

Key to Individual Reports in the Color & Appearance Program

- Lab Code** - A permanent laboratory identification number used to maintain information on a confidential basis.
- WebCode** - A temporary assigned laboratory identification number used to ensure lab confidentiality while permitting a lab to locate its data in the Summary Report published on the CTS website www.collaborativetesting.com. The WebCode will be unique for each analysis and cycle.
- Lab Mean** - The average of the test determinations obtained by the participant.
- Grand Mean** - The average of the LAB MEANS for all included participants. Laboratories flagged with an X or an M (see DATA FLAG column) are excluded from the GRAND MEAN.
- Between-Lab Standard Deviation** - An indication of the precision of measurement between the laboratories. The greater the spread of the LAB MEANS about the GRAND MEAN, the larger the BETWEEN-LAB STANDARD DEVIATION (and vice versa).
- Comparative Performance Value (CPV)** - An indication of how well a laboratory's results agree with the other participants. The CPV is a ratio indicating the number of standard deviations from the GRAND MEAN. (CPV = [LAB MEAN - GRAND MEAN]/ BETWEEN-LAB STANDARD DEVIATION.) The closer a laboratory's COMPARATIVE PERFORMANCE VALUE is to zero, the more consistent its results are with the other participants' data (and vice versa).
- Data Flag** - DATA FLAGS are assigned based on the simultaneous analysis of both samples tested and one or more CPV's exceeded the critical limits. Refer to the following list for an explanation of each symbol:

<u>Data Flag</u>	<u>Statistically Included/Excluded</u>	<u>ACTION REQUIRED</u>
*	INCLUDED	CAUTION - review testing procedure and monitor future results. Results fall outside the drawn 95% ellipse but within a 99% ellipse that is calculated but not drawn. Labs flagged with an * do not typically receive a specific note regarding the flag. If this error is repeated in future rounds, however, a lab may need to stop and review its testing procedures. The initial dataflag is not cause for alarm.
X	EXCLUDED	STOP - immediate review of data and/or testing procedure is required. Results fall outside the 99% ellipse. See the specific note following the data for more information on why the data is excluded.
M	EXCLUDED	PROCEED - lab was unable to report data for at least one sample. However, a lab receiving two or more M flags for a test may need to stop and review its testing procedures.

- Action Items** - If your measurement performance differs from the other laboratories and is assigned an "X" Data Flag, CTS's color data analyst will then detail in an "Action Item" the reason(s) for the Data Flag.
- Individually-Highlighted Control Ellipse Plot** - For each laboratory, the LAB MEAN for the second sample (y-axis) is plotted against the LAB MEAN for the first sample (x-axis) with each point representing a laboratory. The horizontal and vertical cross-hairs are the GRAND MEANS for each sample. When 20 or more laboratories are included in the statistics, an ellipse is also drawn so that 95% of the time a randomly selected laboratory will be included inside the ellipse. Plotted data flags are explained above. Labs not receiving a data flag appear as points on the plot. Your location on any plot is highlighted, enabling you to quickly find your data.
- Historical Gloss Charts** - These charts show the CPVs of your Lab Means for a moving year. This chart graphically documents your on-going interlaboratory testing performance and can provide valuable information that is not apparent in a single analysis.

Features of your Performance Analysis Report (page 1 of 4)

Your Color & Appearance individual report is called the **Performance Analysis Report**. The Performance Analysis Report is designed to serve as the primary tool for evaluating your results for each test. It is focused entirely on providing you with an individualized assessment of your laboratory's measurement performance.

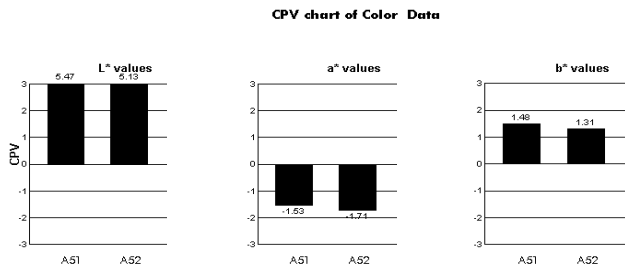
All of the charts and plots have been generated solely for your laboratory, and the data tables contain only data relevant to evaluating and understanding your performance.

If your laboratory's measurements are assigned **Data Flag**, your Performance Analysis Report will provide you with an "**Action Item**," indicating a potential problem.

This guide will walk you through the features of your Color & Appearance Performance Analysis Report.

Color & Color Difference Tests (Analysis 408 & Analysis 409)

Figure 1a



The first page shows your **CPV Chart of Color Data [Figure 1a]**.

This chart plots separately the CPVs for your CIE L*, CIE a* and CIE b* values for current cycle. It graphically shows your interlaboratory testing performance for two samples and can aid in interpreting current results. Do the CPVs show a consistent offset?

Immediately below the Chart an **Overall Analysis for Current Cycle** is shown.

•**Action Items** • If your measurement performance has been flagged in the two-sample analysis and your CPV results are greater than critical value for this test, an **Action Item** will be posted along with the analyst comments. Action Item appears in the Overall Analysis box only for the most current cycle.

Overall Analysis for Current cycle

WebCode:

Sample: A51 Main Color A52 Color Difference

Instrument: BYK-Gardner The Color Machine

Action Item! Your performance for this cycle was assigned an XData Flag. Analyst Comment: High "L*" values.

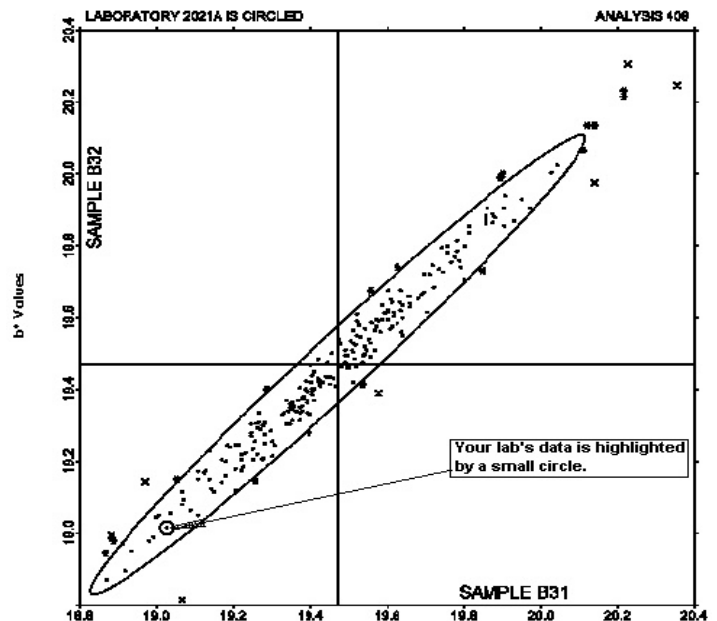
Consensus statistics based on 44 of 55 reporting participants

On the following 3 pages of this Report the individually drawn two sample plots show your data (highlighted by a circle) compare to all participants results.

The **Current Cycle** section of the Performance Analysis Report [Figure 1b] follows on the three pages (one page for each color space) after the CPV Charts. These pages contain the tables with your labs data and consensus results for three samples and **Individually-Highlighted Control Ellipse Plot**. In all three color spaces (CIE L*, CIE a* and CIE b*) we plot the Lab Means for the *Color matching sample* versus the *Main color sample*, the Grand Means for each sample and a control ellipse indicating 95% agreement with the consensus results. Your location on this plot is highlighted by a circle enabling you to quickly determine your location in relation to the other laboratories.

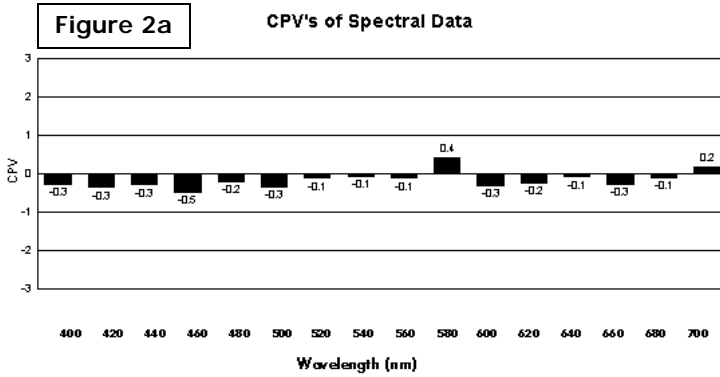
Figure 1b

		b* Values			db* Values		
Samples		Lab Mean [CPV]	Grand Me	Btwn lab SD	Lab Mean [CPV]	Grand Me	Btwn lab SD
Main Color	B31	19.03 [-1.70]	19.47	0.26			
Color Difference	B32	19.02 [-1.76]	19.47	0.26	-0.01 [-0.20]	0.00	0.05



Spectrophotometric Test (Analysis 411)

The Spectrophotometric Performance Analysis Report contains two distinct graphical presentations of the analysis conducted on laboratory's measurements. While the graphics present the same data, the CPV Chart and the Spectral Reflectance Plot enable you to fully evaluate your performance and allow greater insight into the Spectrophotometric Analysis.



The first page of the Performance Analysis Report shows your **Spectral Reflectance CPV Chart [Figure 2a]**. Your lab's CPV at each wavelength is shown as a bar. Immediately below the chart an **Overall Analysis for Current Cycle**, your data and consensus data for this cycle is shown.

Overall Analysis for this Cycle

WebCode:

Sample: C31

Instrument: X-Rite SP88

Data Flag Assigned: None. Your spectral reflectance data was consistent with the other laboratories.

Your Data for this Cycle

Spectrophotometric Reflectance values (as %) and CPV's at selected wavelengths

Lab	400	420	440	460	480	500	520	540	560	580	600	620	640	660	680	700
Mean	11.82	11.87	11.78	11.22	10.22	9.21	8.16	7.52	6.89	7.40	8.42	8.40	8.64	8.75	8.42	8.17
CPV	-0.26	-0.25	-0.29	-0.42	-0.20	-0.34	-0.11	-0.07	-0.11	0.41	-0.31	-0.23	-0.02	-0.27	-0.11	0.12

Summary Statistics

Grand Mean	400	420	440	460	480	500	520	540	560	580	600	620	640	660	680	700
Mean	11.82	11.91	11.21	11.27	10.26	9.24	8.17	7.54	6.91	7.27	8.45	8.42	8.65	8.77	8.44	8.16
STD	0.19	0.12	0.12	0.11	0.10	0.09	0.08	0.08	0.16	0.02	0.02	0.02	0.02	0.09	0.02	0.10

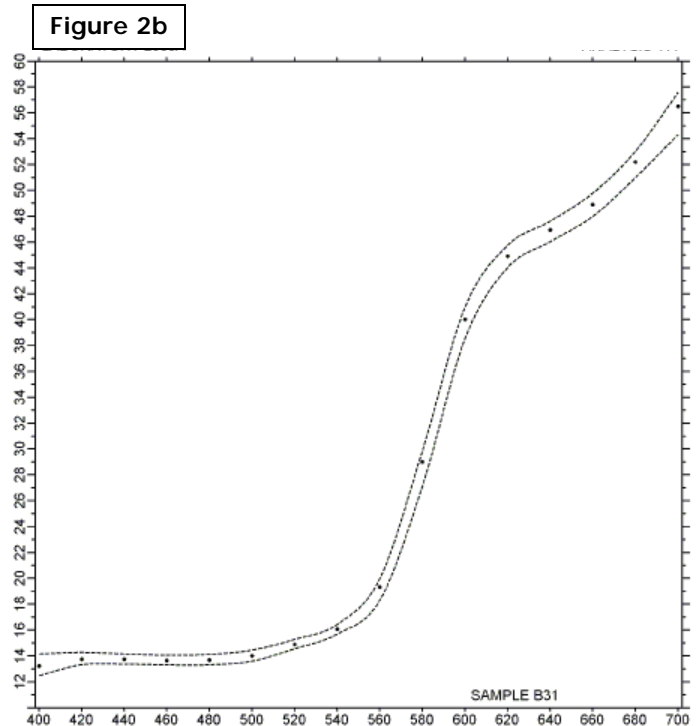
Consensus statistics based on 198 of 217 reporting participants

- **Action Items** • CPVs that exceed the critical limit, usually approximately +/- 2.77, will be indicated by an X Data Flag. If seven or more reflectance values are flagged, an overall X Data Flag is assigned and an Action Item will appear.

The reverse page of the Performance Analysis Report is wholly devoted to the **Individual Spectral Reflectance Plot [Figure 2b]**.

These individually drawn reflectance plots show your data as points at the 16 specified wavelengths and the consensus data as curves(*). The distance between the two curves represents the range of acceptable Lab Means at each wavelength. Data falling outside the range is assigned an X Data Flag and showed as an X on the plot.

* The upper and lower limit lines are interpolated between the 16 wavelengths and do not represent an actual spectrophotometric curve.



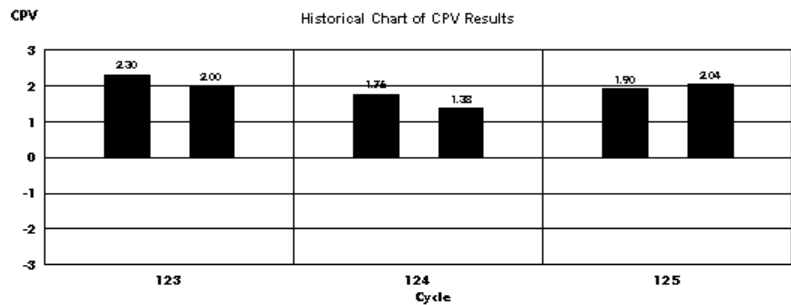
Specular Gloss Tests (Analysis 440 & Analysis 442)

The Specular Gloss Performance Analysis Report focuses on providing you with the ability to analyze your performance as a single event in the on-going interlaboratory program. The first page of each report is devoted solely to the Historical Chart and its supporting data. The stability evidenced in CTS's gloss tests provide a good opportunity to use interlaboratory comparisons as a predictive as well as a diagnostic tool.

The front page of the Performance Analysis Report for *Specular Gloss* shows your **Historical Chart [Figure 3a]** and a data table. The two CPVs from each cycle are plotted as bars over time, proceeding from data collected a year ago to the most current data. The most current data appears on the right of the Historical Chart and at the bottom of the data table. If measurement influencing factors (e.g. instrument, calibration procedure and laboratory conditions) are tightly controlled, users should see a good correlation between the performance over time.

• **Action Items** • X Data Flags are assigned when laboratories fall out of the 99% control limit. The "Action Item" will seek to classify what type of error was observed your lab's performance

Figure 3a

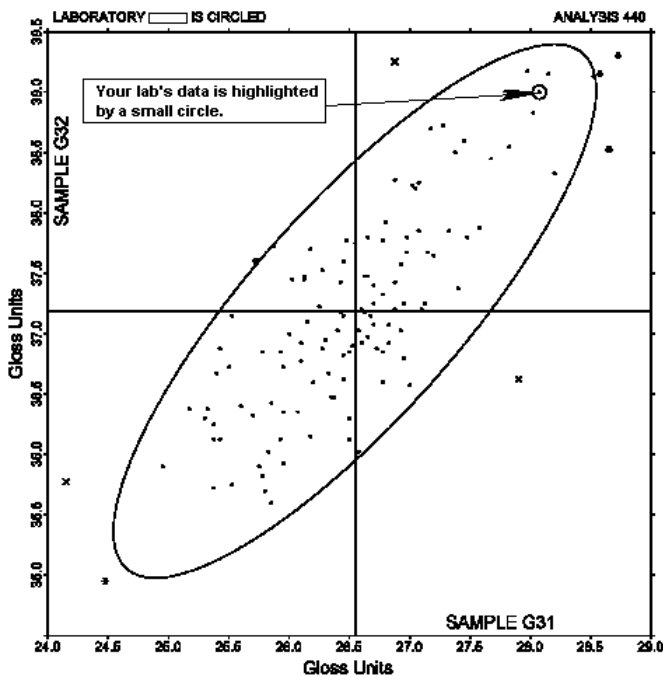


A maximum of 4 test cycles are printed on this page. If there are fewer sets of bars than the maximum and the laboratory was enrolled for all cycles, then one of the following situations occurred: lab did not submit data for a particular test/testing cycle or the data sheets were received late.

WebCode	Test Cycle	Sample Code	Lab Mean	Grand Mean	Between Lab Std Dev	CPV	Data Flag (if assigned)
Not used	123	E31	38.68	36.995	0.729	2.30	108 of 119 labs included
		E32	49.28	47.769	0.754	2.00	
[]	124	F31	54.13	51.883	1.271	1.76	113 of 118 labs included
		F32	64.13	62.089	1.480	1.38	
[]	125	G31	28.08	26.547	0.804	1.90	119 of 130 labs included
		G32	39.00	37.189	0.887	2.04	

Data Flag Assigned: None. Your data was consistent with the other laboratories.

Figure 3b



The reverse page of the Performance Analysis Report for *Specular Gloss* [Figure 3b] contains the table with your labs data and consensus results for both samples and **Individually-Highlighted Control Ellipse Plot.**

Your data, the point at the intersection of both Lab Means, is highlighted by a circle around your point. Use this highlighted point to quickly determine how your data compares to the other laboratories. The location of your data on the plot directly relates to both the assignment of a Data Flag and the content of any "Action Item."

WebCode	Data Flag	Sample G31			Sample G32		
		Lab Mean	Diff from Grand Mean	CPV	Lab Mean	Diff from Grand Mean	CPV
MWTC04		28.08	1.53	1.90	39.00	1.81	2.04

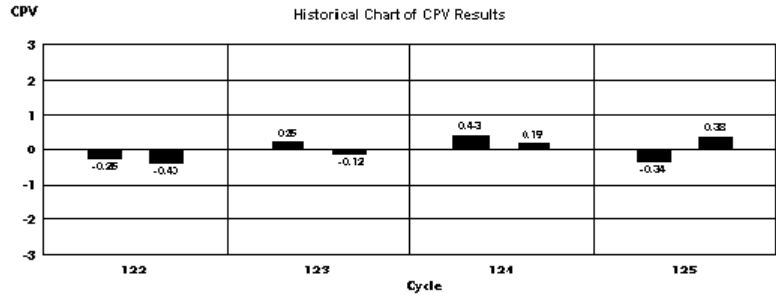
Consensus Results (all laboratories)			
Grand Means	26.547	Gloss Units	37.189
Between Lab Standard Deviation	0.804	Gloss Units	0.887

Consensus statistics based on 119 of 130 reporting participants

CTS uses the CPV ratio to allow for evaluation of measurement performance over time. Small differences in sample means and variation are not of critical importance when using the CPV to evaluate performance, so laboratory results can be compared from cycle to cycle, even though the samples used may be different. When comparing data among test cycles, remember that such comparisons may be limited if there have been changes to equipment, test procedures, or technicians. Despite these limitations and the long time span between the tests, labs that choose to maintain a constant approach to the interlaboratory program may find that the Historical Charts provide more than just additional data; the Historical Charts may have diagnostic and/or predictive value. The following examples illustrate how the information presented in the Performance Analysis Report could be interpreted.

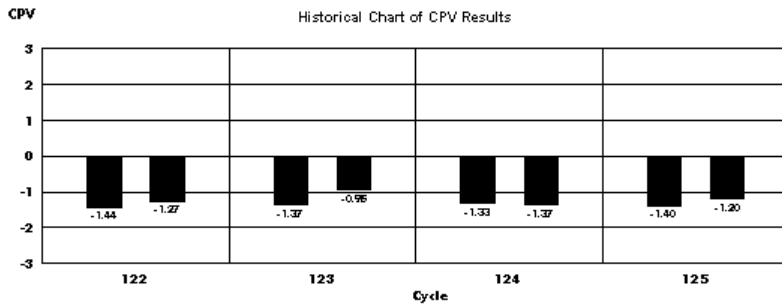
Consistency

The Gloss results are consistent from round to round showing only normal and acceptable flutter about the Grand Means, with all CPVs between -1.00 and +1.00. This should give the lab greater confidence in its Gloss measurements.



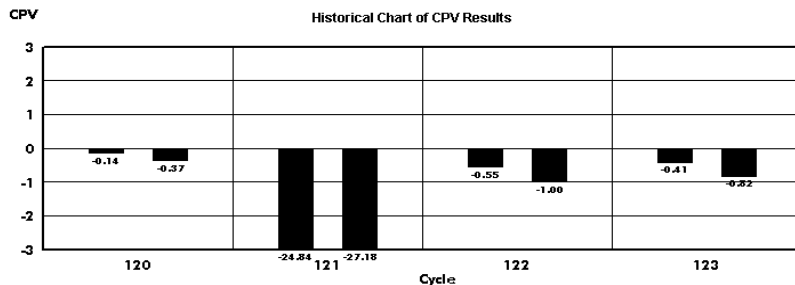
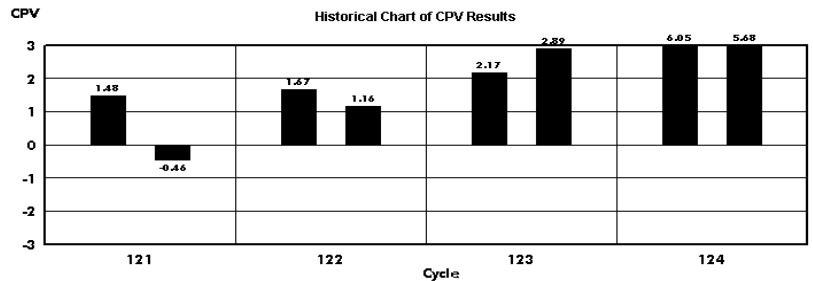
More Consistency

These results show a different type of consistency. The Gloss results from this laboratory are consistently lower than the Grand Mean, but have not been assigned a Data Flag. Depending on the laboratory's interpretation of the results, action may be taken to bring the testing in closer agreement with the consensus.



Trending to extremes

Consistency is good. A bar graph that is growing consistently longer is not. This lab should be on the alert, as the trend chart depicts lab means that are not only slowly moving further and further from the grand means, but also in a direction that is opposite to the previous year's results.



Sudden blip

The historical chart can reveal a one-time deviation from usual performance. These deviations happen, even to the best of labs, and cannot be predicted.

Was there a change in instrument? Improper calibration? A departure from procedures? New technician?