Your **Industry Quality Managers Report,** is designed to serve as tool for the evaluation of results from multiple testing sites.

The reports have been developed to present a large amount of data in ways that are both easy to interpret and actionable by the participating labs. This guide provides an explanation of the information presented in the Quality Managers Reports and how they may be used to improve your company's overall performance.

This document references statistical analyses that are further described in the *Guide to Interpreting Performance Analysis Reports* and the *Key to Individual Reports.* Quality Managers are encouraged to review these documents as they will provide a framework for understanding how the data is presented in this report. Given the broad scope of CTS testing programs, not all interlaboratory statistical analyses can be covered in these documents. Please contact CTS if you have additional questions after reviewing these guides.

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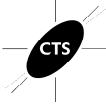
## An Introduction to the CTS Analyses and CPV Calculations

CTS employs comparative statistics for many of the tests that we offer. For most Programs two sample materials are tested by participants, with the most agreed upon (nominally) consensus value of all participating labs determining the best value for that property. Because similar materials are chosen for both samples, there should be a correlation of measurement performance between the two samples

CTS calculates the grand means: usually the mean or median of results for all included laboratories for a given sample. Standard Deviations both between and within laboratory results are also calculated. CTS uses these statistics to calculate the Comparative Performance Value (CPV), which is an important performance indicator.

CPV = (lab mean – grand mean)/between-lab standard deviation

CPV Chart Overview

The first page for each analysis is the **Performance Comparison Chart** page. The example below shows the Cycles results for all participants in this Quality Managers report that were enrolled in the Paper Program Tear test. Each participants corresponding CPV values are shown. Any participant for which data was not returned to CTS will simply be left blank for that site on the trend chart. The Quality Managers charts show multiple lab results for one cycle, while the Individual Report sent to each participating lab will contain trend charts that show one participant's results for up to one years' worth of testing.
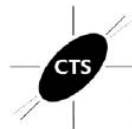
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Quality Manager Report for Testing Cycle 2971, S - (November 2018)

Analysis 312: Tearing Strength - Printing Papers

Report Control Number: **Q111**

CPVs for Each Laboratory

CPV Chart

	1111A Tech Center	1211A Facility #2	1313A Main Lab	1447A Springfield	1500A Northwest
Sample 1	-0.27	1.20	-0.57	0.48	0.38
Sample 2	-0.90	1.64	-0.30	0.64	0.45

■ Sample 1 ■ Sample 2
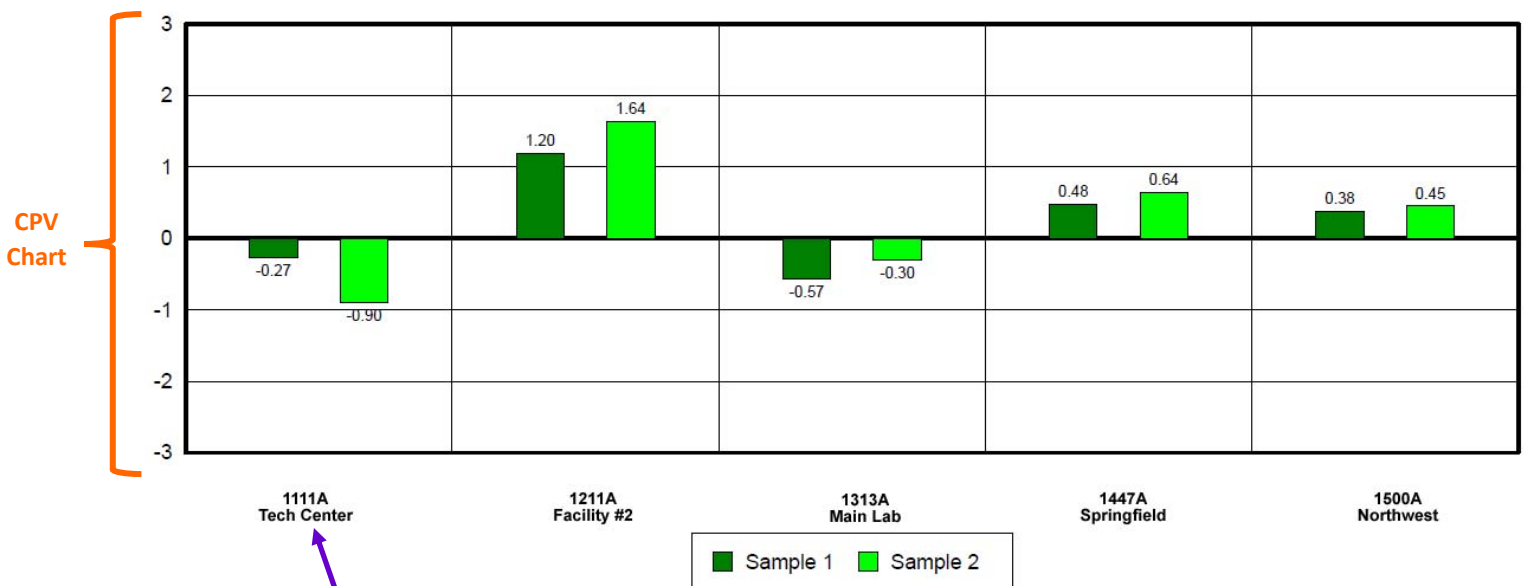
Lab Code and Site Name for each participating lab

Interpreting the CPV Chart

When results for participating labs are consistent, showing only normal and acceptable flutter around the Grand Mean, CPVs will usually be between -1.00 and +1.00. Performance in within these ranges should give the labs greater confidence in their measurements.

Quite often measurement performance that differs from the group can be classified as either a **systematic error** (means for both samples are similarly offset from the group means) or an **inconsistency in testing** (measurements for both samples were not as correlated as other laboratories).

CPV Data Flags: In laboratory testing, we always expect our results to vary from test to test and from lab to lab; but how much variation is too much? That is the question that this report seeks to answer. If your CPV exceeds the warning limit, defined by the 5% significance level, a warning statement will be issued and an "*****" data flag will be assigned. CTS advises you to closely monitor tests that trigger a warning signal. If your results exceed the critical limit, defined by a 0.5% significance level, an Action Item will be posted to the data table and an "**X**" flag will be assigned.

For any flagged results like those shown below, an **Action Item** is posted below the data in the Quality Managers Report, and an analyst comment for the flag will appear. The Action Item should serve as notice of a problem that requires immediate attention.

> **This lab shows Systematic Difference, with both sample results running**

> **This lab shows inconsistency in testing. In this case the sample 1 results are very low compared to Sample 2.**
>
> **Note: Inconsistency can also occur when two samples are within the acceptable limits, but have a large difference between them.**

Systematic Error: Bias is an unavoidable fact of life in laboratory testing. Differences in procedures, conditions, instrumentation and sample preparation all contribute to the bias of a laboratory. When these differences become too large a laboratory may receive a Data Flag for a *Systematic Error*. When the test results for both samples are either high or low compared to the group, a laboratory has a fixed set of factors to focus on to identify a cause.

Inconsistency in testing: Because the samples provided are similar to each other, there is an expectation that there should be a correlation between the measurement results for the two samples. The test results for all labs are compared against each other, thereby determining an "acceptable" level of inconsistency. A lab flagged for *Inconsistency in testing* has exceeded what the results from all labs have determined is a reasonable correlation between the means for the samples.

Data Table Overview

The second page is the **Quality Managers Report – Data Table** page, which lists the lab CPVs shown in the trend chart and also provides supporting information which includes Lab Means and differences from the Grand Means. Additionally, information regarding the methods and instruments reported by the participants may also be shown.
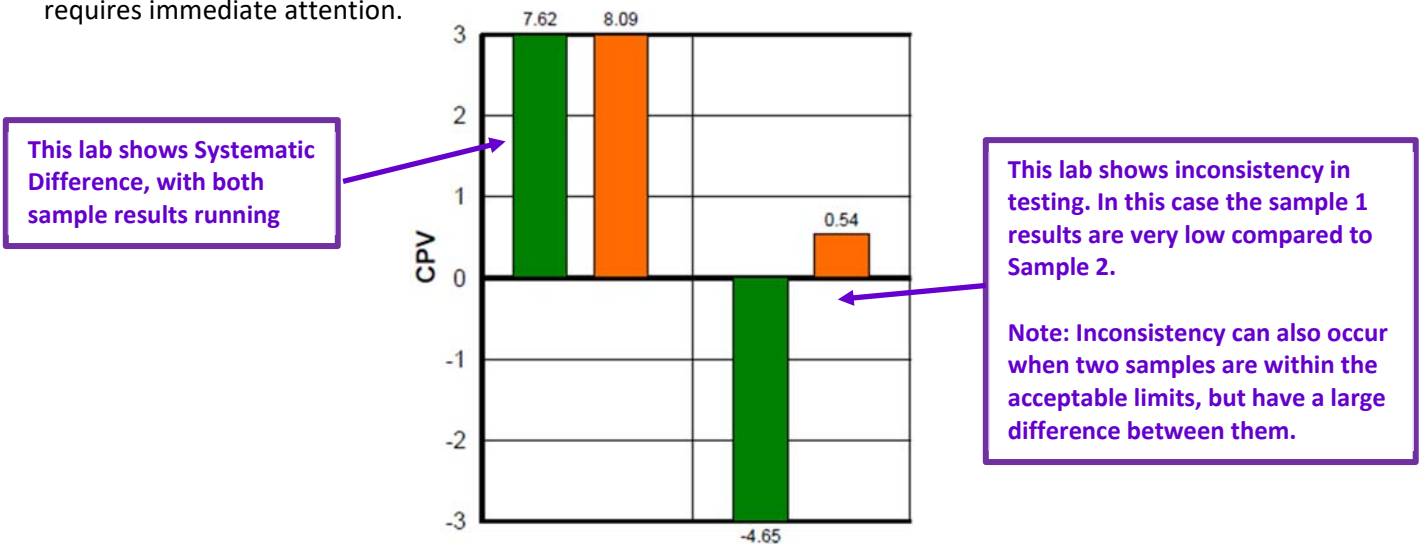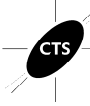
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Quality Manager Report for Testing Cycle 2971, S - (November 2018)

Analysis 312: Tearing Strength - Printing Papers

Using TAPPI Official Test Method T414

Data shown in: Grams

LabCode	WebCode	Site	Data Flag	Lab Mean	Sample SC61 Diff from Grand Mean	CPV	Lab Mean	Sample SC62 Diff from Grand Mean	CPV	Instr Code
U1111A	BH4YPQ	Tech Center		63.40	-0.91	-0.27	58.83	-3.05	-0.90	ZZ
U1211A	MR2N6B	Facility #2		68.32	4.01	1.20	67.42	5.54	1.64	ZZ
U1313A	K8BUJH	Main Lab		62.38	-1.93	-0.57	60.86	-1.02	-0.30	ZZ
U1447A	HJURM2	Springfield		65.92	1.61	0.48	64.04	2.16	0.64	ZZ
U1500A	X6GQUE	Northwest		65.59	1.28	0.38	63.41	1.53	0.45	ZZ

Group Results (laboratories from your enrolled group)		
Group Means (Average CPV)	65.12 (0.24)	62.91 (0.31)
Between Lab Standard Deviation	2.32	3.27
Coefficient of Variation	3.57%	5.19%

Consensus Results (44 of 48 laboratories included)		
Grand Means	64.31	61.88
Between Lab Standard Deviation	3.36	3.38
Coefficient of Variation	5.22%	5.47%

Group and Consensus Results:
The Group and Consensus Results sections of this page show how well your participating labs did when analyzed as a stand-alone group, as well as giving the overall results for all labs that returned data for the test.

Data Flags: If any labs results have been flagged, a **Data Flag** will be posted before the data. The Data Flag should serve as notice of a problem that requires immediate attention.

| Lab Code	Site	WebCode	Methodology	Data Flag	Lab Mean	Sample SA19 Diff from Grand Mean	CPV	Lab Mean	Sample SA20 Diff from Grand Mean	CPV
1111	Tech Center	BH4YPQ	Autotitration	*	6.450	0.64	1.90	6.550	0.75	2.26
1211	Facility #2	MR2N6B	Manual Titration	X	7.375	1.56	4.65 X	7.420	1.62	4.89 X
1313	Main Lab	K8BUJH	Manual Titration	X	7.165	1.35	4.03 X	6.905	1.10	3.33 X
1447	Springfield	HJURM2	Manual Titration		5.460	-0.35	-1.05	5.465	-0.34	-1.01
1500	Northwest	X6GQUE	Autotitration		6.380	0.57	1.69	6.360	0.56	1.69

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Interpreting the Control Ellipse

For most tests CTS uses a bi-variate analysis technique (represented by the ellipse) to judge measurement performance for both samples simultaneously. When considering the positions of your participating labs on the plot relative to the control ellipse, remember that, generally speaking, if a lab's plotted point falls on the major axis of the ellipse, the lab is consistent in its measurements between the two samples but exhibits an offset from the grand mean (systematic bias/error). If a plotted point falls to the side of the ellipse, it indicates possible differences in the way that the lab tested the two samples or differences in lab sample behavior (inconsistency in testing). The two-sample plot enables you to see which sample, if either, is out of control and to ascertain the nature of the out of control situation.

A robust analysis will result in a narrow ellipse oriented approximately at a 45° angle. If random error, or material variation overwhelms any bias within the analysis, the ellipse will become more circular.

For the Quality Managers Report Ellipse all the labs participating in the Quality Managers Report are circled, allowing the reader to easily see the performance of the group compared to all others reporting.
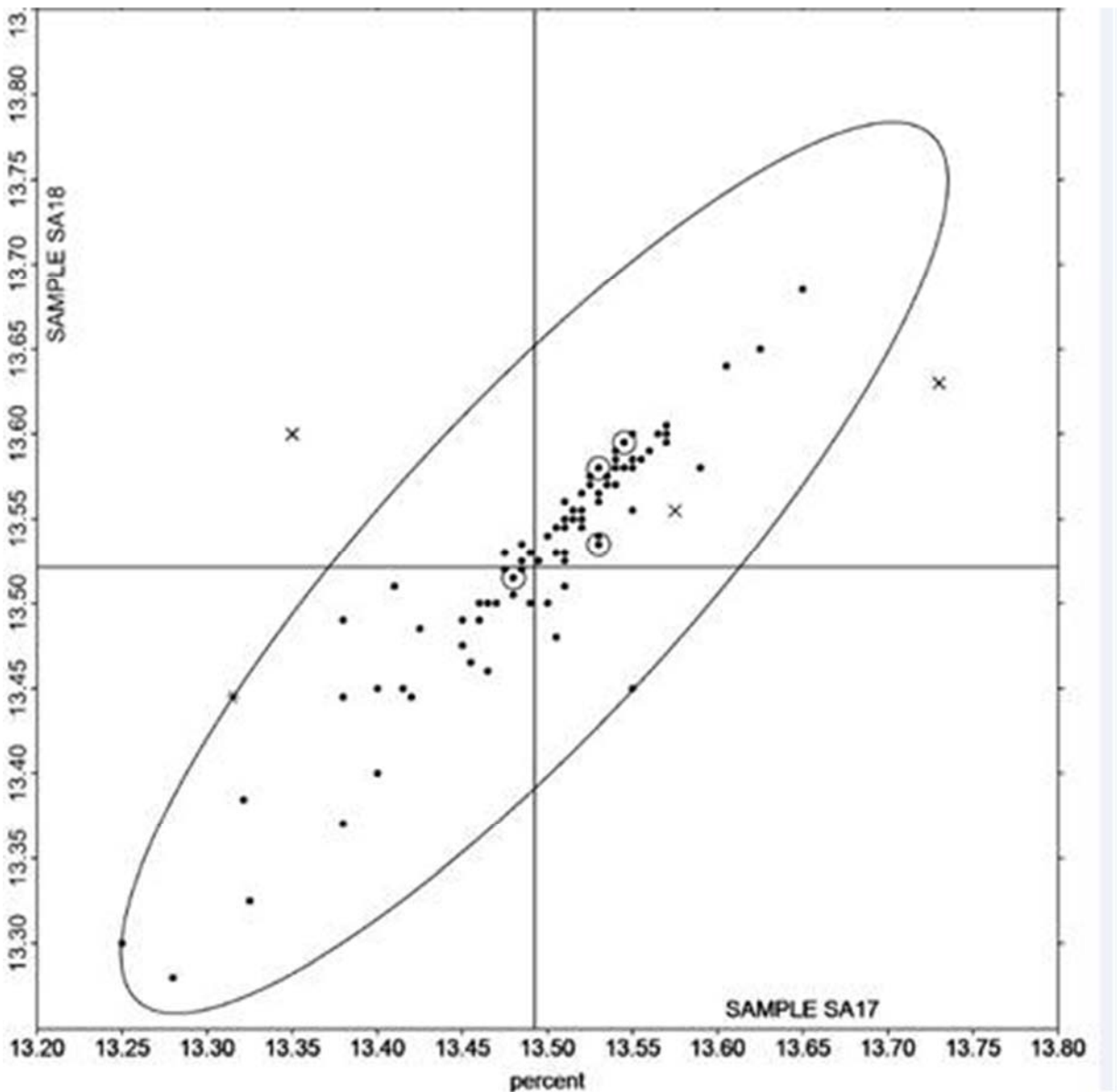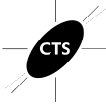
Program Specific Variations

Results by Methodology

Some test in the CTS Program allow for multiple methods be used. The Quality Managers report includes a table showing the statistics for the cycle broken out by methods reported by the participants. This in depth analysis allows participants to make a more informed decision on method related biases when analyzing results.

Results by Methodology (as reported by laboratory)

Test Methodology	Sample SA19 Pinot Grigio			Sample SA20 Pinot Grigio			Labs Incl / Rpt	
	Group Mean	Btwn Lab STD	Diff from GM	Group Mean	Btwn Lab STD	Diff from GM		
Autotitration	5.829	0.324	0.016	5.807	0.322	0.006	63	70
Manual Titration	5.799	0.383	-0.014	5.814	0.370	0.013	22	30
FTIR	5.735	0.337	-0.079	5.733	0.341	-0.068	6	7
Segmented Flow Analyzer	5.608	0.000	-0.205	5.578	0.000	-0.224	1	1