2 | 2.6 |
| Blue | 1.2 | 1.3 |
| Yellow | 1.8 | 1.5 |
| Cyan | 1.1 | 0.7 |
| Magenta | 2.4 | 1.4 |
| Red 80% | 2.8 | 0.6 |
| Red 60% | 2.7 | 0.6 |
| Red 40% | 2.2 | 0.8 |
| Red 20% | 2.3 | 1.0 |
| Green 80% | 1.4 | 0.9 |
| Green 60% | 1.4 | 0.7 |
| Green 40% | 1.7 | 0.5 |
| Green 20% | 1.4 | 0.8 |
| Blue 80% | 1.2 | 0.4 |
| Blue 60% | 1.4 | 0.5 |
| Blue 40% | 2.4 | 0.6 |
| Blue 20% | 2.2 | 0.4 |
| Yellow 80% | 2.1 | 0.6 |
| Yellow 60% | 2.2 | 0.2 |
| Yellow 40% | 3.0 | 0.5 |
| Yellow 20% | 2.7 | 0.3 |
| Cyan 80% | 1.7 | 0.5 |
| Cyan 60% | 1.6 | 0.5 |
| Cyan 40% | 1.8 | 0.4 |
| Cyan 20% | 2.6 | 0.5 |
| Magenta 80% | 1.5 | 0.4 |
| Magenta 60% | 1.4 | 0.2 |
| Magenta 40% | 1.6 | 0.4 |
| Magenta 20% | 1.5 | 0.2 |
| **Mean** | **1.9** | **0.7** |