Test Group Summary Report
C44 Nutrients in Soil
June 2020 PT Round

Issued: October 1, 2020

PTC | Proficiency Testing Canada

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1.0 The Proficiency Testing Report

The Proficiency Testing Report consists of two parts.

- *PTC Proficiency Testing Report*: This report contains participant-specific data and other confidential information. This report is emailed to participants at the end of the PT round.
- *Test Group Summary Report*: A Test Group Summary Report is created for each quantified test group at the end of the PT round. These reports contain more detailed information on the round than are found in the participant-specific PTC Proficiency Testing Report. These reports do not contain any confidential information and are made available on the PTC web site.

2.0 Definitions

The participant-specific PTC Proficiency Testing Report contains some terms that new participants may not be familiar with.

Code:	The registration code that is unique to each analyte that a participant is registered for.
App:	If a participant is accredited by CALA, this three-digit number is the appendix number that the accredited method is assigned to.
N:	The number of participants results that were used to calculate the summary statistics. This excludes qualified data (e.g., <) and any results that were flagged as outliers.
Assigned:	The Assigned Value is the robust mean of the reported results, outliers excluded. This is often referred to as the "target" value.
$\pm u$*:*	The uncertainty of the assigned value.
Reported:	The result reported by the participant.
s:	The Standard Deviation of Proficiency Assessment. This value is used to determine the acceptance limits for the PT evaluation.
z-Score:	A value assigned to each reported result that is a measure of the degree to which it deviates from the Assigned Value.
Score:	The composite score of the four results reported for each analyte. It is normalized to a score out of 100.
Bias:	A flag assigned if bias is detected using the re-scaled *z*-score procedure.

3.0 Scoring System

Participant performance is evaluated for each proficiency testing sample by a quantitative method that is consistent with ISO/IEC 17043:2010 *Conformity assessment — General requirements for proficiency testing*, the *International Harmonized Protocol for Proficiency Testing of (Chemical) Analytical Laboratories* (2006), and ISO 13528:2015 *Statistical methods for use in proficiency testing by interlaboratory comparisons*.

The following is a brief description of the evaluation procedure used by PTC. The detailed evaluation procedure is described in PROC09 – PT Evaluation *Procedure*, which is available on the PTC website www.PTCanada.org).

3.1 HOMOGENEITY AND STABILITY ASSESSMENT

Homogeneity and stability are assessed using participant data. Regression analysis is performed on reported result against order of sample production (Homogeneity) and reported result against date of analysis (Stability). If the slope is significantly different than zero for either then the Standard Deviation of Proficiency Assessment (s) is increased to minimize the impact.

3.2 THE Z SCORE

A "z-score" is calculated for each reported result as follows:

$$z = \frac{(x - \overline{X})}{s}$$

where: x = participant result;
$\overline{X}$ = the Assigned Value;
s = the Standard Deviation for Proficiency Assessment.

The assigned value $\overline{X}$ is generally estimated from the inter-laboratory Robust mean after outliers due to obvious gross errors (e.g., reported in wrong units) have been removed.

The Standard Deviation for Proficiency Assessment, s, is determined as follows:

- The inter-laboratory Robust standard deviation (stdev) is calculated using reported results, obvious outliers removed;
- The expected inter-laboratory standard deviation (s!) is estimated from regression equations derived from previous studies (see PROC11- *PT Regression Equations* for details);
- If s! is higher than stdev then si is used in the z score equation;
- If s! is lower than stdev then stdev is used in the z score equation;
- When a laboratory reports its detection limit, s will be estimated using a pooled variance procedure that uses both the inter-laboratory data and the reported detection limit.

3.2 COMPOSITE (PT) SCORE

Since each PT round involves four or two separate samples of distinct concentration for each test, it is necessary to calculate a composite PT score for each test to determine overall performance. The composite score is calculated by first averaging the absolute *z*-scores for the four results and then calculating a final score as 100 + (-15 x avg |z|).

Acceptable PT Scores equal or exceed 70.

3.3 IDENTIFYING BIAS

The proficiency testing report provides flags for bias. These are determined using the re-scaled *z*-score procedure.

$$RSZ = \frac{\sum z}{\sqrt{N}}$$

where z = the z- score
N = the number of samples

Flags are assigned for each test group/parameter combination as follows:

RSZ ≥ -2 and ≤ 2	no flag assigned
RSZ > 2	H (High)
RSZ > 3	VH (Very High)
RSZ < -2	L (LOW)
RSZ < -3	VL (Very Low)

3.4 DEVIATIONS FROM EVALUATION PROCEDURE

Other than changes to the Standard Deviation of Proficiency Assessment due to homogeneity or stability flags, any deviation from the published evaluation procedure is described on the cover page(s) of the final *PTC Proficiency Testing Report*.

4.0 PT Round Specific Data Summary

The following pages provide more detailed information about the PT round indicated in the cover page of this report than is found in the participant-specific PTC Proficiency Testing Report. The graphical representations and the statistical summaries are based upon the data after outliers have been removed.

4.1 SUMMARY STATISTICS

In addition to some of the statistics found in the customer reports, this table includes additional summary statistics such as Median, different measures of dispersion, the number of outliers removed, the number of results in the Questionable range (|z| between 2 and 3) and the Unacceptable range (z > 3), and whether a data set was flagged for Homogeneity or Stability. This section also includes sorted scatter plots of the data for each sample.

4.2 z- SCORE PLOTS

The z-scores for each sample are ranked in increasing order and plotted. When the data is normally distributed, the plot should show a slight sigmoidal curve, with an equal number of points above zero as below. Each bar in these plots is colour-coded to indicate the analytical method used by the participant.

4.3 KERNEL DENSITY PLOTS

Kernel density plots are generated for each data set. These plots are a graphical way to represent the overall data distribution and are used to visualize possible deviations from normality and unimodality.

4.4 STABILITY AND HOMOGENEITY PLOTS

Plots of reported result against analysis date, and reported result against order of bottling are displayed, along with the regression line. These regression analyses are used to determine if the SDPA should be adjusted due to homogeneity or stability.

AMMONIA-N

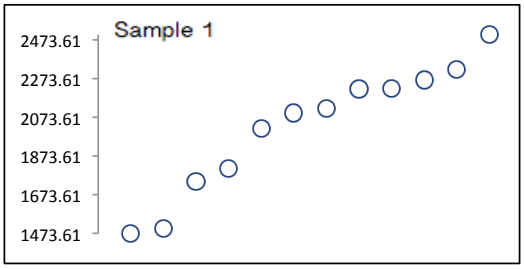
Summary Statistics

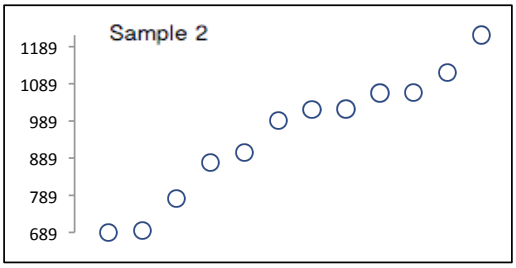
Statistic	C44-1	C44-2	C44-3	C44-4
N	12	12	12	12
Median	2110	1010	382	325
Robust Mean	2020	954	356	313
U	134	68.6	37.9	40.4
Robust Standard Deviation	370	190	105	112
Regression Standard Deviation				
Stability Flag				
Homogeneity Flag				
Standard Deviation Used	370	190	105	112
Outliers	1	1	1	1
|z|>3.0	0	0	0	0
2<|z|<3	0	0	0	0

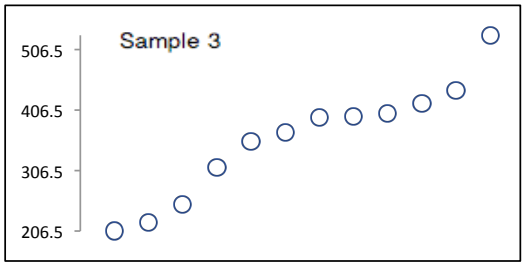
Methods Used

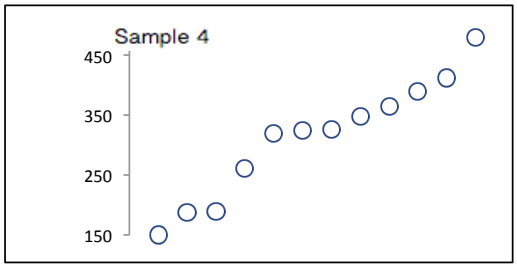
Method	C44-1	C44-2	C44-3	C44-4
CLR-A	2	2	2	2
COLOR	9	9	9	9
ISE	1	1	1	1

All summary stats and the plots below are based on the data excluding any flagged outliers





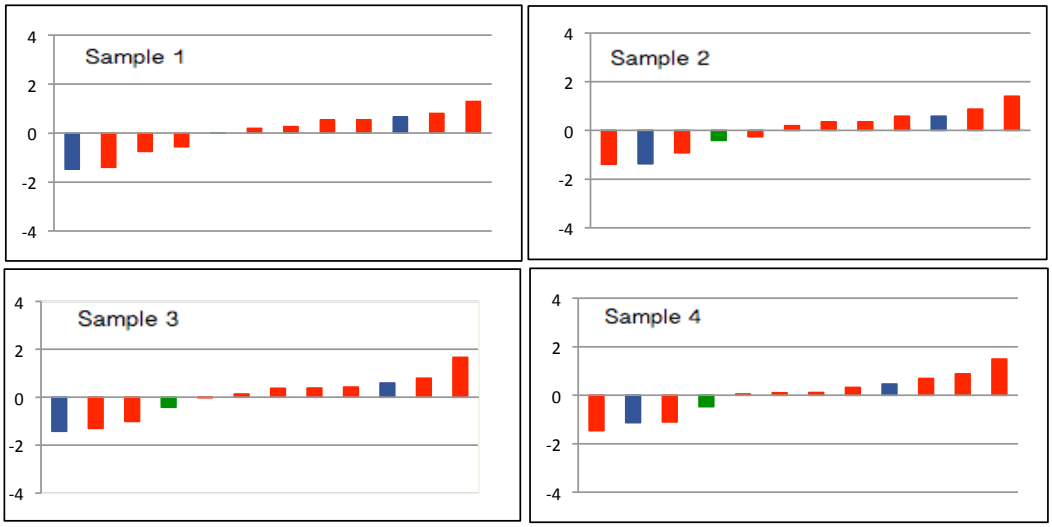




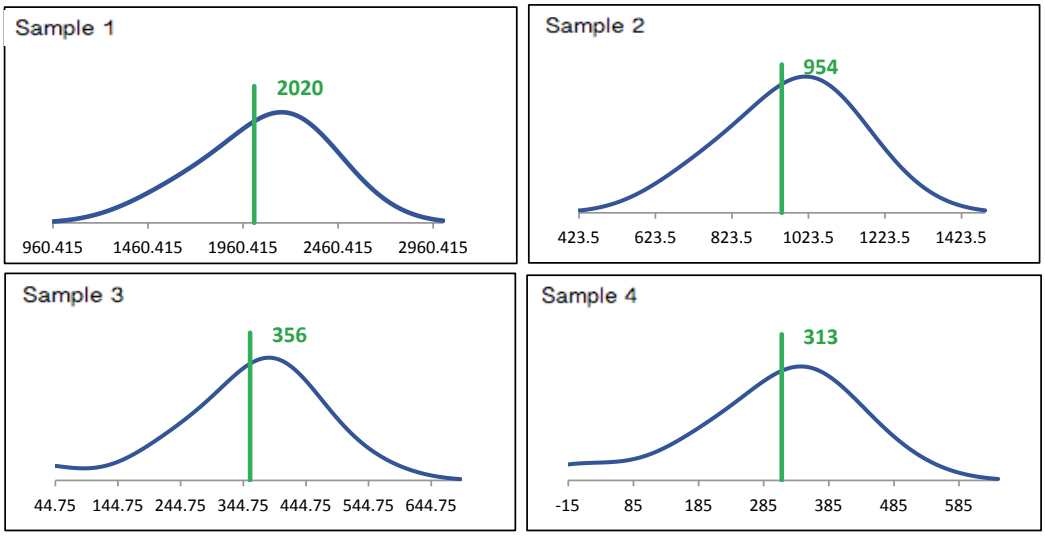
Annex A Summary by Analyte

AMMONIA-N

z-Score Plots



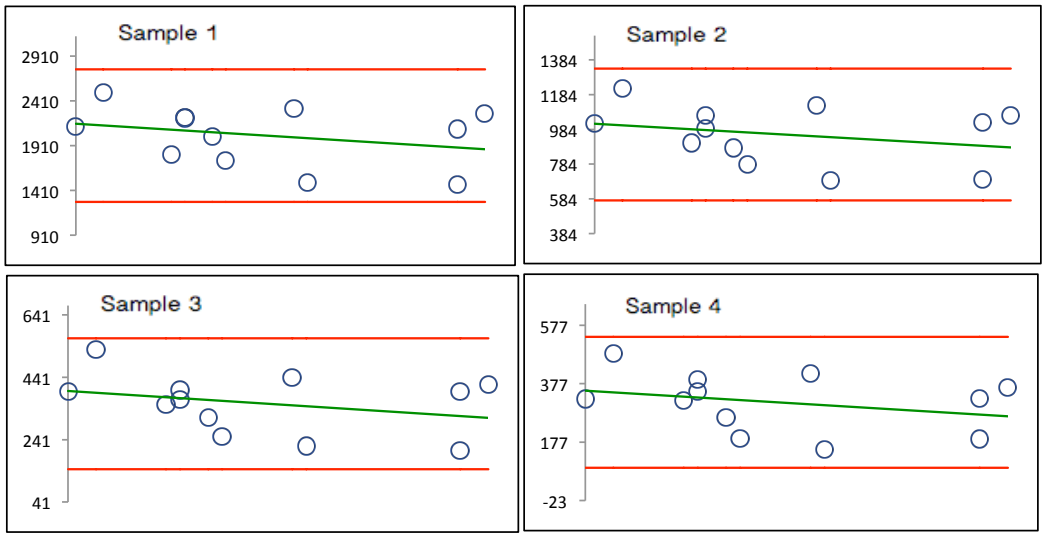
Kernel Density Plots



Annex A Summary by Analyte

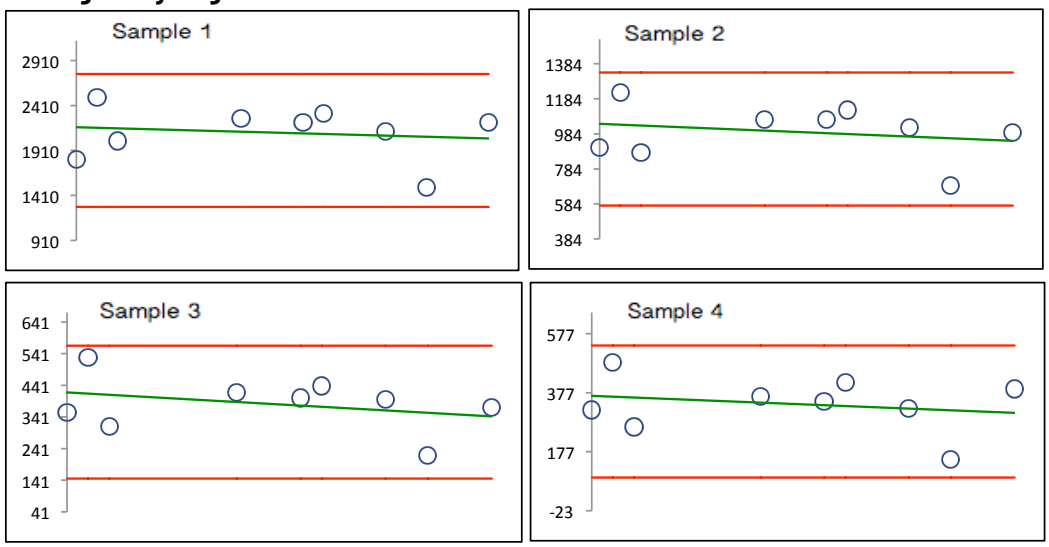
AMMONIA-N

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).

KJELDAHL NITROGEN

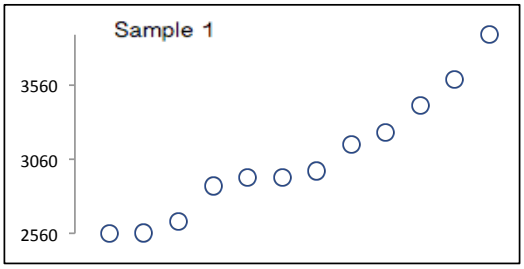
Summary Statistics

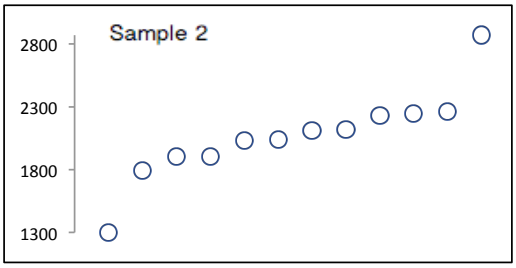
Statistic	C44-1	C44-2	C44-3	C44-4
N	12	12	12	12
Median	2960	2080	1200	1250
Robust Mean	3050	2060	1210	1230
U	157	87.3	52.7	83.7
Robust Standard Deviation	435	242	146	232
Regression Standard Deviation				
Stability Flag				
Homogeneity Flag		Homogeneity	Homogeneity	
Standard Deviation Used	435	814	456	232
Outliers	0	0	0	0
|z|>3.0	0	0	0	0
2<|z|<3	0	0	0	1

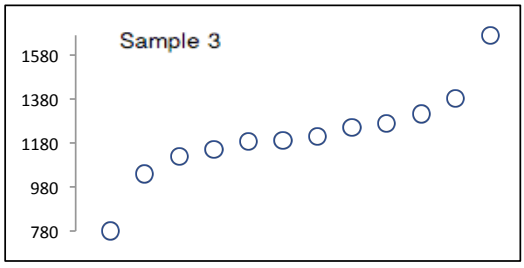
Methods Used

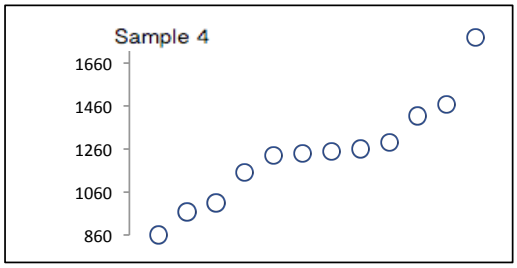
Method	C44-1	C44-2	C44-3	C44-4
CLR-A	4	4	4	4
TITR	1	1	1	1
COLOR	7	7	7	7

All summary stats and the plots below are based on the data excluding any flagged outliers



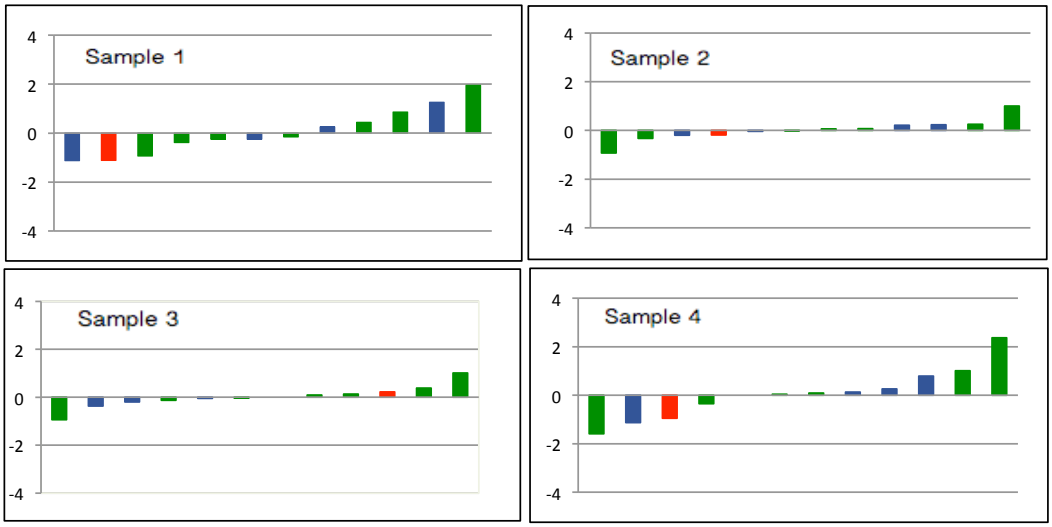




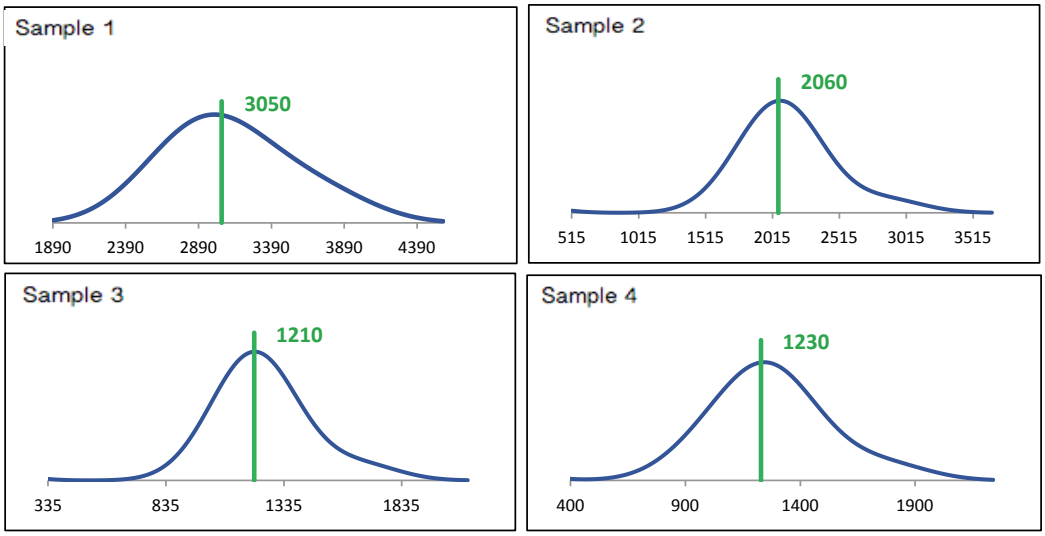


KJELDAHL NITROGEN

z-Score Plots



Kernel Density Plots



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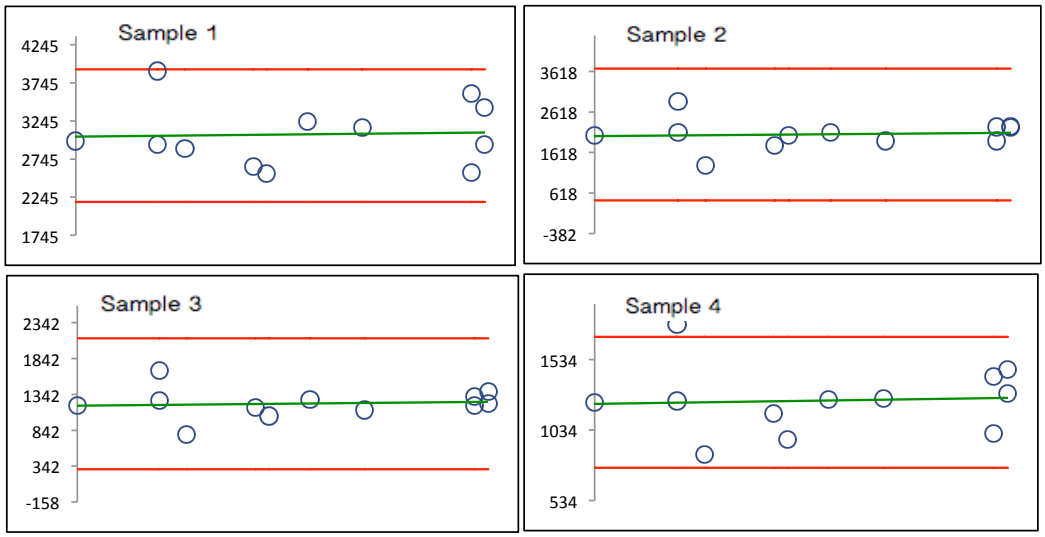
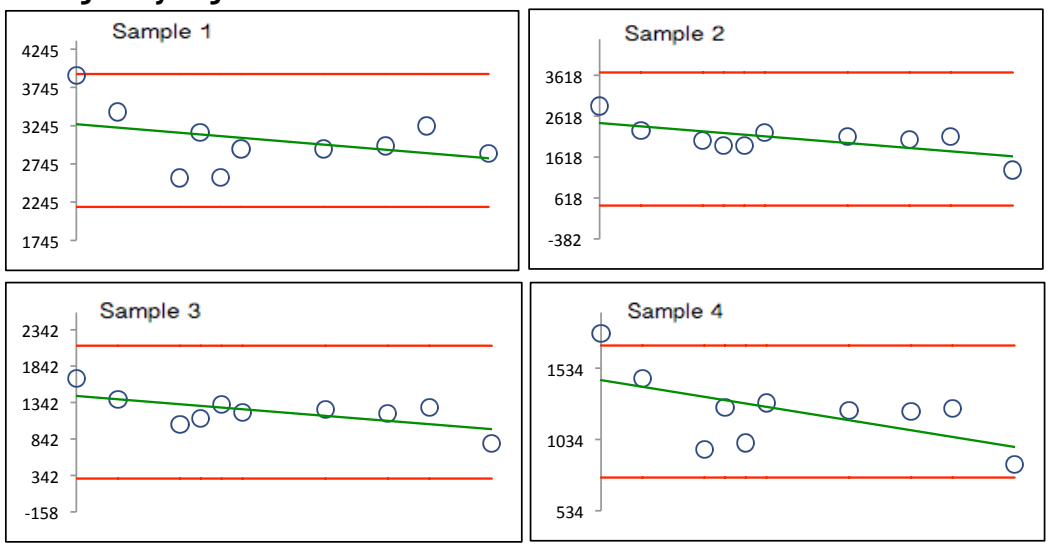
KJELDAHL NITROGEN

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).

ORGANIC CARBON

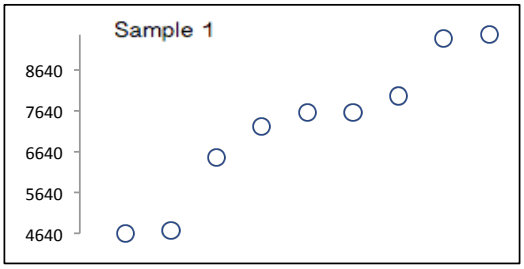
Summary Statistics

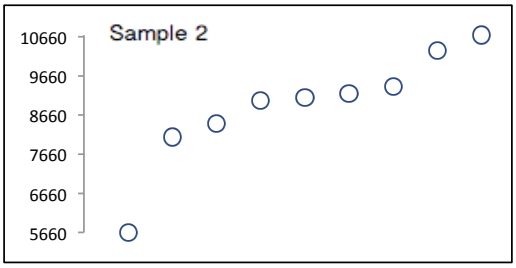
Statistic	C44-1	C44-2	C44-3	C44-4
N	9	9	9	9
Median	7590	9110	6200	10300
Robust Mean	7240	9060	6110	10000
U	825	496.0	529	904
Robust Standard Deviation	1980	1190	1270	2170
Regression Standard Deviation				
Stability Flag				
Homogeneity Flag				
Standard Deviation Used	1980	1190	1270	2170
Outliers	1	1	1	1
|z|>3.0	0	0	0	0
2<|z|<3	0	1	0	0

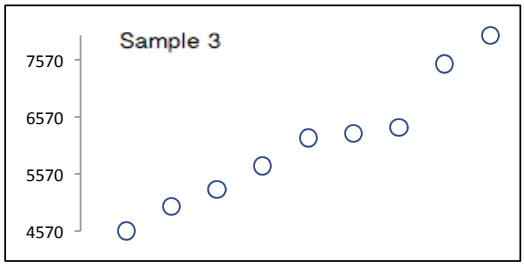
Methods Used

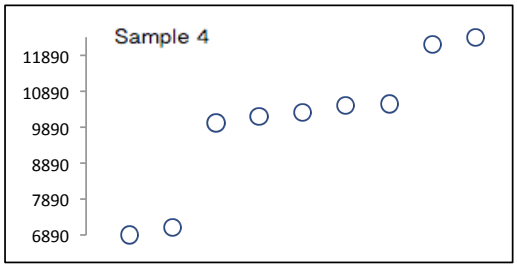
Method	C44-1	C44-2	C44-3	C44-4
INFRARED	4	4	4	4
TITR	2	2	2	2
CALC	1	1	1	1
COLOR	2	2	2	2

All summary stats and the plots below are based on the data excluding any flagged outliers





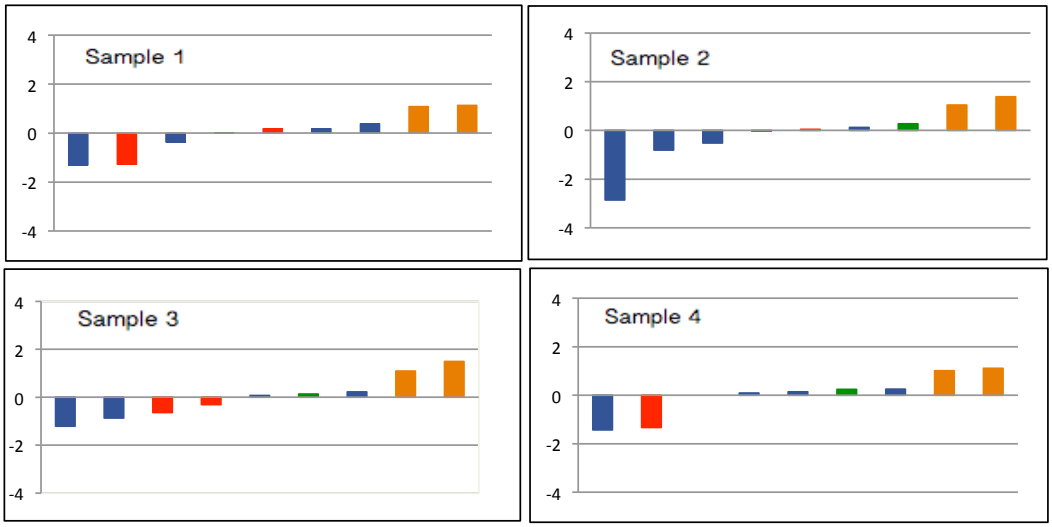




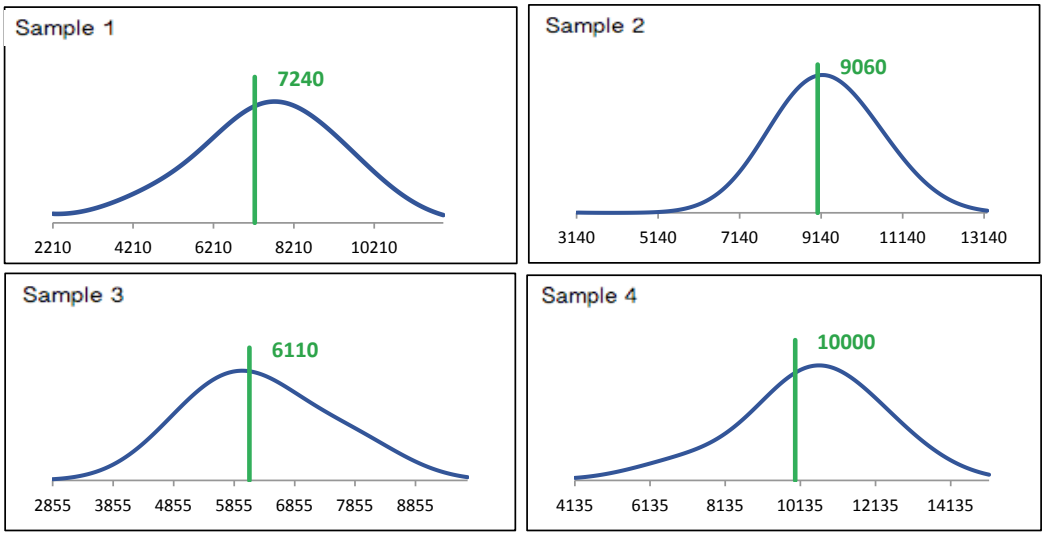
Annex A Summary by Analyte

ORGANIC CARBON

z-Score Plots

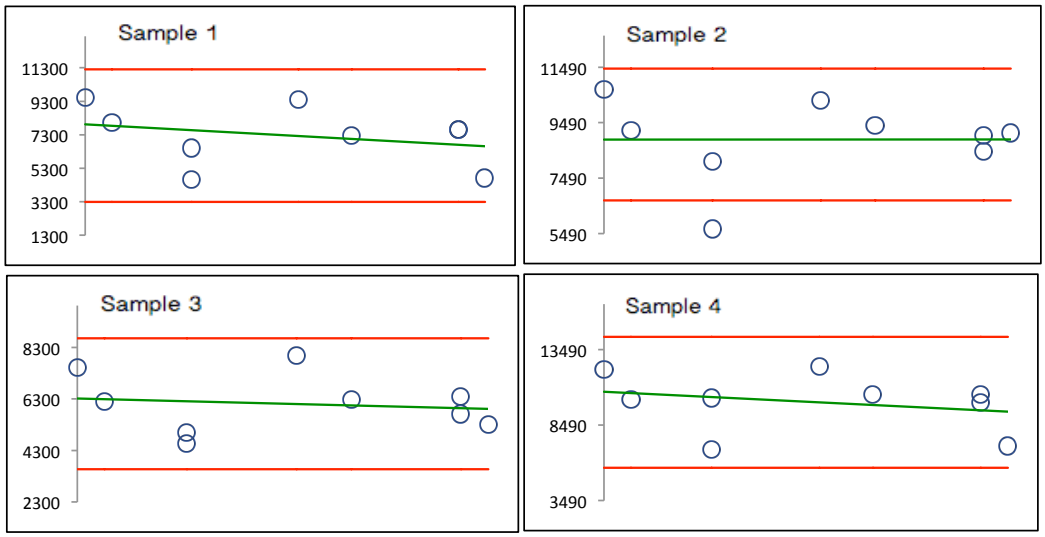


Kernel Density Plots



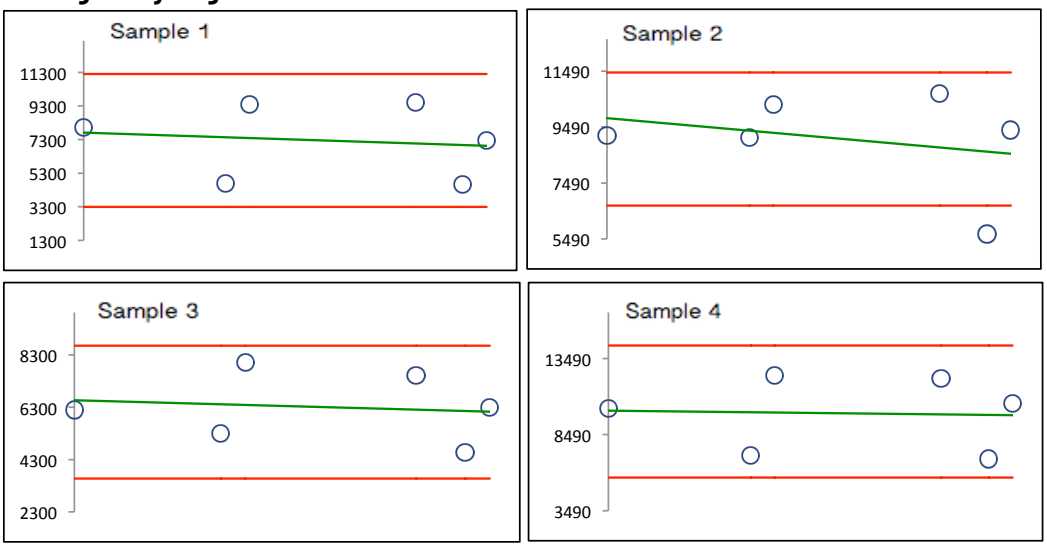
ORGANIC CARBON

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).

PHOSPHORUS

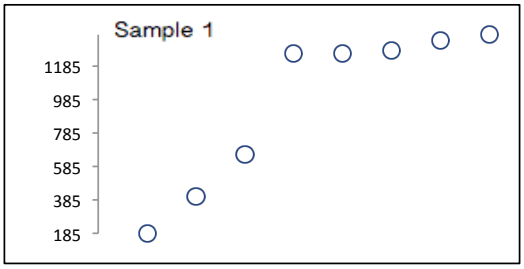
Summary Statistics

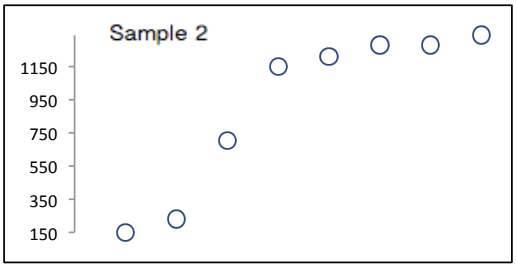
Statistic	C44-1 (Excluded)	C44-2 (Excluded)	C44-3 (Excluded)	C44-4 (Excluded)
N	8	8	8	8
Median	1260	1180	968	810
Robust Mean	970	918	772	627
U	240	246	227	206
Robust Standard Deviation	542	557	513	466
Regression Standard Deviation				
Stability Flag				
Homogeneity Flag				
Standard Deviation Used	542	557	513	466
Outliers	0	0	0	0
|z|>3.0	0	0	0	0
2<|z|<3	0	0	0	0

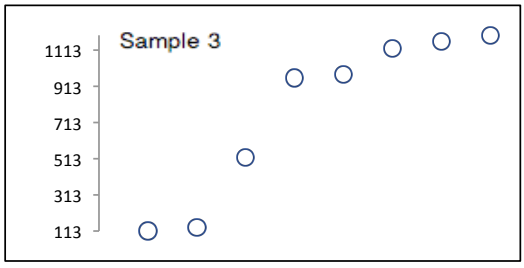
Methods Used

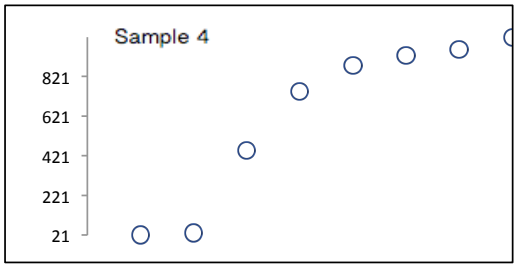
Method	C44-1	C44-2	C44-3	C44-4
COLOR	4	4	4	4
ICP/OES	2	2	2	2
ICP/MS	1	1	1	1
CLR-A	1	1	1	1

All summary stats and the plots below are based on the data excluding any flagged outliers



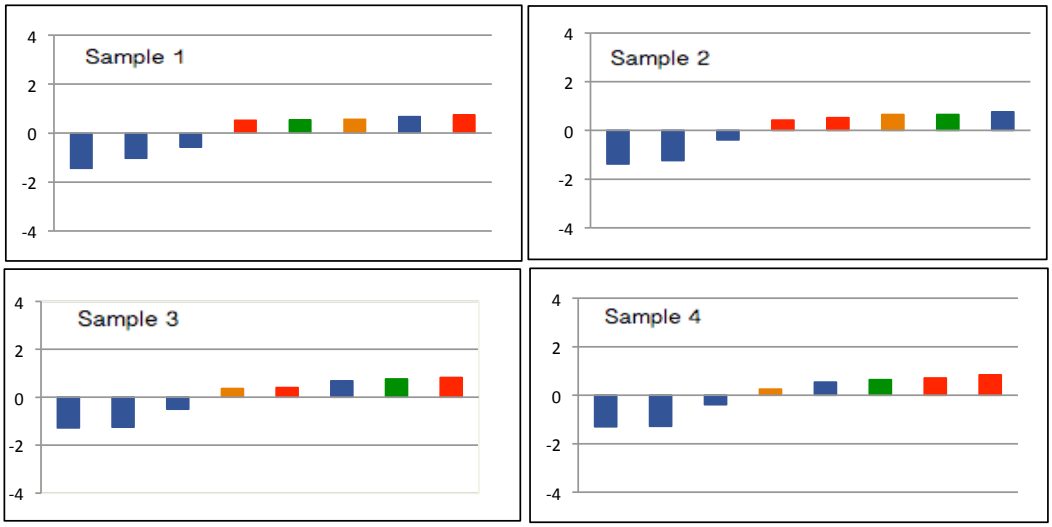




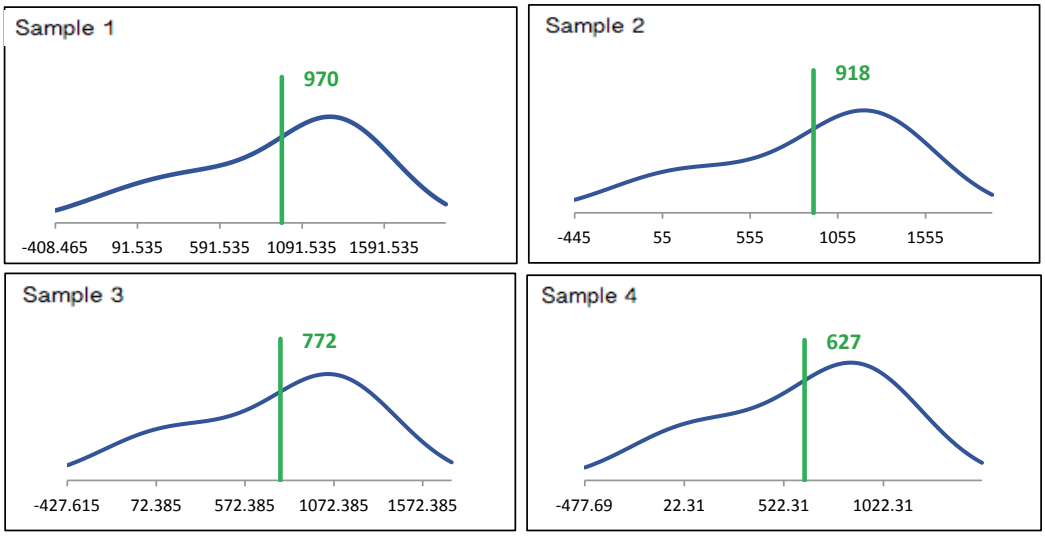


PHOSPHORUS

z-Score Plots

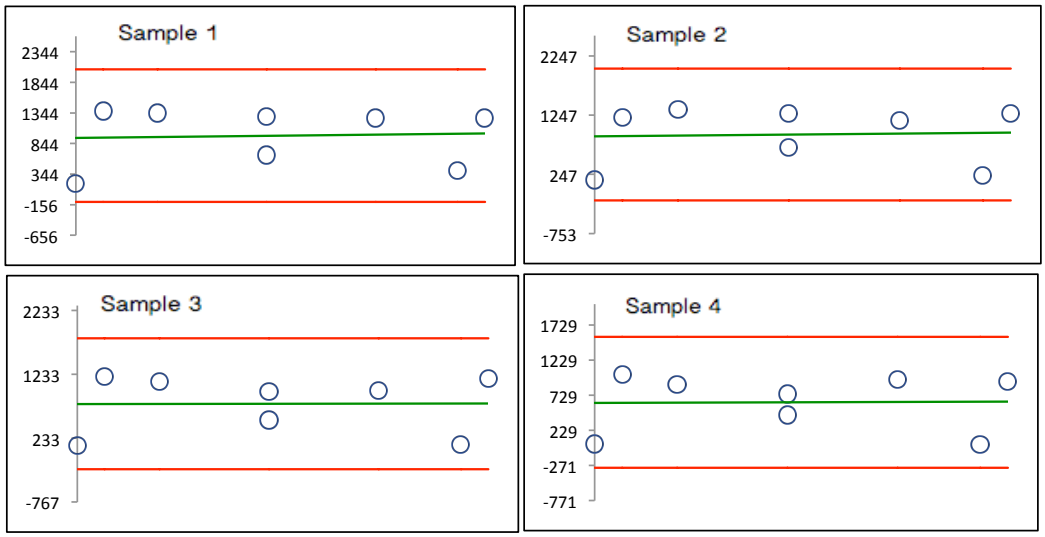


Kernel Density Plots



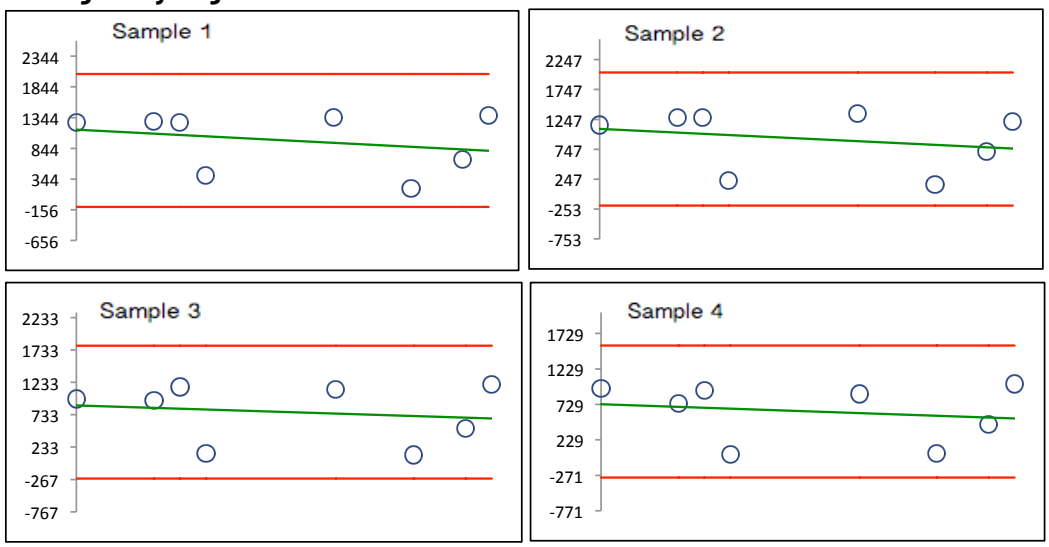
PHOSPHORUS

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).