ERIMSA INTERLABORATORY PROFICIENCY TEST REPORT

DETERMINATION OF METALLIC AND NON-METALLIC ELEMENTS IN QUARTZ SAMPLES

29th EDITION

2021

Erimsa

Polígono Industrial A Grela

C/Copérnico 7- 2º A1

15008, A Coruña

Spain

Contact information

Alejandro Arenosa

Head of Laboratory

Tel.: +34 683 569 520

E-mail: alejandro.arenosa@erimsa.com

http://erimsa.com/

How to cite: C. Forján, A. Arenosa and J.M. Mariño; ”Erimsa-ITL-21 Proficiency Test Report”.

CONTENTS

LIST OF ABBREVIATIONS

ASTM	American Society for Testing and Materials
Avg	Average
ECLab	Erimsa Central Laboratory
ICP-MS	Inductively Coupled Plasma - Mass Spectrometry
ICP-OES	Inductively Coupled Plasma - Optical Emission Spectrometry
ISO	International Organization for Standardization
ITL	Interlaboratory comparison programme
LL	Lower Limit
LLD	Low Limit Detection
PT	Proficiency Test
RM	Reference Material
SD	Standard Deviation
UL	Upper Limit
XRF	X-Ray Fluorescence

1. INTRODUCTION

Interlaboratory comparison programme (ITL) studies are an essential and very important element of laboratory quality assurance, which allow individual laboratories to compare their analytical results with those from other laboratories while providing them objective standards to perform against. This in turn allows them to demonstrate performance.

One of the core duties of Erimsa Central Laboratory (ECLab) is to organize ITLs which allow Erimsa to includes this programme in its quality assurance system as a service to the customer for the correct and updated control of its product.

2. SCOPE

The scope of this comparison is to test the competence of the appointed laboratories to analyze quartz samples, which once analyzed with the report can be used as an important support tool to improve methods and systems.

The reporting results were assessed following the administrative and logistic procedures of the ECLab Unit in charge of the Erimsa ITL, following the rules for PTs according to ISO 17043:2010 [1].

3. PLANNING

3.1. TIME FRAME

The organization of the Erimsa ITL-21 exercise was launched in January 2021 Samples were sent to participants on March 30, 2021. The deadline reporting of results was set to July 31, 2021.

3.2. CONFIDENTIALITY

The procedures used for the organization of PTs are accredited according to ISO 17043:2011 [1] and guarantee that the identity of the participants and the information provided by them is treated as confidential.

Samples for a new exercise were prepared and homogeneity tests were performed. The samples were dispatched to participants together with instruction letter (Annex 1). An email with an excel file were also send for the compilation of results to be return with the analytical results (Annex 2)

3.3. INTRUCTIONS TO PARTICIPANTS

Detailed instructions were given to participants in the “Test item accompanying letter” mentioned above.

Participants were asked to perform two or three independent measurements, to report their calculated mean (x_i) and the associated standard deviation (u) and the analytical technique used for analysis.

Participants received an individual code to report their measurement results.

Participants were informed that the procedure used for the analysis should resemble as closely as possible their routine procedures for this type of matrix/analytes.

The laboratory codes were given randomly and communicated to the participants by e-mail.

4. TEST MATERIAL

4.1. PREPARATION

The preparation of the material was done by ECLab.

The final powder material was mixed in a rotation mixer for 4 hours.

Portions of 35 g were manually filled into 100 mL transparent bag using acid washed plastic spoons.

Each bag was identified with a unique number of the PT exercise.

4.2. HOMOGENITY ASSESSMENT

For testing interlaboratory comparisons the objective of homogeneity testing is to establish suitably small sample variability, where the samples are sufficiently homogenous.

Homogeneity was evaluated according to ISO 13528:2015 [2] and ISO 5725-2:2019 [3]. The test item proved to be adequately homogeneous for the investigated analytes.

Once the samples have been prepared and packaged, at least 10 samples are selected at random for homogeneity testing. The tests selected are those that are considered to best indicate any significant differences in the samples. All testing is performed at least in duplicate and under repeatability conditions i.e., same laboratory; same operator; same method; over as short a time interval as possible.

For the samples to be accepted as suitable for use, the results of this testing and any applicable statistical analysis (e.g., Anova) of the results must indicate that no significant variability existed. Thus, any outlier results subsequently identified in a program will not be attributable to sample variability.

The samples were tested for homogeneity by ECLab.

The statistical treatment of data was performed by the ECLab. Analysis of Variance F test at α=0.05 was used for check statistically significant differences between proficiency test items.

$$H_0: \mu_1 = \mu_2 = \cdots = \mu_j$$

$$H_1: otherwise$$

The expressions for the calculation of the elements that intervene in the Anova are the following:

$$\bar{x} = \frac{\sum_{j=1}^{k}\sum_{i=1}^{nj} x_{ij}}{n} \quad (1)$$

$$M_b = \frac{\sum_{j=1}^{J} n_j(\bar{x}_j - \bar{x})^2}{J-1} \quad (2)$$

$$M_w = \frac{\sum_{j=1}^{J}\sum_{i=1}^{n_j}(x_{ij} - \bar{x}_j)^2}{n-J} \quad (3)$$

$$F_{J-1,n-J} = \frac{M_b}{M_w} \quad (4)$$

Where,

$\bar{x}$ = is the global average.

M_b = Mean square Between-groups.

M_w = Mean square Within-groups.

Assuming true H_0, this statistic follows a F of Snedecor with J-1 and n-J degrees of freedom; so, given a significance level α, critical region will be determinated by values such that $F > F_{J-1,n-J}^{1-\alpha}$, where $P\left[F > F_{J-1,n-J}^{1-\alpha}\right] = 1 - \alpha$.

Homogeneity was tested for those elements that at least eight laboratories, according ASTM E 691-99 [5], have performed the analysis referenced to historical data of ITL (Annex 1).

4.3. DISTRIBUTION

Each participant received:

- Envelope containing 4 samples of the test items (containing approx. 35 g each);
- The "Test item accompanying letter" (Annex 2);
- The "Confirmation of receipt" form to be sent back to Erimsa-ITL-21 Coordinator after receipt of the test items (Annex 3); and
- The form for reporting the results (Annex 4) (via email).

5. LIST OF PARTICIPANTS

In alphabetical order:

List of participants	Country
CRS Laboratories Oy	Finland
Dorfner Anzaplan	Germany
Elkem ASA Tana	Norway
Elkem Iceland	Iceland
Elkem Paraguay	Paraguay
Elkem Technology Lab	Norway
Elkem Yongdeng	China
Erimsa	Spain
Ferroatlántica Sabón	Spain
Ferroglobe Cuarzos Industriales	Spain
FerroPem LCA	France
Norwegian University of Science and Technology (NTNU)	Norway
PCC Bakkisilicon	Iceland
Quebec Silicon LP	Canada
Research Institutes of Sweden (RI.SE)	Sweden
Simcoa	Australia
SINTEF Norlab AS	Norway
Spectro	Germany
University of A Coruña (UdC)	Spain
University of Santiago de Compostela (USC-RIADT)	Spain
University of Vigo (UVigo)	Spain
Wacker Chemicals Holla AS	Norway
XEAL	Spain

6. EVALUATION OF RESULTS

6.1. APPLIED STATISTICAL DESCRIPTION

The guide to the expression of uncertainty in measurement ISO/IEC Guide 98-3 [4] gives guidance on evaluation measurement uncertainties.

When σ_{pt} is calculated as the standard deviation of participant results, the uncertainty componenets due to inhomogeneity, transport and instability are in large reflected in the variability of participant results.

In this case the assigned value x_{pt} for the proficiency test item is derived as a robust analysis. This algorithm yields robust estimates of the mean and standard deviation of the data to which it is applied according to ISO 13528:2015 [2].

Denote the *p* items of data, sorted into increasing order by,

$$x_{\{1\}}, x_{\{2\}}, \ldots, x_{\{p\}}$$

Denote the robust average and robust standard deviation of these data by x^* and s^*.

Calculate initial values for x^* and s^* as:

x^*= median of x_i (i = 1, 2, ..., p) (5)

s^* = 1.483 median of $|x_i - x^*|$ with (i = 1, 2, ..., p) (6)

Update the values of x^* and s^* as follows. Calculate:

$$\delta = 1.5 s^* \quad (7)$$

For each x_i (i = 1, 2, ..., p), calculate:

$$x_i^* = \begin{cases} x^* - \delta \text{ when } x_i < x^* - \delta \\ x^* + \delta \text{ when } x_i > x^* + \delta \\ x_i \text{ otherwise} \end{cases} \quad (8)$$

Calculate the new values of x^* and s^* from:

$$x^* = \sum_{i=1}^{p} \frac{x_i^*}{p} \quad (9)$$

$$s^* = 1.134 \sqrt{\sum_{i=1}^{p} \frac{(x_i^* - x^*)^2}{(p-1)}} \quad (10)$$

The robust estimates x^* and s^* may be derived by an iterative calculation, i.e., by updating the values of x^* and s^* several times until the process converges.

From this result the assigned value and the standard deviation for reproducibility are obtained.

The standard uncertainty of the assigned value is estimated as:

$$u(x_{pt}) = 1.25 \frac{s^*}{\sqrt{p}} \quad (11)$$

where s^* is the robust standard deviation of the results. (Here a “result” for a participant is the average of all their measurements on the proficiency test item.)

For results reported as "smaller than" (< - values), the reported value was not used in any calculations and no evaluation of the measurement results was made. No scores were given.

Values of x^* and s^* will be displayed when there is more than one result.

6.2. SCORES AND EVALUATION CRITERIA

The individual laboratory performance was expressed in terms of z and z' scores according to ISO 13528:2015 [2]:

$$z = \frac{x_i - x_{pt}}{\sigma_{pt}} \quad (12)$$

Where:

x_i = is the measurement results reported by a participant;

x_{pt} = is the assigned value (calculated mean based on participant's results);

σ_{pt} = is the standard deviation for proficiency test assessment (standard deviation based on participant's results);

According to ISO 13528:2015 [2], when $u(x_{pt}) > 0.3\sigma_{pt}$ the uncertainty of the assigned value ($u(x_{pt})$) can be taken into account by expanding the denominator of the z score and calculating the z' score, as follows:

$$z' = \frac{x_i - x_{pt}}{\sqrt{\sigma_{pt}^2 + u^2(x_{pt})}} \quad (13)$$

Where:

x_i = is the measurement results reported by a participant;

x_{pt} = is the assigned value (calculated mean based on participant's results);

σ_{pt} = is the standard deviation for proficiency test assessment (standard deviation based on participant's results);

$u(x_{pt})$ = is the standard measurement uncertainty of the assigned value.

$$u(x_{pt}) = \sqrt{\frac{\sum_{k=1}^{n}(x_i - x_{pt})^2}{n(n-1)}} \quad (14)$$

The interpretation of the z (or z') performance scores is done according ISO 13528:2015 [2]:

	|score|	≤ 2	Satisfactory performance
2 <	|score|	< 3	Questionable performance
	|score|	≥ 3	Unsatisfactory performance

The z (or z') scores compare the participant's deviation from the assigned value with the standard deviation for proficiency test assessment (σ_{pt}) used as common quality criterion. The scores and charts for those elements that at least eight laboratories[1], according ASTM E 691-99 [5], have performed the analysis on are shown.

[1] Scores and charts will not be performed for ZrO_2. Values should be handled with care, because possible contamination in sample preparation is likely due to the zirconium vessels used for grinding.

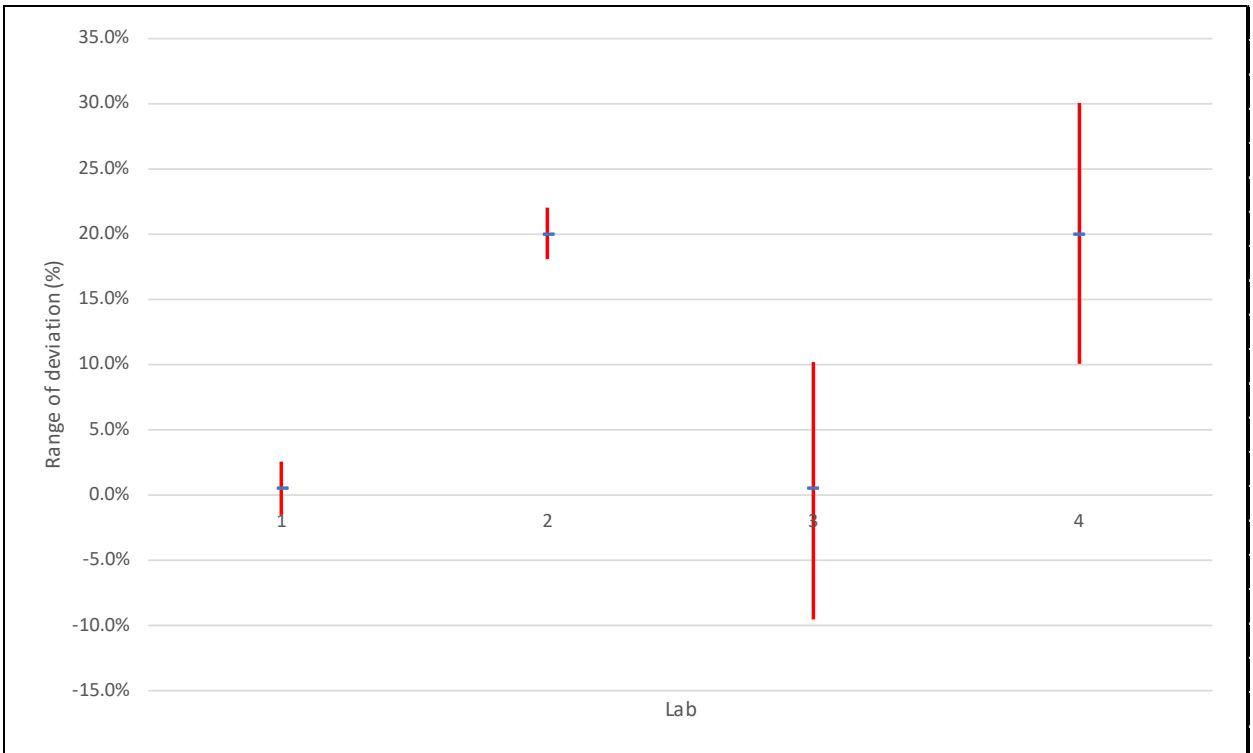
6.3. INTERSAMPLE AVERAGES

Intersamples Average of differences show the trend of the laboratory. The charts show the accuracy (capacity of getting the real value) as the average of the differences, and the precision (capacity of getting the same results on different tests) as the range of deviations (Annex 6).

They can be balanced if some of the differences of the same laboratory and elements are positive and some other are negative if it shows big differences referring to the true analysis.

In this case the intersample standard deviation must be checked, because that means that the above-mentioned laboratory could get analysis too deviated from the real value (the average is considered as the real value in the present study), although in a long term (more analysis) the deviation could be balanced. At any case, even if the average of differences trends to zero, they would never be sure when they are getting the correct result. Usually, this fact is due to random errors which are difficult to solve. They can be due to the method or the equipment used to have not enough precision for the value pretended to be measured.

Example: In the attached chart the intersample averages of an analysis can be seen for four laboratories. In the case of lab 3, the intersample average is 0.5%, however the standard deviation is 10.0%. In such case the differences for the samples A, B, C and D could be something like 20.0%, -22.0%, 12.0% and -16.0%. That is, the analysis varies around +25 and -25 %. Hence the intersample average is 0.5 % even though the individual analysis performed by this lab are more deviated.



Lab	1	2	3	4
Upper Limit	2.5%	-1.5%	0.5%	2.0%
Lower Limit	22.0%	18.0%	20.0%	2.0%
Average	10.2%	-9.5%	0.5%	10.0%
Std. Dev.	30.0%	10.0%	20.0%	10.0%

See the lab 2 analysis in the attached chart where the intersample average of differences is too high, 20.0%, but the standard deviation is only 2.0%.

The opposite situation would take place when a laboratory gets an intersample average considerably far from 0, but the standard deviation of differences is too low. In this case the solution of the problem seems to be easier, because the lab gets analysis deviated, but the deviation is always the same. This fact usually implies the evidence of systematic error. This kind of error is often easy to solve by finding the fact creating the error or using a correction factor.

Referring to the differences as percentage, they must be considered taking into account the absolute value of the analysis and the accuracy of the equipment used. For instance, a difference of +10% for Fe_2O_3 in a sample with 0.010% Fe_2O_3 means to give 0.011% Fe_2O_3 as a result. This error could be considered as an acceptable precision for the equipment or the purpose of the laboratory depending of its needs and usual products.

Of course, the best situation is to get low intersample average of differences and low standard deviation. Consistently, the worst situation would be to get high intersample average and standard deviation of differences.

6.4. ANALYTICAL METHODS

It has been noticed along the using of the interlab programme that some deviations or trends are shown very often whenever the analytical procedures of the participants labs are the same. In order to get all the participants aware of this fact a new chart displaying the analytical methods/equipments of each element analysis is included in the report (Annex 7).

7. CERTIFICATE VALUES

Referring to this point the aim of this certified value is to offer the possibility of making use of the samples sent as RM to calibrate additionally the equipment of each lab. In order to achieve a certain level of security the uncertainty of each sample was calculated according EURACHEM / CITAC Guide CG 4 [6]. Certified value is obtained as follows:

$$Cv = x_{pt} \pm U \quad (15)$$

Where,

Cv = Certified value;

x_{pt} = is the assigned value (calculated mean based on participant's results);

U = Expanded Uncertainty

The expanded uncertainty provides an interval within which the value of the measurand is believed to lie with a higher level of confidence. U is obtained as follows:

$$U = k * u_{pt} \quad (16)$$

Where,

k = is a factor depending of the level of confidence and the number of the data used and it is equivalent to t-Student for 95% confidence range.

u_{pt} = is the standard uncertainty of the sample, and it is calculated as follows:

$$u_{pt} = \frac{\sigma_{pt}}{\sqrt{n}} \quad (17)$$

Where,

σ_{pt} = is the standard deviation for proficiency test assessment (standard deviation based on participant's results);

n = number of data performed for each sample and analysis.

With this certified value the samples can be used as a comparison system but not as exclusive calibration standard samples (Annex 8).

8. REFERENCES

[1] ISO/IEC 17043 *"Conformity assessment – General requirements for proficiency testing"*, issued by ISO-Geneva (CH), International Organization for Standardization, 2010.

[2] ISO 13528:2015 *"Statistical methods for use in proficiency testing by interlaboratory comparisons"*, issued by ISO-Geneva (CH), International Organization for Standardization, 2015.

[3] ISO 5725-2:2019 *"Accuracy (trueness and precision) of measurement method sand results"*. *Part2: Basic methods for determination of repeatability and reproducibility of a standard measurement method*, issued by ISO-Geneva (CH), International Organization for Standardization, 2019.

[4] ISO/IEC Guide 98-3 *"Uncertainty of measurement". Part3: Guide to the expression of uncertainty in measurement*, issued by ISO-Geneva (CH), International Organization for Standardization, 2008.

[5] ASTM E 691-99, *"Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method"*.

[6] EURACHEM / CITAC Guide CG 4 *"Quantifying Uncertainty in Analytical Measurement"*.

ANNEX 1: HOMOGENEITY

	Al_2O_3		Fe_2O_3		TiO_2		CaO		Na_2O	
	%		%		%		%		%	
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
1	0.050	0.048	0.004	0.004	31.254	31.013	0.003	0.004	0.005	0.004
2	0.050	0.048	0.004	0.003	31.556	31.189	0.004	0.004	0.005	0.004
3	0.050	0.048	0.004	0.004	31.399	30.935	0.004	0.004	0.005	0.005
4	0.051	0.049	0.004	0.004	32.653	30.975	0.004	0.005	0.005	0.004
5	0.051	0.050	0.004	0.003	32.120	31.541	0.003	0.004	0.005	0.004
6	0.052	0.048	0.004	0.003	32.208	31.397	0.004	0.004	0.005	0.004
7	0.049	0.052	0.004	0.003	33.055	31.031	0.004	0.004	0.005	0.004
8	0.050	0.051	0.004	0.003	31.145	32.545	0.004	0.004	0.004	0.004
9	0.051	0.051	0.003	0.003	31.218	30.984	0.004	0.004	0.005	0.004
10	0.050	0.058	0.005	0.003	31.426	31.862	0.004	0.004	0.004	0.004
M_b	4.21988E-08		5.42662E-07		1.040614876		3.01291E-07		5.89685E-08	
M_w	5.08869E-06		1.6857E-07		0.356445201		1.51758E-07		1.53844E-08	
F	0.008		3.219		2.919		1.985		3.833	
F_{crit}	4.414		4.414		4.414		4.414		4.414	
Sample A	passed		passed		passed		passed		passed	

	Al_2O_3		Fe_2O_3		TiO_2		CaO		Na_2O	
	%		%		%		%		%	
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
1	0.331	0.326	0.066	0.065	55.214	55.094	0.008	0.008	0.013	0.013
2	0.331	0.324	0.066	0.065	55.219	52.916	0.008	0.008	0.013	0.013
3	0.330	0.324	0.066	0.065	52.858	55.097	0.008	0.008	0.013	0.013
4	0.334	0.325	0.068	0.064	55.260	53.654	0.008	0.008	0.013	0.013
5	0.330	0.324	0.067	0.063	54.686	52.822	0.008	0.008	0.013	0.013
6	0.320	0.329	0.063	0.065	52.225	54.752	0.007	0.007	0.013	0.013
7	0.322	0.328	0.064	0.064	52.187	53.117	0.007	0.008	0.013	0.014
8	0.326	0.329	0.065	0.064	52.965	53.671	0.007	0.008	0.013	0.014
9	0.325	0.333	0.064	0.065	52.889	55.953	0.008	0.008	0.013	0.014
10	0.328	0.331	0.065	0.065	53.575	53.191	0.008	0.009	0.013	0.014
M_b	7.91101E-07		4.26985E-06		0.508164389		3.72732E-08		1.55434E-07	
M_w	1.41359E-05		1.30863E-06		1.410634729		1.27011E-07		9.19236E-08	
F	0.056		3.263		0.360		0.293		1.691	
F_{crit}	4.414		4.414		4.414		4.414		4.414	
Sample B	passed		passed		passed		passed		passed	

	Al_2O_3		Fe_2O_3		TiO_2		CaO		Na_2O	
	%		%		%		%		%	
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
1	0.488	0.470	0.048	0.047	30.140	30.720	0.004	0.003	0.003	0.003
2	0.483	0.487	0.048	0.048	29.653	29.701	0.003	0.003	0.003	0.003
3	0.489	0.479	0.049	0.047	30.328	29.657	0.003	0.003	0.003	0.003
4	0.482	0.484	0.048	0.048	30.090	31.017	0.003	0.003	0.003	0.003
5	0.480	0.480	0.047	0.047	29.951	29.552	0.003	0.003	0.003	0.003
6	0.477	0.481	0.048	0.048	30.950	33.013	0.003	0.003	0.003	0.003
7	0.487	0.485	0.049	0.047	31.715	31.410	0.003	0.003	0.003	0.003
8	0.484	0.467	0.047	0.046	30.878	29.611	0.003	0.003	0.003	0.003
9	0.479	0.486	0.047	0.048	29.558	31.424	0.003	0.003	0.003	0.003
10	0.477	0.483	0.047	0.049	30.740	31.298	0.003	0.003	0.003	0.003
M_b	3.23835E-05		9.00354E-07		0.577632252		1.0555E-07		2.49498E-09	
M_w	3.12022E-05		5.69172E-07		0.856935909		3.70042E-08		2.90945E-08	
F	1.038		1.582		0.674		2.852		0.086	
F_{crit}	4.414		4.414		4.414		4.414		4.414	
Sample C	passed		passed		passed		passed		passed	

	Al_2O_3		Fe_2O_3		TiO_2		CaO		Na_2O	
	%		%		%		%		%	
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
1	0.159	0.153	0.067	0.069	38.773	38.774	0.009	0.009	0.015	0.015
2	0.159	0.153	0.067	0.070	39.154	38.519	0.009	0.009	0.015	0.015
3	0.159	0.153	0.068	0.069	39.313	38.401	0.008	0.009	0.015	0.015
4	0.157	0.152	0.065	0.070	37.980	38.635	0.009	0.009	0.015	0.014
5	0.161	0.153	0.067	0.071	37.647	38.826	0.009	0.009	0.015	0.014
6	0.160	0.153	0.067	0.065	40.122	39.717	0.009	0.009	0.015	0.015
7	0.156	0.162	0.069	0.064	39.941	39.736	0.009	0.009	0.015	0.015
8	0.155	0.161	0.066	0.065	39.325	40.377	0.009	0.010	0.015	0.015
9	0.152	0.161	0.067	0.064	40.464	41.063	0.010	0.010	0.014	0.016
10	0.153	0.158	0.067	0.066	38.742	37.880	0.009	0.010	0.014	0.015
M_b	6.8424E-06		5.78166E-07		0.011025284		6.14091E-07		1.6042E-12	
M_w	1.3136E-05		4.40603E-06		0.899410337		1.85893E-07		1.25553E-07	
F	0.521		0.131		0.012		3.303		0.000	
F_{crit}	4.414		4.414		4.414		4.414		4.414	
Sample D	passed		passed		passed		passed		passed	

ANNEX 2: TEST ITEM ACCOMPANYING LETTER

A Coruña, 31 January 2021

<<Title>> <<Firstname>> <<Surname>>
<<Organisation>>
<<Department>>
<<Address>>
<< Address 2>>
<<Zip>> <<Town>>
<<Country>>

Subject: Participation in Erimsa Interlaboratory comparison programme (Erimsa-ITL-21)

Dear <<Title>> <<Surname>>,

Thank you for participation in the Erimsa-ITL-21 Interlaboratory comparison programme.

The parcel you receive contains, in addition to this letter:

- 4 samples of the test item (approx. 35 g each); and
- The "Confirmation of receipt" form.

Upon arrival of this parcel, please check whether the test item is undamaged after transport, and send us by email the "Confirmation of receipt" form at your earliest convenience.

The procedure used for the analyses should resemble as closely as possible the one you use in routine analyses.

Perform two or three independent measurements and report:

- the mean of your two or three measurements results,
- the associated standard deviation,
- the analytical technique used.

Excel file to report the results will be sent to email. In case you have not received them or the file is damaged, please contact to us as soon as possible.

The deadline for submission of results is **July 31, 2021**.

Your participation in this project is greatly appreciated.

Do not to hesitate to contact us, in case of questions/doubts,

Yours sincerely,

/signed electronically /

Alejandro Arenosa

Laboratory Head, Erimsa-ITL-21 Coordinator

ANNEX 3: CONFIRMATION OF RECEIPT

A Coruña, 31 January 2021

Attn.: <<Title>> <<Firstname>> <<Surname>>
<<Organisation>>
<<Department>>
<<Address>>
<< Address 2>>
<<Zip>> <<Town>>
<<Country>>

Subject: "Confirmation receipt" form Erimsa Interlaboratory comparison programme (Erimsa-ITL-21)

Please return this form at your earliest convenience, to confirm that the package arrived well. If samples are damaged, mention it under "Remarks" and contact us as soon as possible.

Date of package arrival _____

Remarks _____

_____

Signature _____

Thank you for returning this form by email to:

Mr. Alejandro Arenosa

Laboratory Head, Erimsa-ITL-21 Coordinator

e-mail: alejandro.arenosa@erimsa.com

ANNEX 4: FORM FOR REPORTING THE RESULTS

Interlab 2021 **LabX** **Sample A**

Main Elements

Element	Units	Average	StdDev	Ner Data
Al_2O_3	%			
As_2O_3	%			
B_2O_3	%			
BaO_2	%			
Bi_2O_3	%			
CaO	%			
CdO	%			
CoO	%			
Cr_2O_3	%			
CuO	%			
Fe_2O_3	%			
K_2O	%			
La_2O_3	%			
LOI	%			
MgO	%			
MnO	%			
MoO_3	%			
Na_2O	%			
NiO	%			
P_2O_5	%			
PbO	%			
Sb_2O_3	%			
SiO_2	%			
SnO_2	%			
SrO	%			
TiO_2	%			
V_2O_5	%			
ZnO	%			
ZrO_2	%			

Additional Elements

Element	Units	Average	StdDev	Ner Data
	%			
	%			
	%			
	%			
	%			

ANNEX 5

ANNEX 5.1. MEASUREMENTS SAMPLE A[2]

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO	MnO	P_2O_5	B_2O_3
	%	%	%	%	%	%	%	ppm	ppm	ppm
x_{pt}	0.0403	0.0048	0.0033	0.0039	0.0056	0.0064	0.0009	3.79	10.84	3.96
σ_{pt}	0.0114	0.0029	0.0007	0.0017	0.0023	0.0013	0.0004	4.14	13.39	4.35
N	27	25	24	23	23	24	18	15	13	4

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO	MnO	P_2O_5	B_2O_3
	%	%	%	%	%	%	%	ppm	ppm	ppm
Lab 1	0.0506	0.0037	0.0032	0.0037	0.0044	0.0065	0.0011	1.29	6.47	4.42
Lab 2	0.0454	0.0042	0.0038	0.0042	0.0045	0.0055	0.0007	1.00	2.50	
Lab 3	0.0500	0.0210	0.0040	0.0036	0.0550	0.0070		8.00	10.00	<3
Lab 4	0.0490	0.0220	0.0034	0.0066	0.0067	0.0078	0.0002			
Lab 5	0.0510	0.0240	0.0030	0.0030	0.0037	0.0070	<0.0001	10.00	3.00	
Lab 6	0.0398	0.0038	0.0033	0.0029	0.0055	0.0072	0.0009	1.00	2.00	1.00
Lab 7	0.0480	0.0038	0.0035	0.0040	0.0053	0.0065	0.0007	0.50		
Lab 8	0.3729	0.0405	0.0029	0.0373		0.0070	0.0008	3.20	1.10	9.20
Lab 9	0.0276	0.0093	0.0029	0.0021	0.0040	0.0051	0.0012		1.00	
Lab 10	0.0445	0.0042	0.0024	0.0072	0.0070	0.0055	0.0011			
Lab 11	0.0351	0.0063	0.0043	<0.0001	0.0048	0.0046	<0.0001	5.00	<1	
Lab 12	0.0461	0.0010	0.0025	0.0012						
Lab 13	0.0210		0.0030	0.0060			0.0110			
Lab 14										
Lab 15	0.0394	0.0036	0.0033	0.0029	0.0053	0.0059	0.0009			
Lab 16	0.0364	0.0035	0.0033	0.0031	0.0044	0.0055	0.0006			
Lab 17	0.0388	0.0038	0.0034	0.0026	0.0055	0.0060	0.0008	1.90	<0.1	
Lab 18	0.0340	0.0020	0.0030	0.0030	0.0040	0.0050	0.0070		10.00	
Lab 19	0.0300	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Lab 20	0.0719	0.0216	0.0174	0.0127		0.0136		11.30	11.00	
Lab 21	0.0369	0.0038		0.0029	0.0123	0.0064	0.0004	1.57		
Lab 22	0.0352	0.0034	0.0060		0.0034	0.0044	0.0006	0.86		
Lab 23	<0.003	0.0060		0.0060	0.0280	0.0150			30.00	
Lab 24	0.0538	0.0058	0.0040	0.0047	0.0064	0.0084	0.0023	2.00	66.00	
Lab 25	0.0260	0.0003	0.0063	<LLD	0.0017	0.0067	<LLD	9.30	<LLD	
Lab 26	0.0295	0.0014	0.0010	0.0012	0.0013	0.0038	0.0000	<0.002		<0.07
Lab 27	0.0227	0.0029	0.0010	0.0029	0.0180	0.0064			75.80	
Lab 28										
Lab 29	0.0404	0.0051	0.0036	0.0113	0.0056	0.0068	0.0012	1.24	1.95	1.20
Lab 30	0.0400				0.0200					

[2] < - values are marked in Orange.

	ZnO	V_2O_5	NiO	PbO	CuO	CoO	CdO	Cr_2O_3	Sc_2O_3	BaO_2
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
x_{pt}	4.87	4.13	1.74	3.45	3.28	1.98	1.00	2.54	28.01	17.34
σ_{pt}	7.05	5.73	1.29	6.44	1.51	1.22	1.07	0.63	54.40	26.65
N	5	5	7	3	10	8	3	13	3	11

	ZnO	V_2O_5	NiO	PbO	CuO	CoO	CdO	Cr_2O_3	Sc_2O_3	BaO_2
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Lab 1	1.10	0.76	0.72	0.24	4.57	1.82	<0.1	2.60	0.32	
Lab 2		0.20	1.10		2.00			2.40		
Lab 3										70.00
Lab 4										
Lab 5										<0.001
Lab 6		1.00	1.00					3.00		
Lab 7								2.30		
Lab 8					3.20	1.50		2.80		0.90
Lab 9										94.00
Lab 10										
Lab 11										45.00
Lab 12										
Lab 13										
Lab 14										
Lab 15								3.00		3.00
Lab 16										
Lab 17	0.50		2.70		1.80	2.20		2.30		
Lab 18										
Lab 19										<0.01
Lab 20		11.70			7.00			157.00		
Lab 21						10.81	1.96	2.63		3.32
Lab 22	1.70		0.73	0.10	1.82	1.45	0.95	1.78		0.97
Lab 23										
Lab 24	18.00				3.00			2.00		1.00
Lab 25	<LLD	7.00	<LLD	10.00	<LLD			<LLD		10.00
Lab 26	<0.02	<0.006	<0.4	<0.005	2.39	0.30	<0.008	0.14	83.40	<0.003
Lab 27			3.60		4.70	3.09				11.00
Lab 28										
Lab 29	5.66	<0.24	2.32	<0.31	3.79	1.71	0.08	3.18	0.29	1.02
Lab 30										

	LiO_2	SO_3	MoO_3	HfO_2	Nb_2O_5	ZrO_2	As_2O_3	Bi_2O_3	Sb_2O_3	SnO_2
	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
x_{pt}	17.15	12.60	4.03	70.33		0.3405	0.45	0.17	0.05	0.05
σ_{pt}		8.13	6.04	3.09		0.0334	0.08	0.21		
N	1	4	2	2		11	2	2	1	1

	LiO_2	SO_3	MoO_3	HfO_2	Nb_2O_5	ZrO_2	As_2O_3	Bi_2O_3	Sb_2O_3	SnO_2
	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
Lab 1										
Lab 2										
Lab 3										
Lab 4										
Lab 5		20.00								
Lab 6										
Lab 7										
Lab 8							0.40	0.30		
Lab 9		9.00				0.3438				
Lab 10										
Lab 11		17.00								
Lab 12										
Lab 13										
Lab 14										
Lab 15						0.3210				
Lab 16						0.3220				
Lab 17						0.3490				
Lab 18										
Lab 19										
Lab 20										
Lab 21										
Lab 22			0.27			0.3081		0.04	0.05	0.05
Lab 23										
Lab 24						0.3002				
Lab 25						0.3473				
Lab 26			<0.04	68.40		0.3820	<0.008	<0.005	<0.02	<0.03
Lab 27			7.80			0.4913	0.50			
Lab 28										
Lab 29	17.15	4.40	<0.18	72.25	<0.46	0.3601				
Lab 30						0.3200				

	SrO	Ga_2O_3	GeO_2	Rb_2O	La_2O_3	Y_2O_3	Cl	LOI	SiO_2
	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%
x_{pt}	21.21		1.62	1.02	0.04	288.80	0.0042	0.2200	99.6742
σ_{pt}	41.04						0.0036	0.0607	0.2507
N	3		1	1	1	1	2	4	12

	SrO	Ga_2O_3	GeO_2	Rb_2O	La_2O_3	Y_2O_3	Cl	LOI	SiO_2
	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%
Lab 1									
Lab 2									
Lab 3									
Lab 4									
Lab 5									99.900
Lab 6									
Lab 7									99.930
Lab 8									
Lab 9									99.604
Lab 10									
Lab 11									99.696
Lab 12									
Lab 13									99.959
Lab 14									
Lab 15									99.500
Lab 16									
Lab 17								0.2000	
Lab 18									
Lab 19								0.3000	99.600
Lab 20							0.0064		99.720
Lab 21	0.42								
Lab 22	0.20				0.04				
Lab 23								0.1900	99.930
Lab 24									
Lab 25	63.00							0.1900	
Lab 26	<0.08	<0.003	1.62	1.02					
Lab 27						288.80	0.0019		99.400
Lab 28									
Lab 29									99.554
Lab 30									98.130

ANNEX 5.1.1. Z-SCORE SAMPLE A

	Al2O3	Fe2O3	TiO2	CaO	Na2O	K2O	MgO
Lab 1	0.9	-0.4	-0.2	-0.1	-0.5	0.1	0.4
Lab 2	0.4	-0.2	0.6	0.2	-0.5	-0.7	-0.3
Lab 3	0.8	5.6	1.0	-0.2	21.5	0.5	
Lab 4	0.8	5.9	0.1	1.6	0.5	1.1	-1.6
Lab 5	0.9	6.6	-0.5	-0.5	-0.8	0.5	
Lab 6	0.0	-0.4	-0.1	-0.6	0.0	0.6	0.1
Lab 7	0.7	-0.4	0.2	0.1	-0.1	0.1	-0.4
Lab 8	29.2	12.3	-0.6	19.4		0.5	-0.2
Lab 9	-1.1	1.5	-0.6	-1.0	-0.7	-0.9	0.8
Lab 10	0.4	-0.2	-1.4	1.9	0.6	-0.6	0.5
Lab 11	-0.5	0.5	1.4		-0.3	-1.3	
Lab 12	0.5	-1.3	-1.3	-1.5			
Lab 13	-1.7		-0.5	1.2			24.4
Lab 14							
Lab 15	-0.1	-0.4	-0.1	-0.6	-0.1	-0.3	0.1
Lab 16	-0.3	-0.5	-0.1	-0.4	-0.5	-0.6	-0.7
Lab 17	-0.1	-0.4	0.1	-0.7	0.0	-0.3	-0.2
Lab 18	-0.6	-1.0	-0.5	-0.5	-0.7	-1.0	14.8
Lab 19	-0.9						
Lab 20	2.8	5.8	20.7	5.1		5.4	
Lab 21	-0.3	-0.3		-0.6	2.9	0.0	-1.2
Lab 22	-0.5	-0.5	3.9		-0.9	-1.4	-0.7
Lab 23		0.4		1.2	9.8	6.5	
Lab 24	1.2	0.3	1.0	0.5	0.4	1.5	3.3
Lab 25	-1.3	-1.6	4.4		-1.7	0.3	
Lab 26	-0.9	-1.2	-3.4	-1.5	-1.9	-1.9	-2.0
Lab 27	-1.5	-0.6	-3.5	-0.6	5.4	0.0	
Lab 28							
Lab 29	0.0	0.1	0.5	4.3	0.0	0.3	0.8
Lab 30	0.0				6.3		

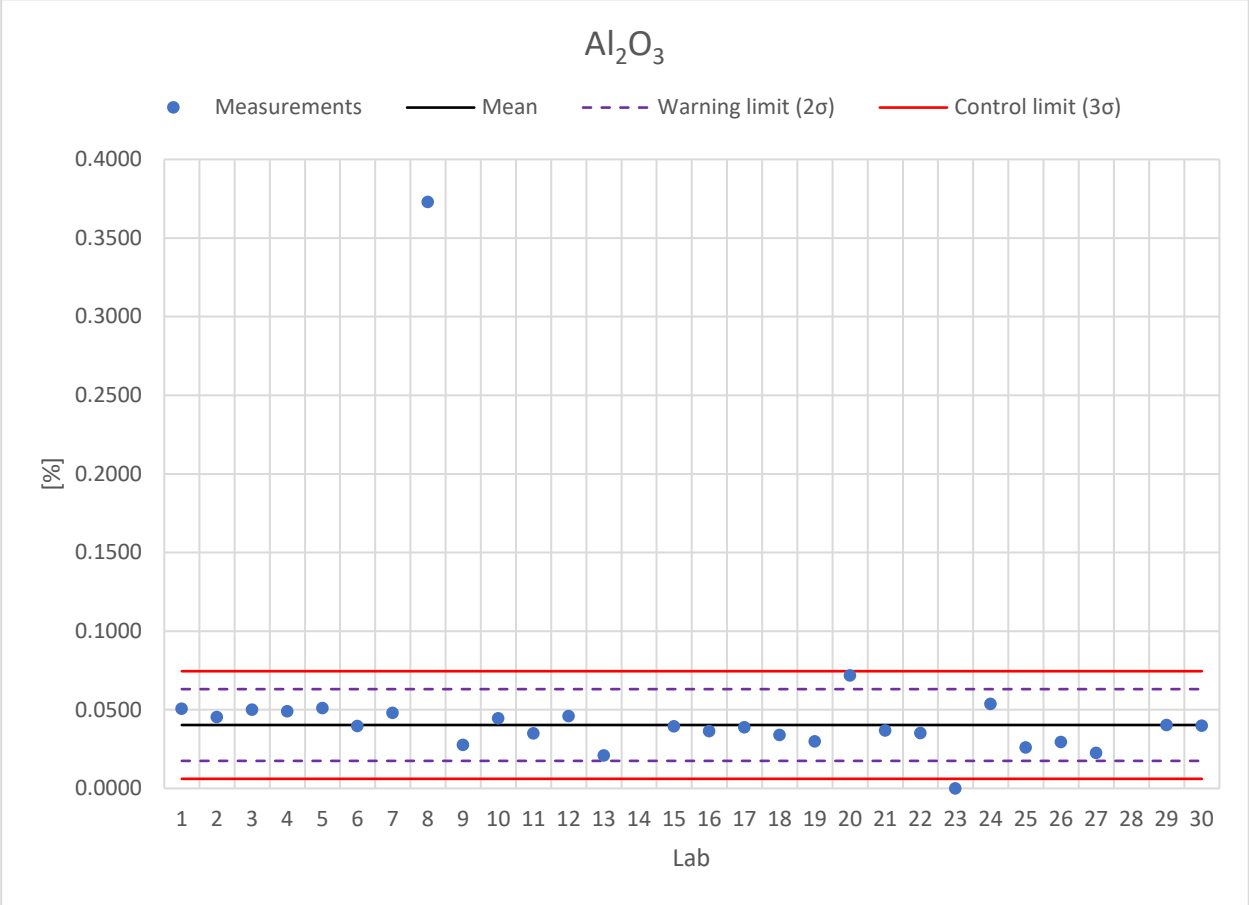
Satisfactory performance
Questionable performance
Unsatisfactory performance

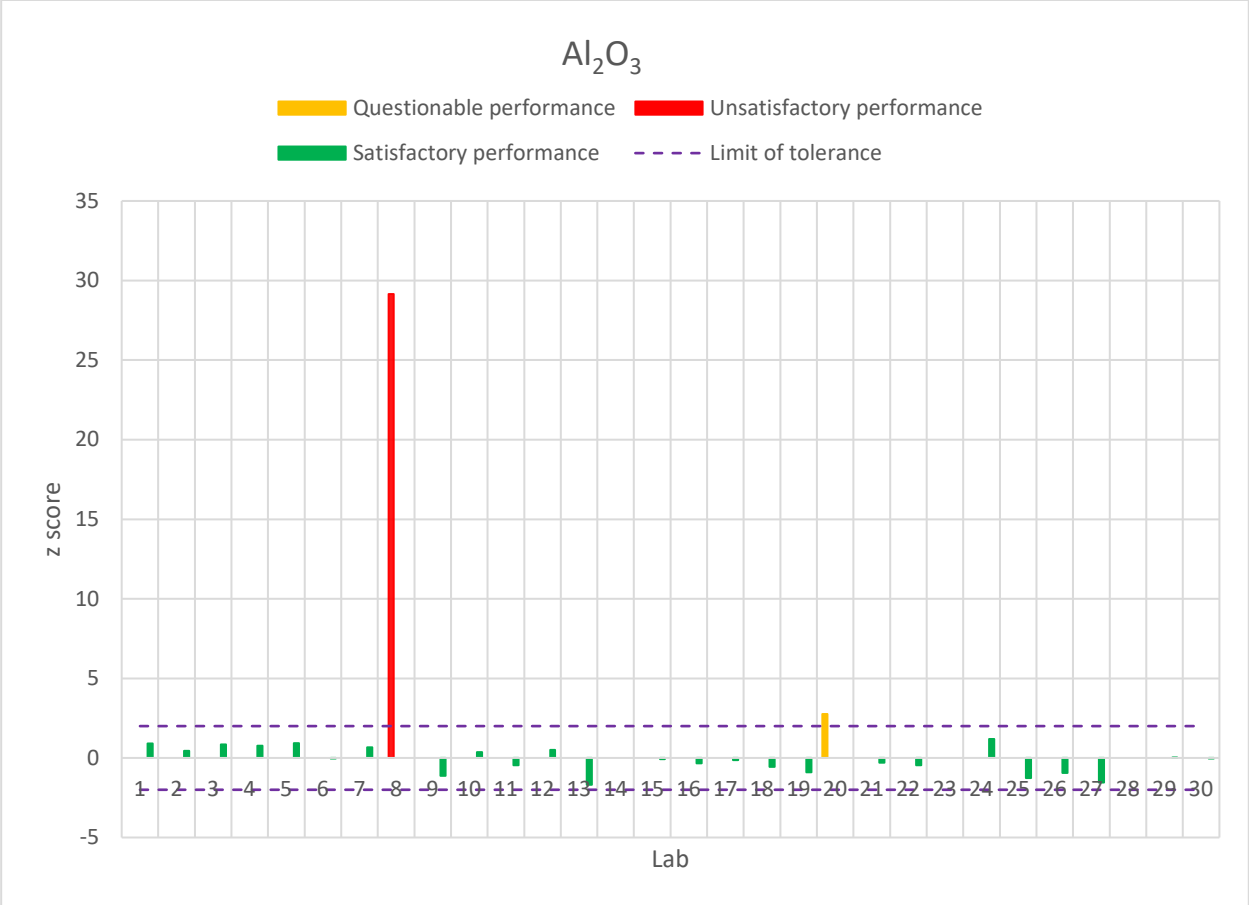
ANNEX 5.1.2. Z'-SCORE SAMPLE A

	MnO	P_2O_5	CoO	Cr_2O_3	BaO_2	SiO_2
Lab 1	-0.6	-0.3	-0.1	0.1		
Lab 2	-0.6	-0.6		-0.2		
Lab 3	1.0	-0.1			1.8	
Lab 4						
Lab 5	1.4	-0.6				0.9
Lab 6	-0.6	-0.6		0.7		
Lab 7	-0.8			-0.4		1.0
Lab 8	-0.1	-0.7	-0.4	0.4	-0.6	
Lab 9		-0.7			2.7	-0.3
Lab 10						
Lab 11	0.3				1.0	0.1
Lab 12						
Lab 13						1.1
Lab 14						
Lab 15				0.7	-0.5	-0.7
Lab 16						
Lab 17	-0.4		0.2	-0.4		
Lab 18		-0.1				
Lab 19						-0.3
Lab 20	1.7	0.0		231.8		0.2
Lab 21	-0.5		6.6	0.1	-0.5	
Lab 22	-0.7		-0.4	-1.1	-0.6	
Lab 23		1.4				1.0
Lab 24	-0.4	3.9		-0.8	-0.6	
Lab 25	1.3				-0.3	
Lab 26			-1.3	-3.6		
Lab 27		4.6	0.8		-0.2	-1.1
Lab 28						
Lab 29	-0.6	-0.6	-0.2	1.0	-0.6	-0.5
Lab 30						-6.2

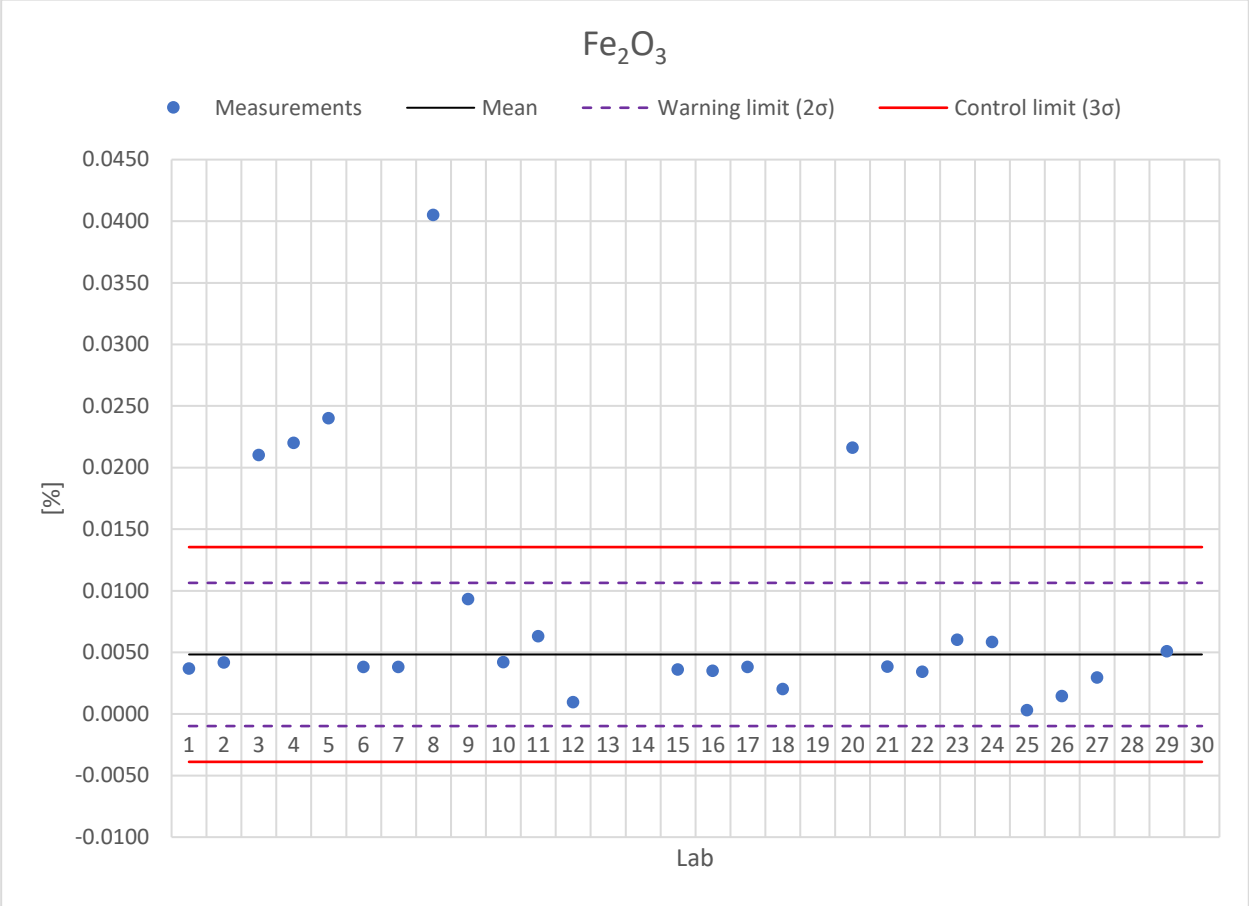
Satisfactory performance
Questionable performance
Unsatisfactory performance

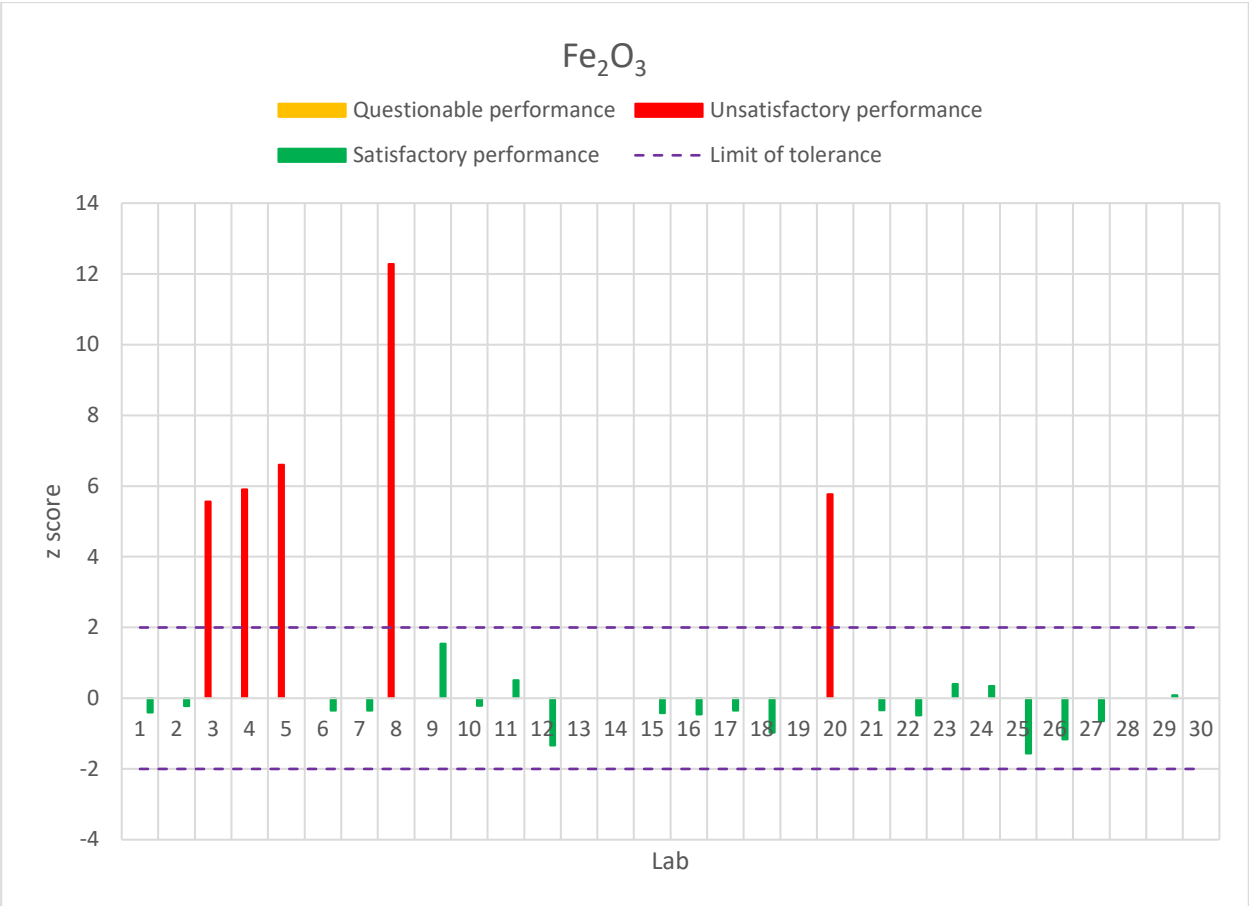
ANNEX 5.1.3. CHARTS SAMPLE A



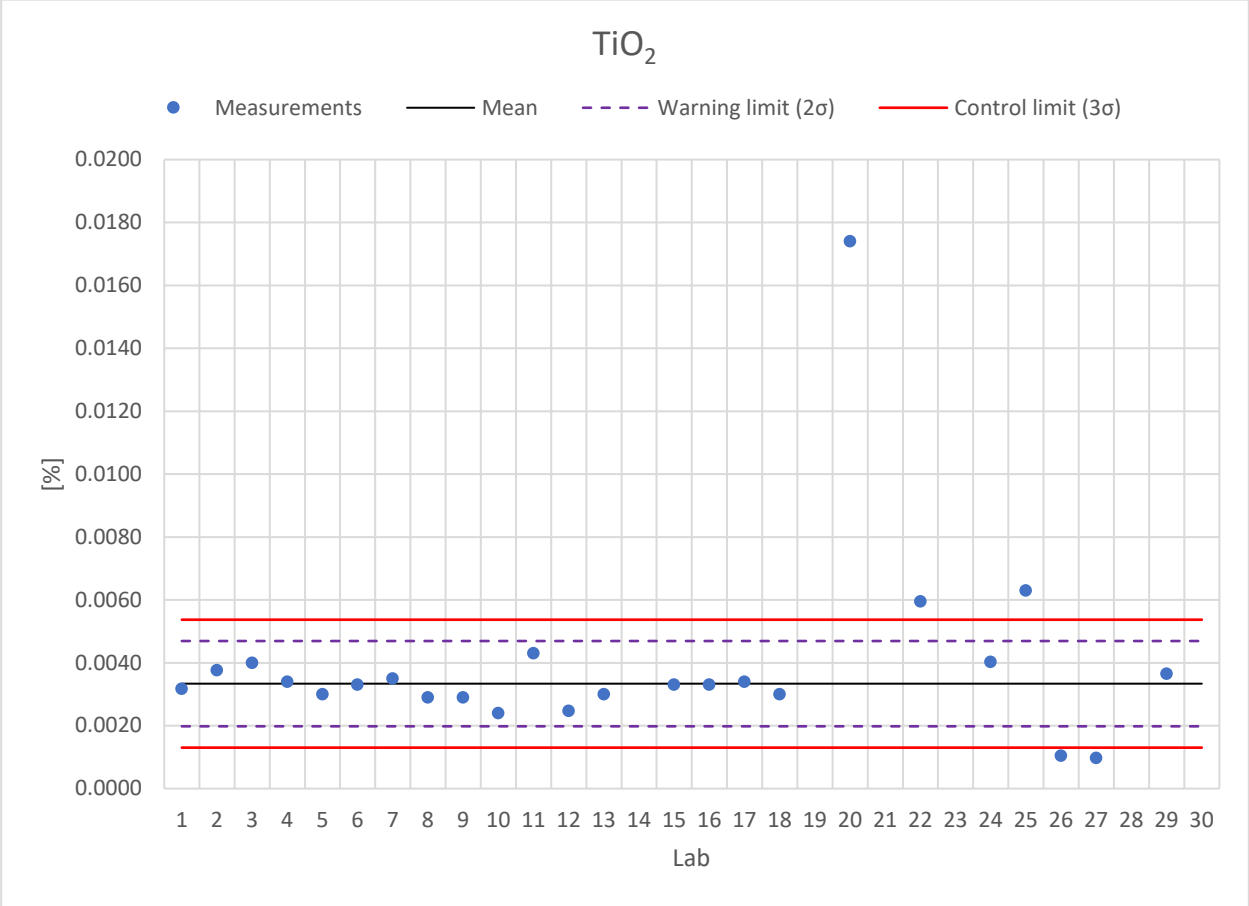


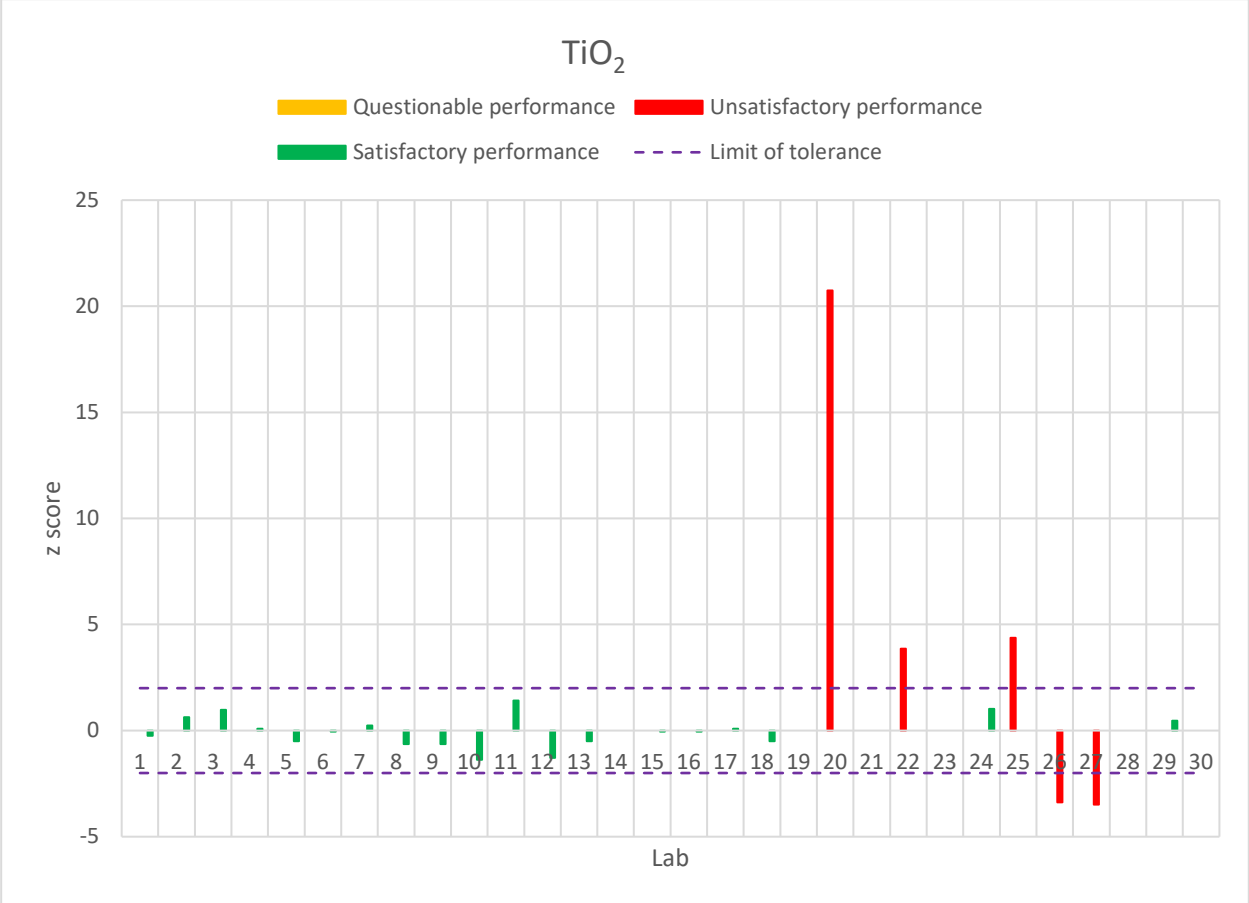
CHARTS SAMPLE A



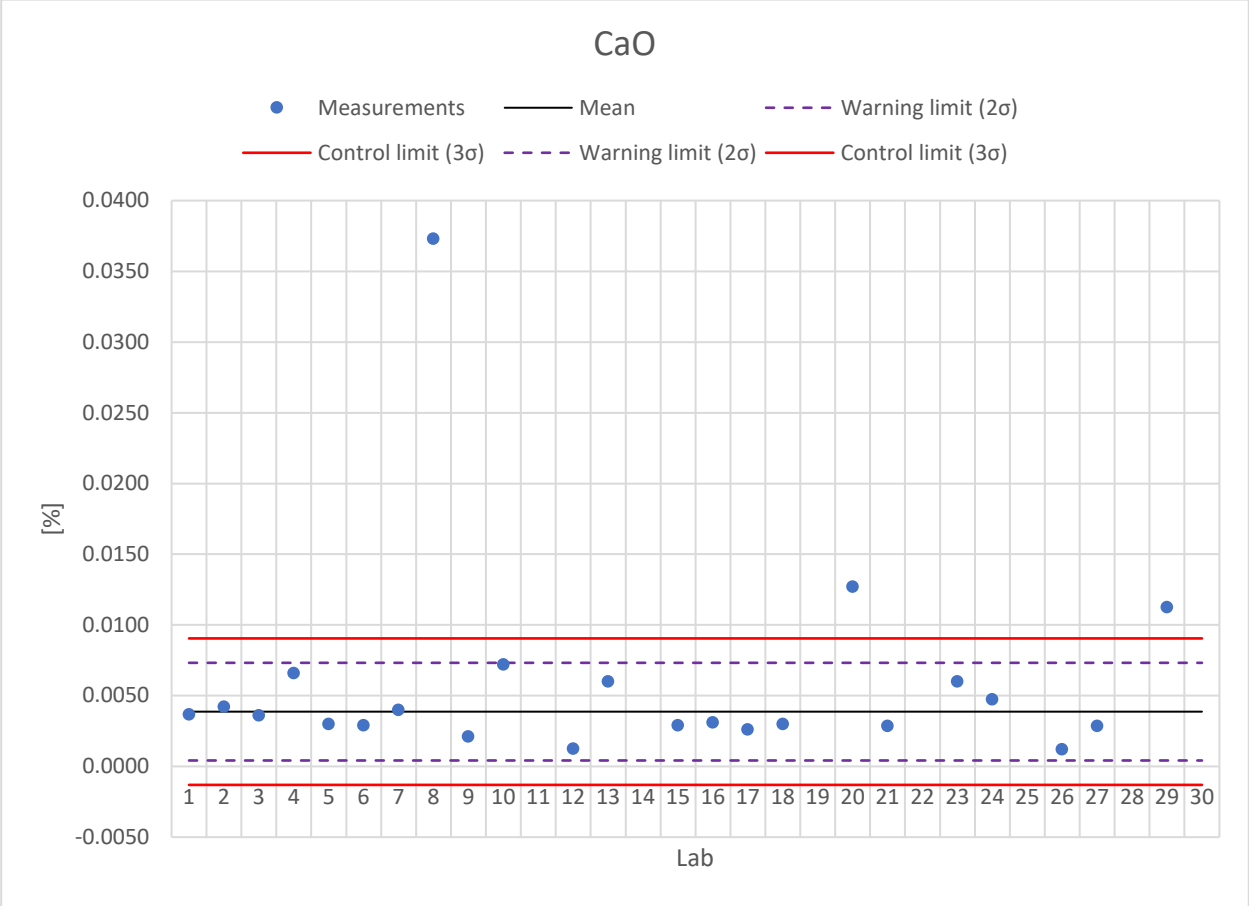


CHARTS SAMPLE A

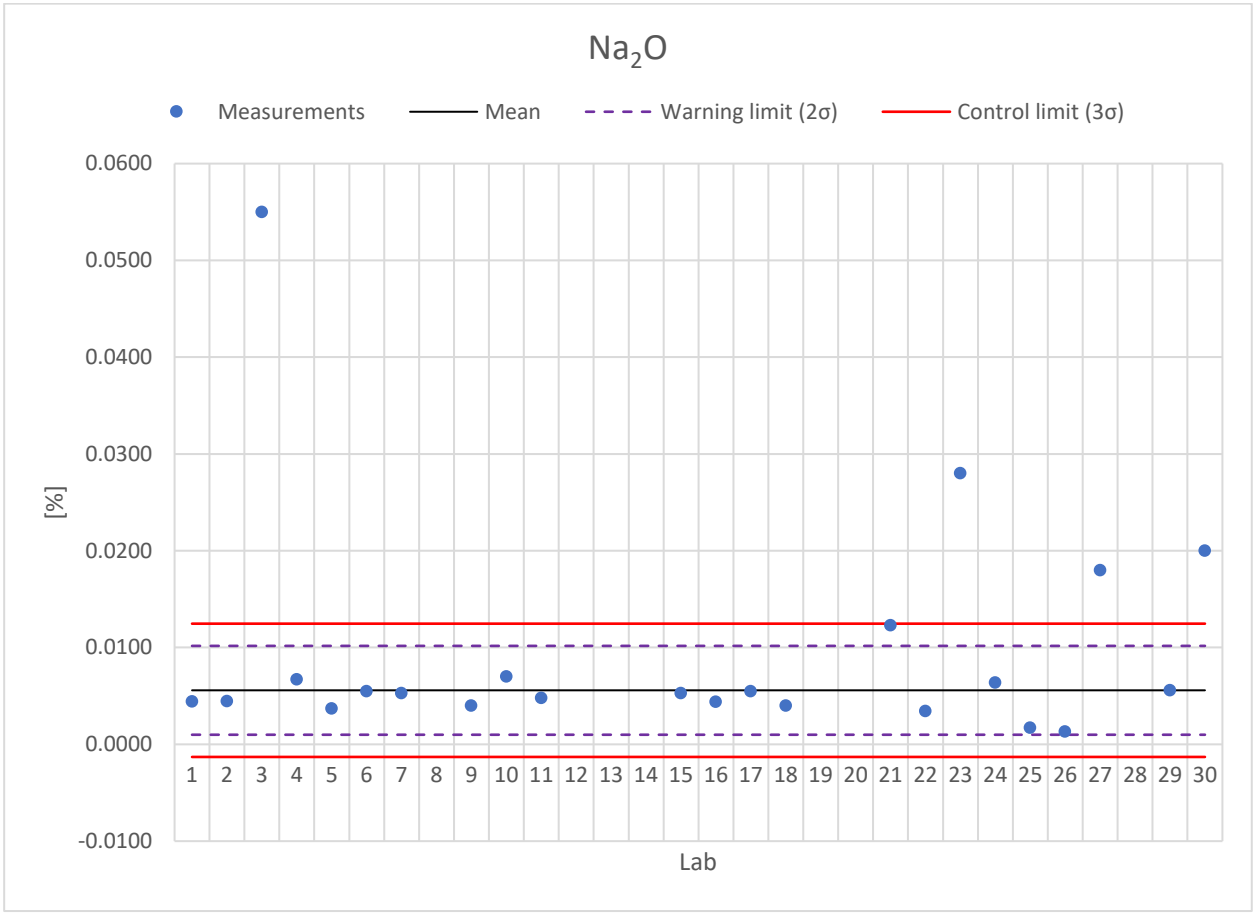


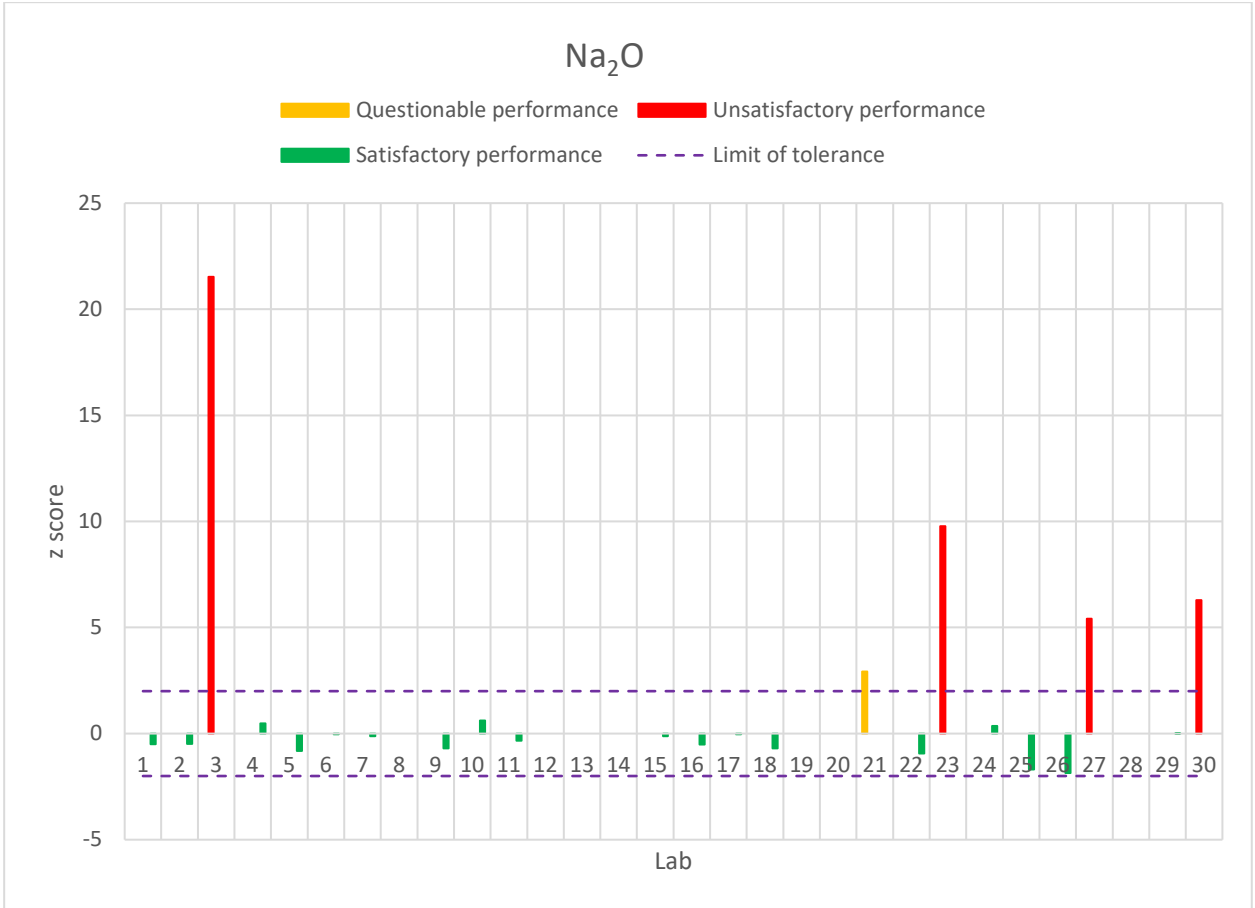


CHARTS SAMPLE A

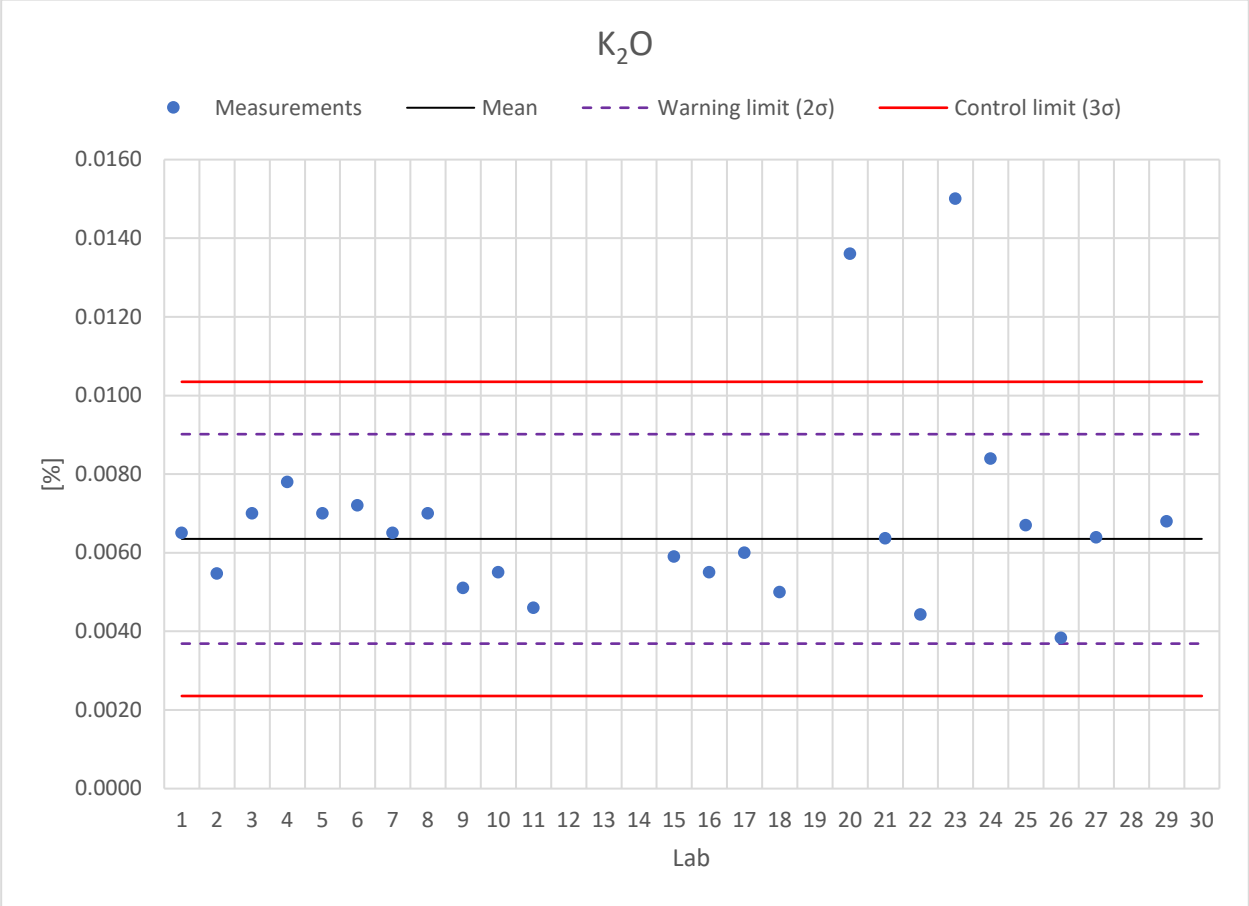


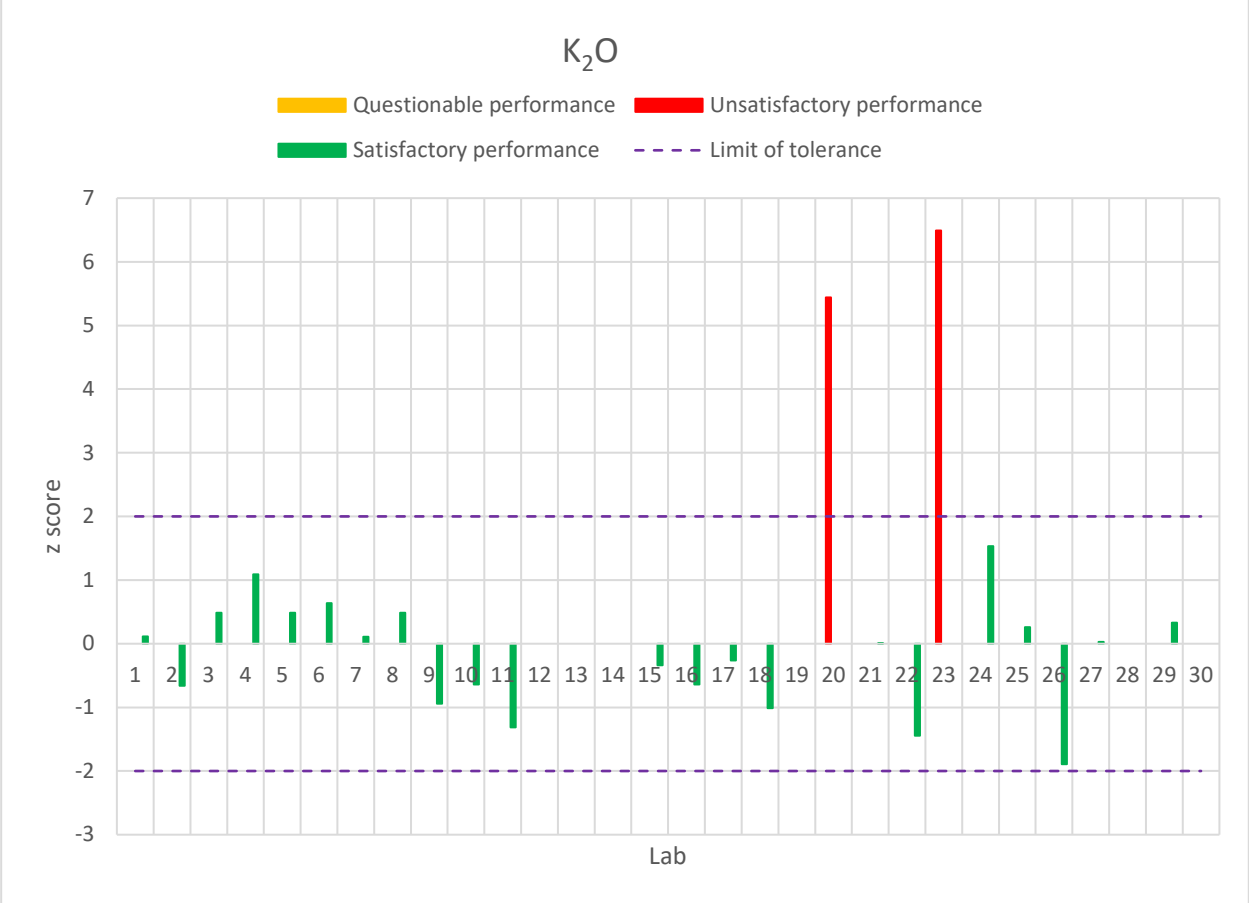
CHARTS SAMPLE A



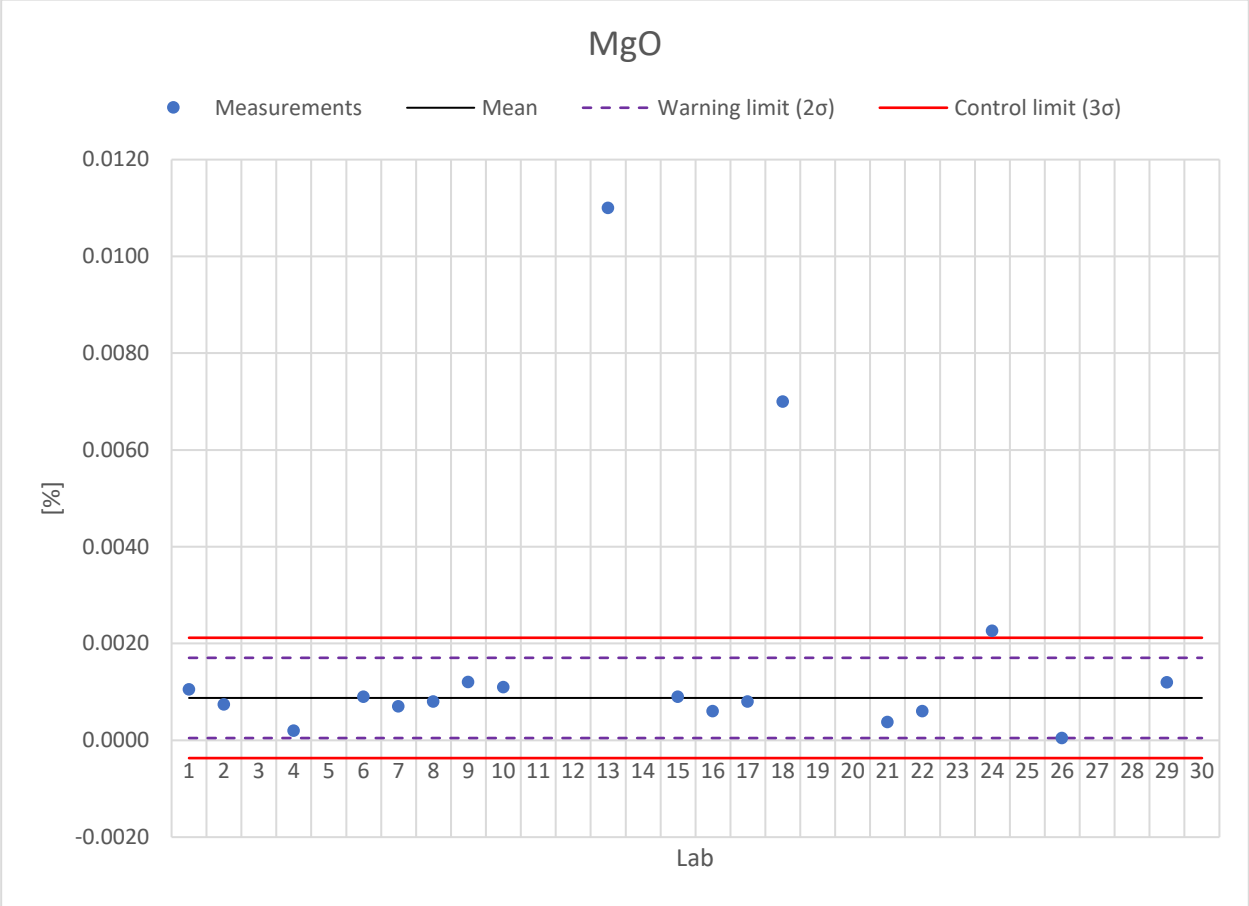


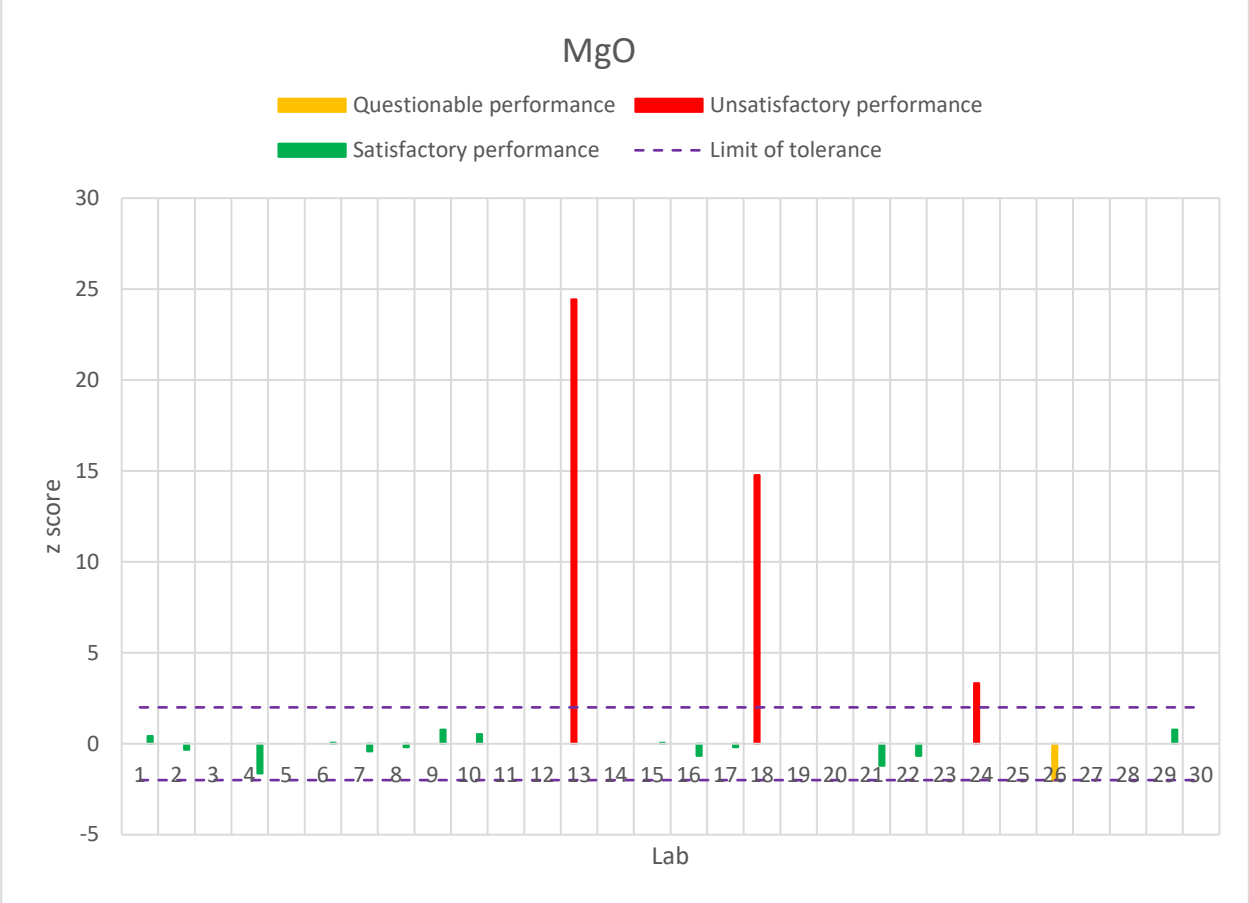
CHARTS SAMPLE A



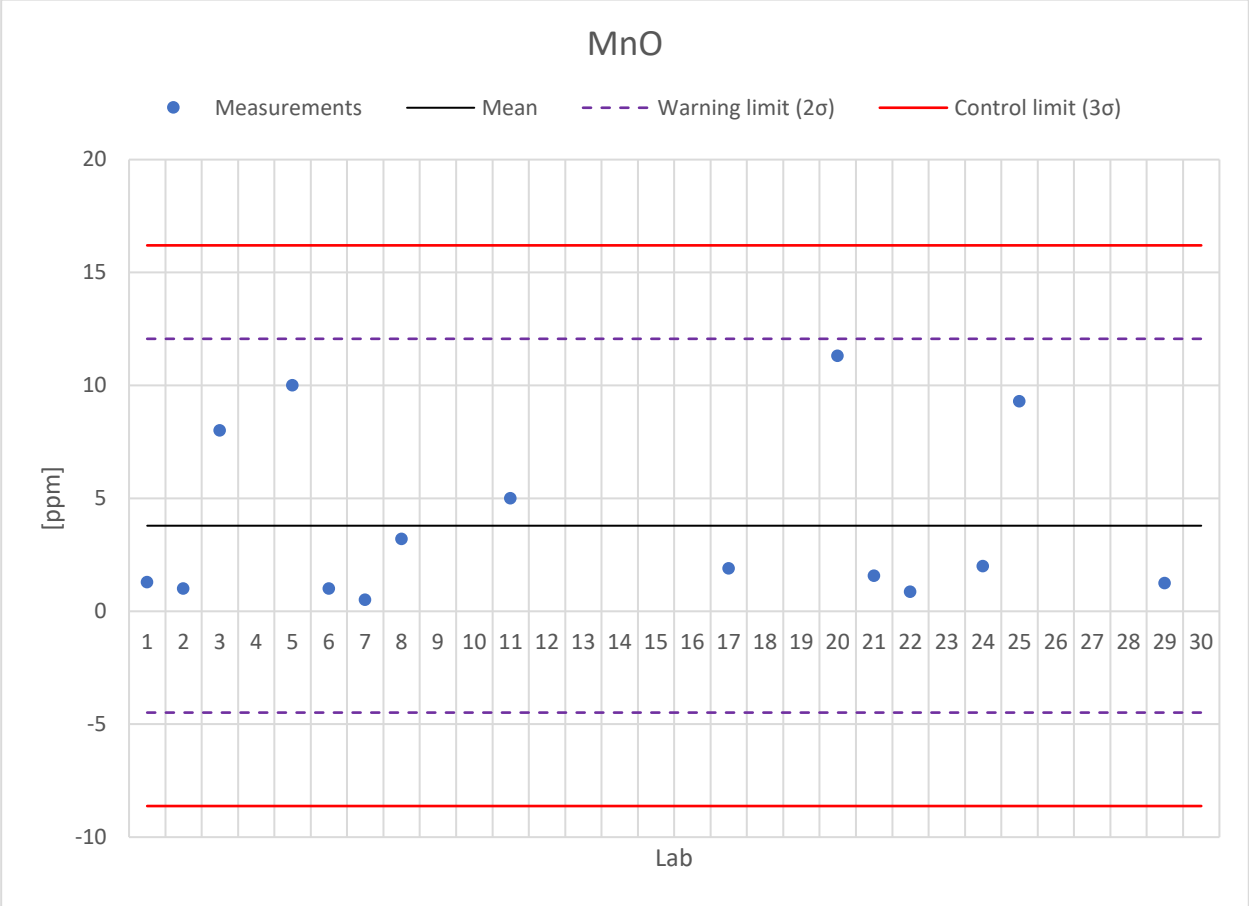


CHARTS SAMPLE A

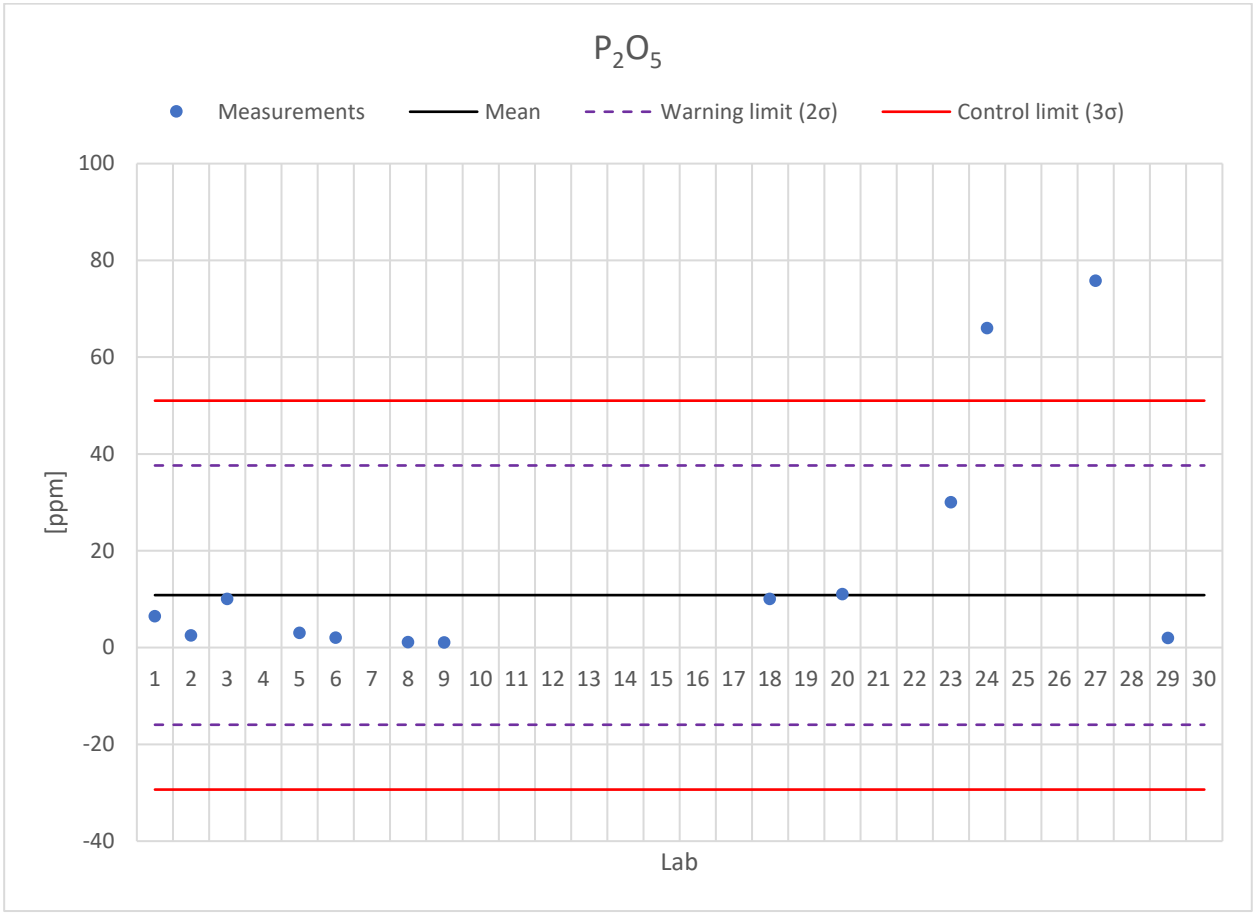


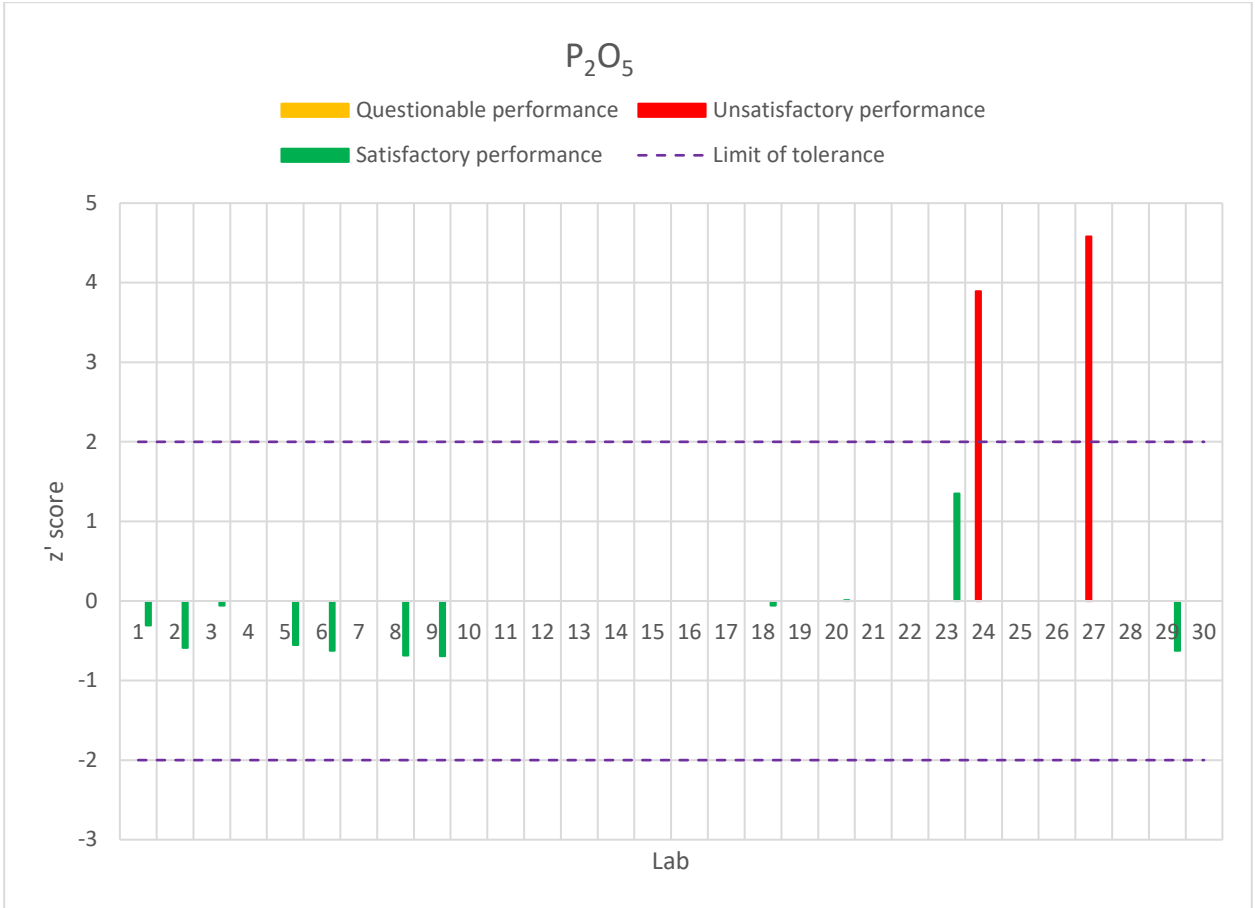


CHARTS SAMPLE A

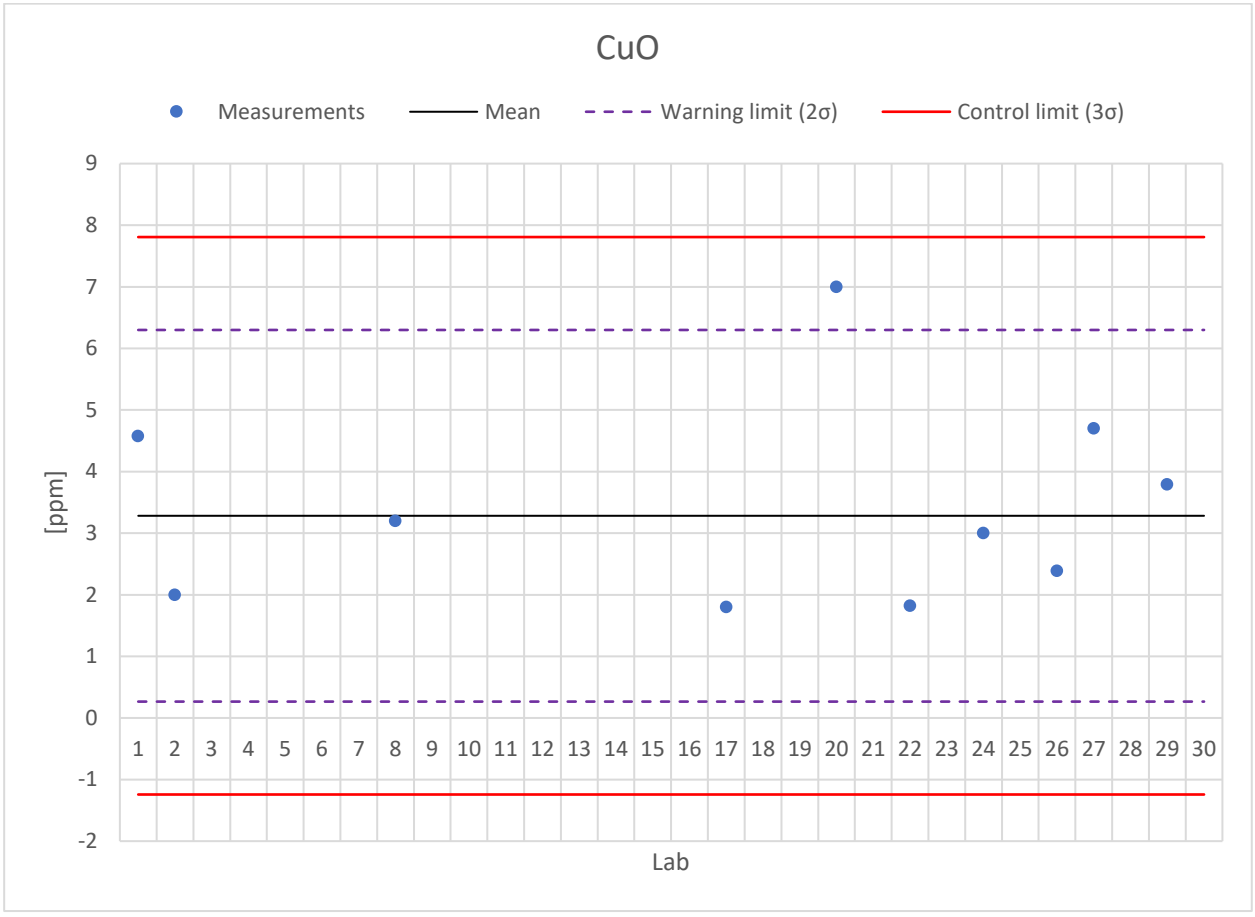


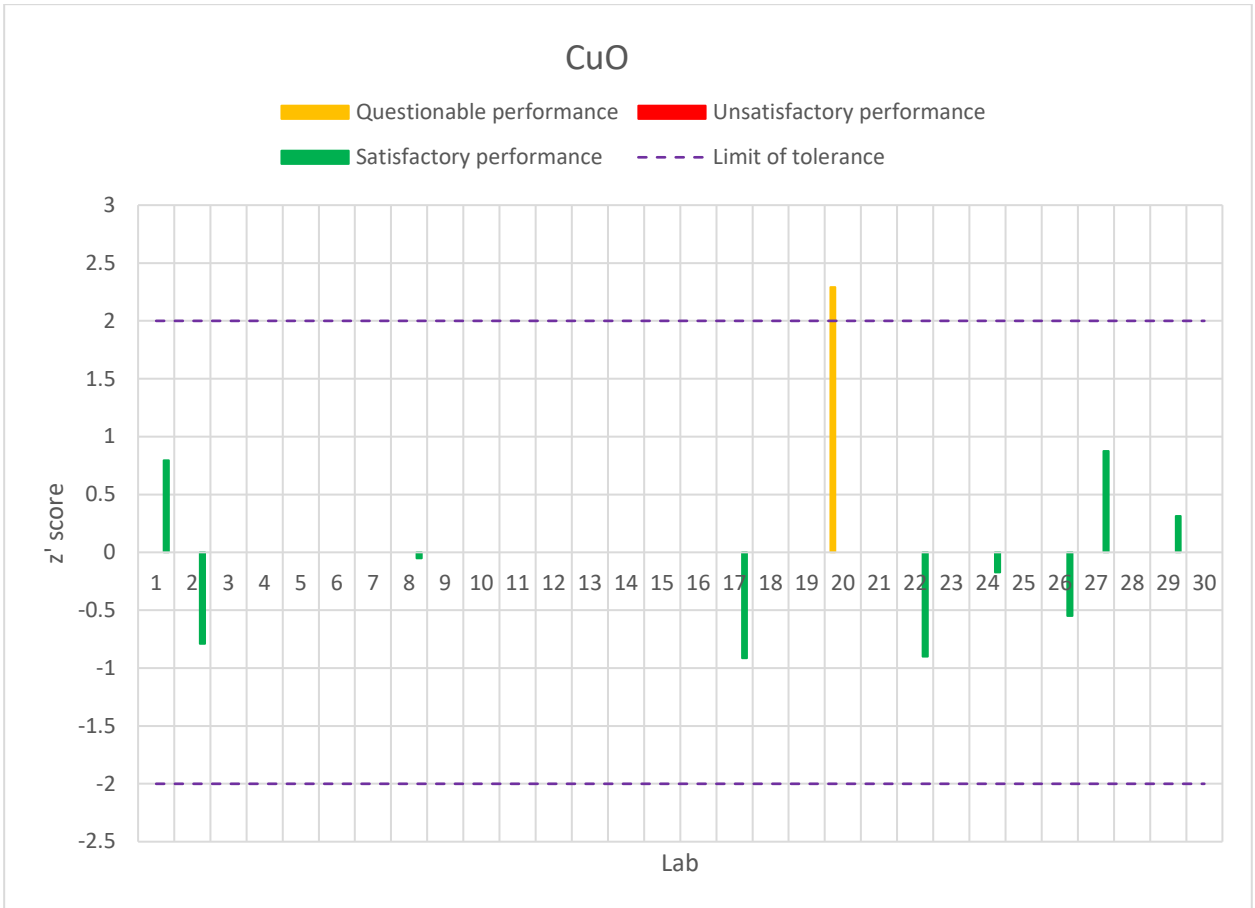
CHARTS SAMPLE A



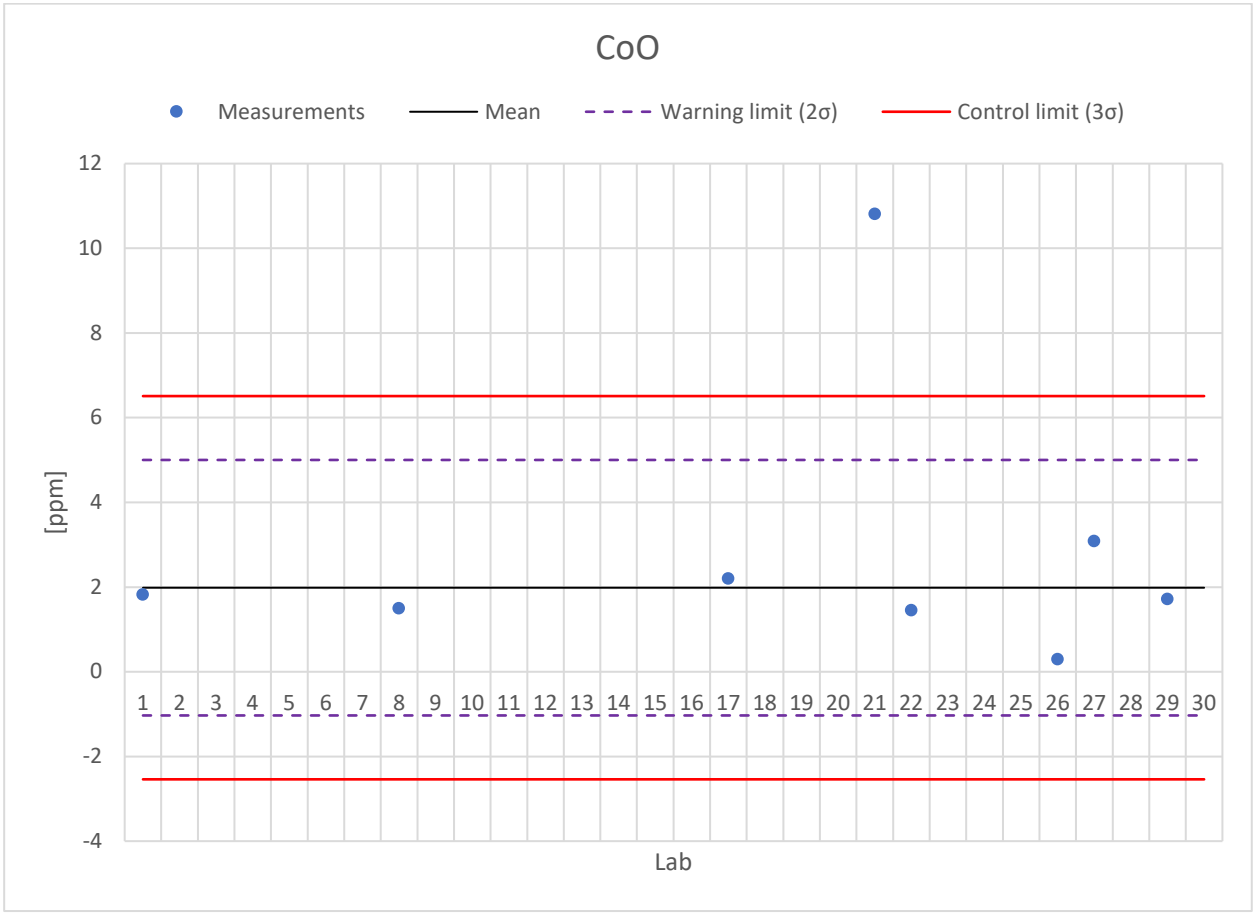


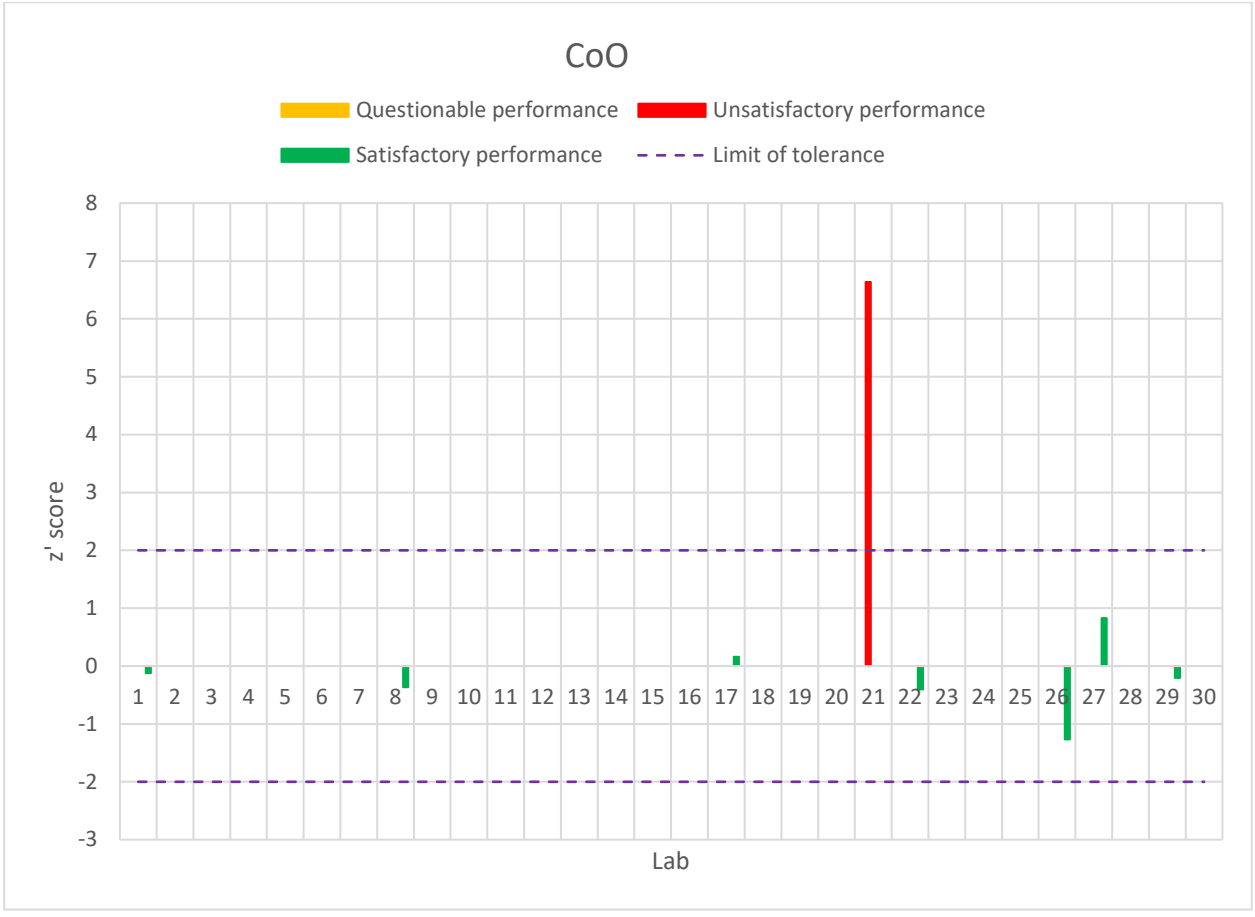
CHARTS SAMPLE A



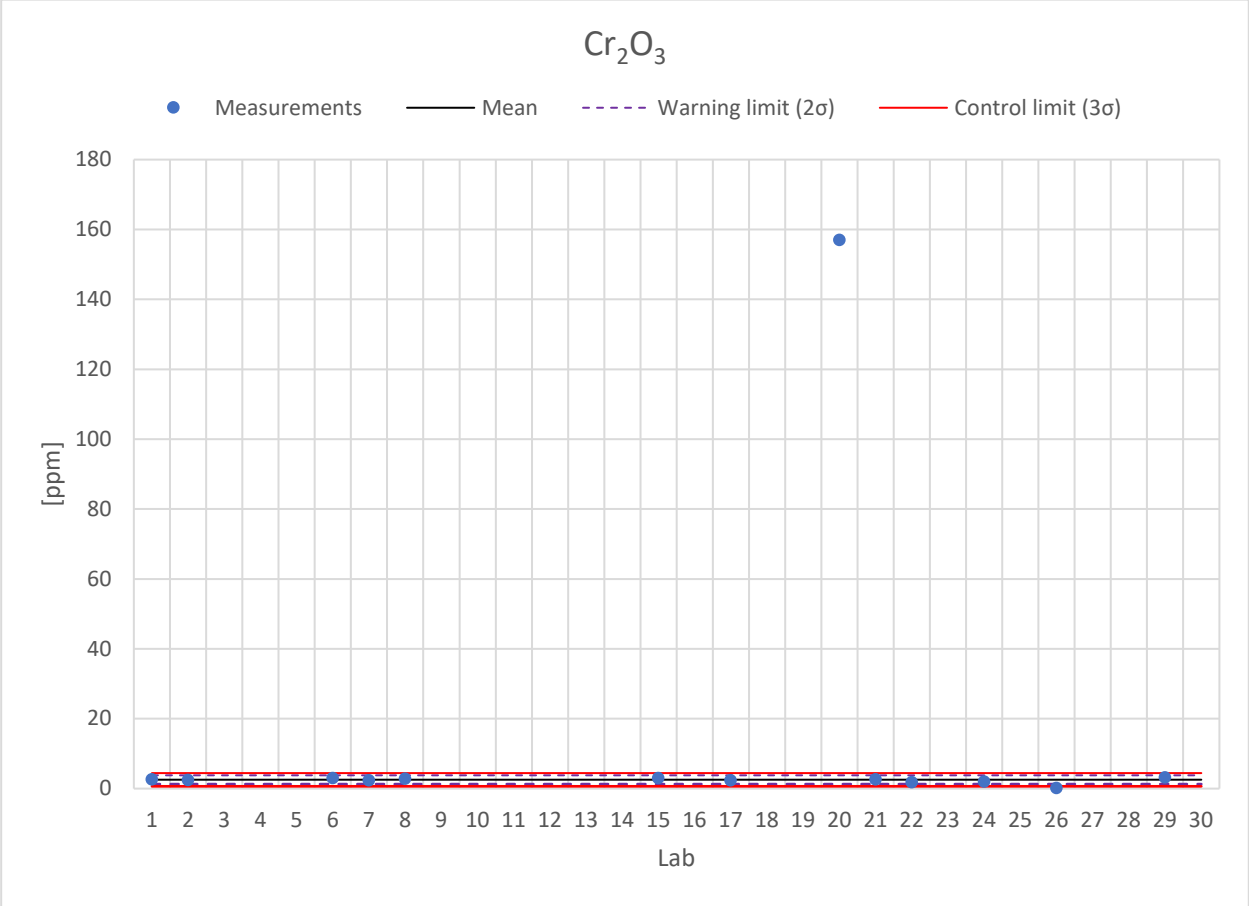


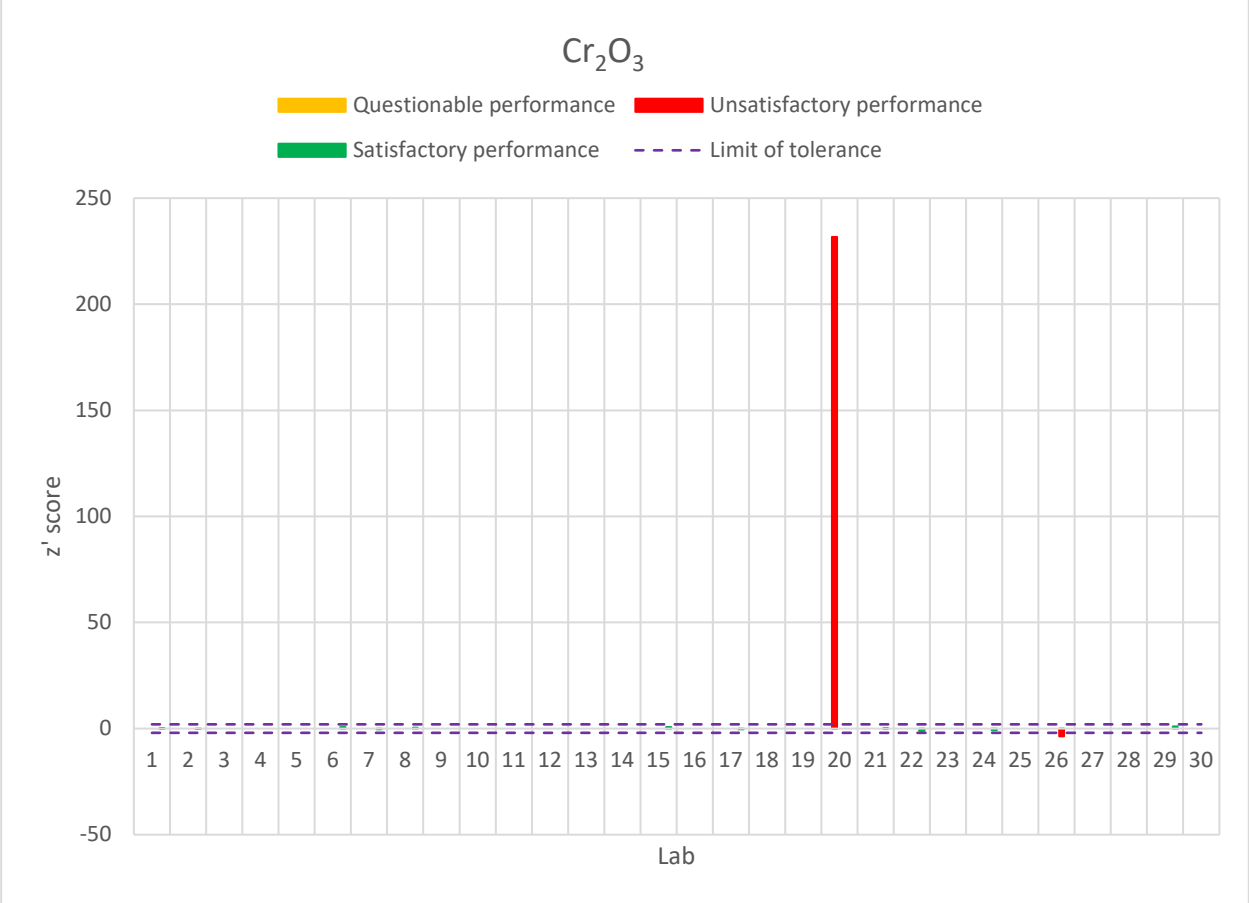
CHARTS SAMPLE A



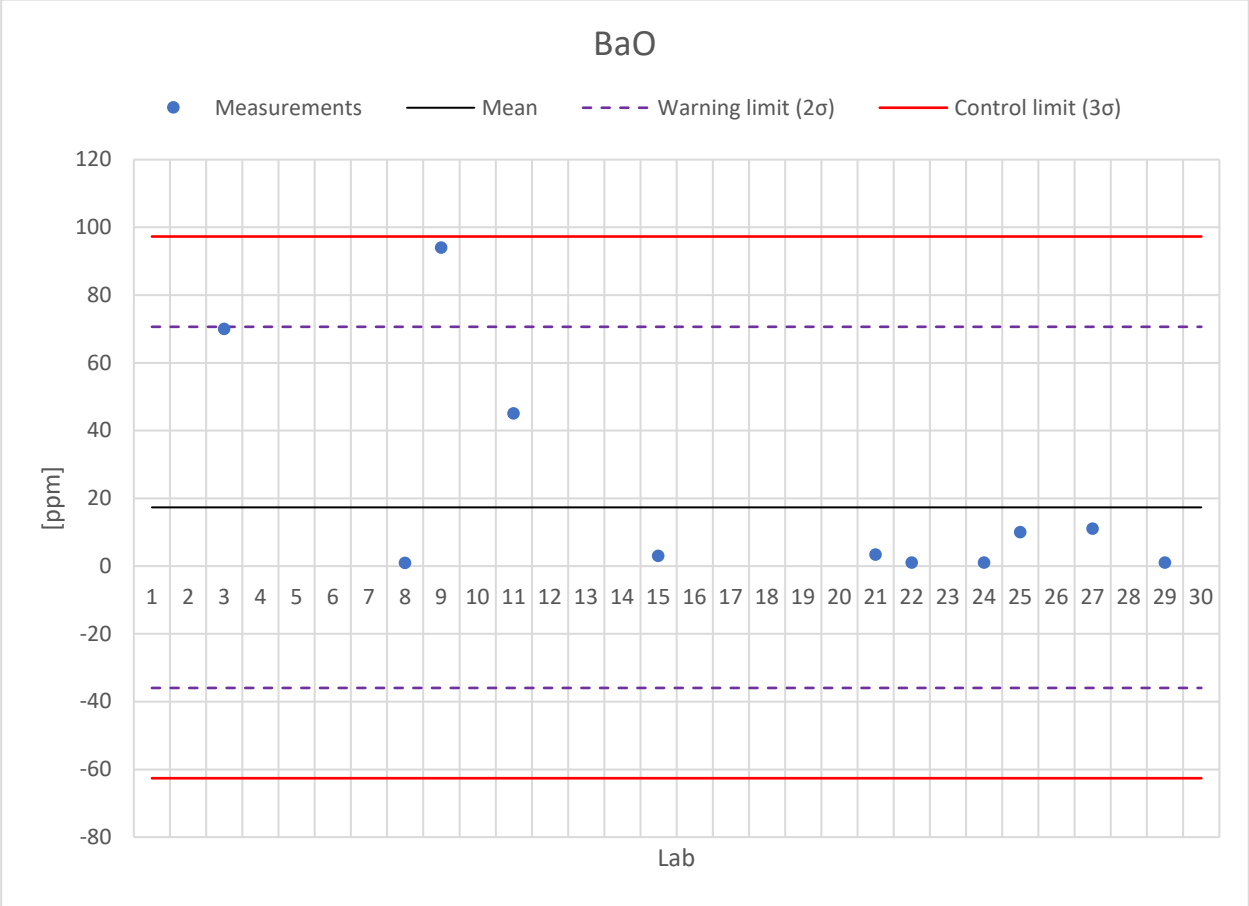


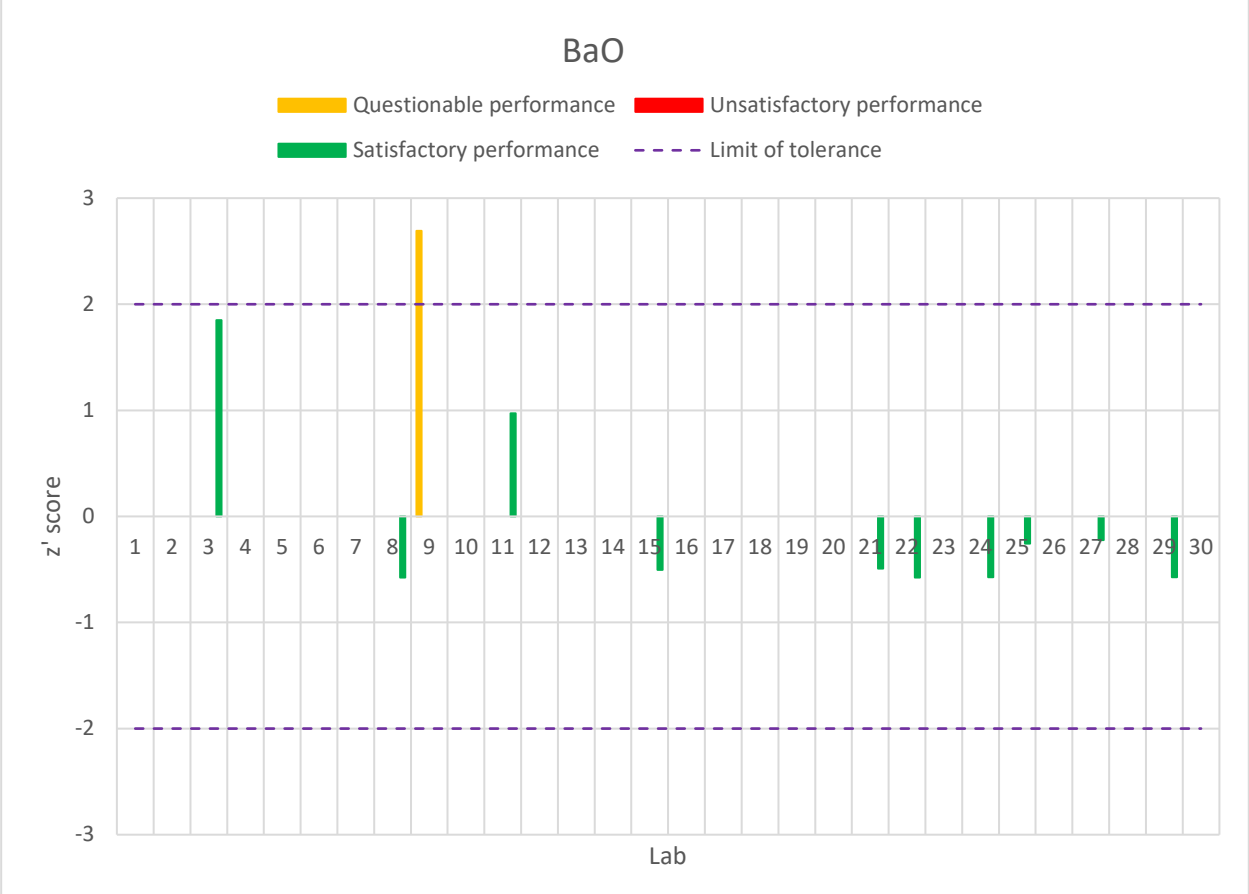
CHARTS SAMPLE A



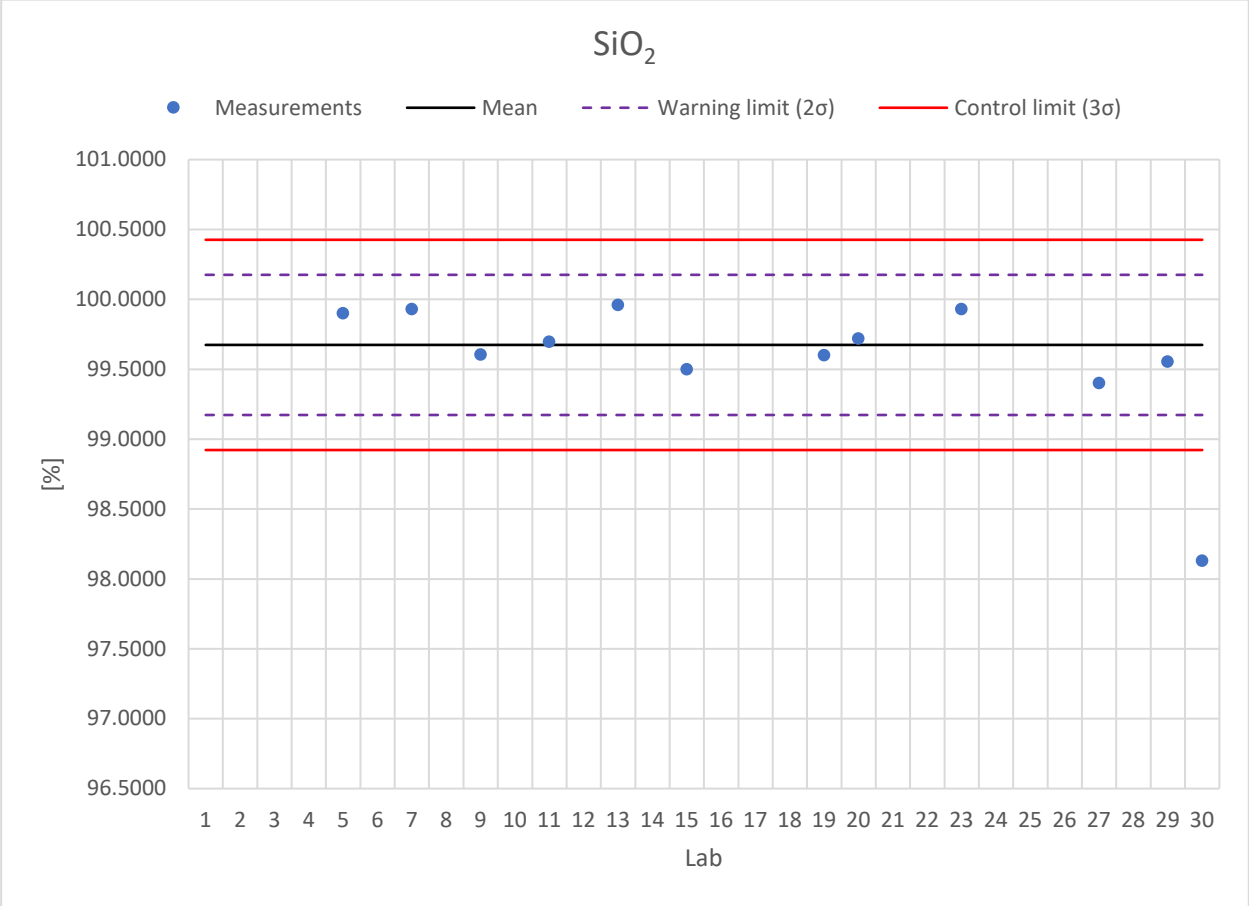


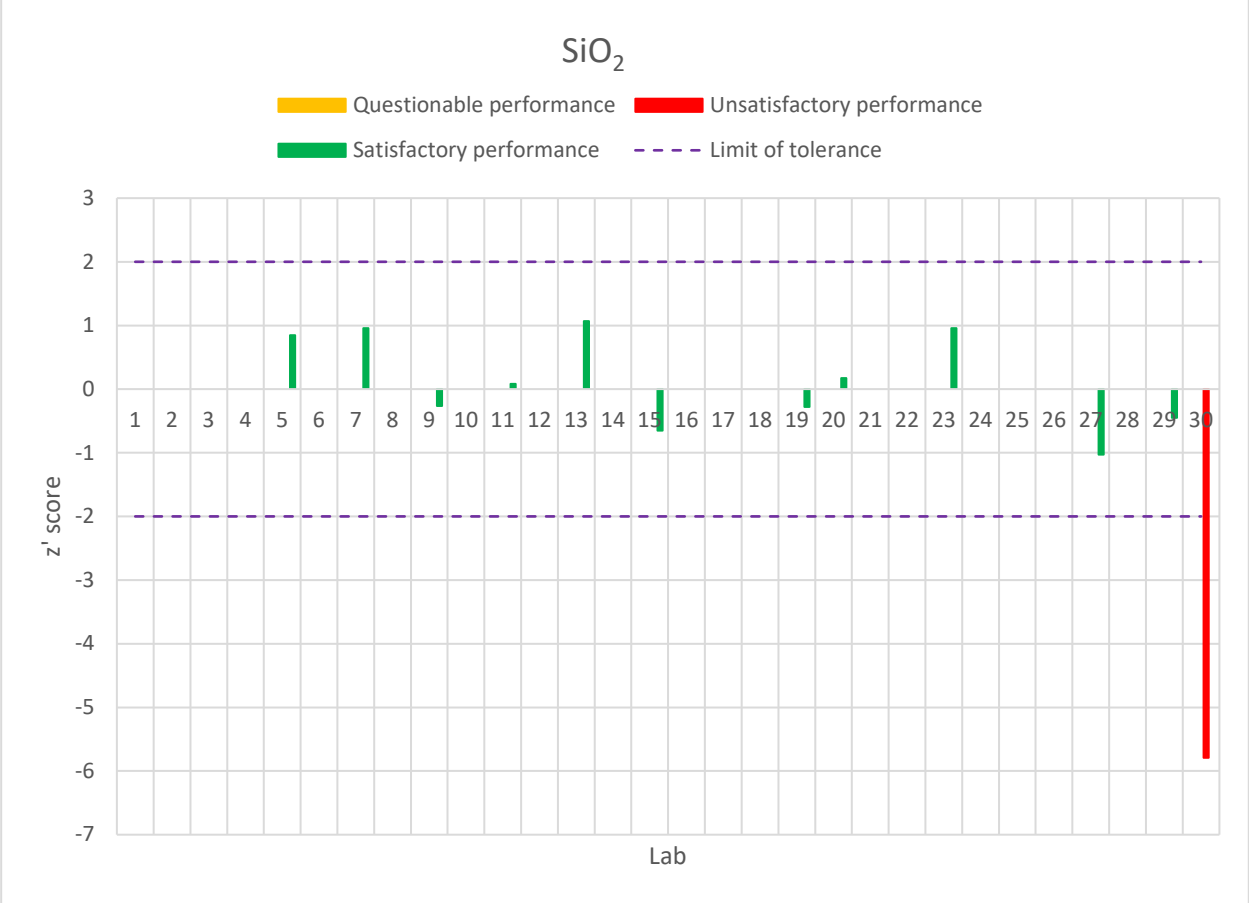
CHARTS SAMPLE A





CHARTS SAMPLE A





ANNEX 5.2. MEASUREMENTS SAMPLE B[3]

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO	MnO	P_2O_5	B_2O_3
	%	%	%	%	%	%	%	ppm	ppm	ppm
x_{pt}	0.3026	0.0663	0.0058	0.0074	0.0129	0.0978	0.0097	7.88	34.24	18.16
σ_{pt}	0.0347	0.0071	0.0011	0.0025	0.0021	0.0138	0.0014	1.48	6.51	4.72
N	28	27	26	25	22	26	23	16	16	5

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO	MnO	P_2O_5	B_2O_3
	%	%	%	%	%	%	%	ppm	ppm	ppm
Lab 1	0.3262	0.0647	0.0054	0.0084	0.0138	0.1017	0.0099	7.35	30.42	19.88
Lab 2	0.3310	0.0658	0.0061	0.0086	0.0127	0.1025	0.0103	7.30	36.10	
Lab 3	0.2860	0.0730	0.0060	0.0052	0.0099	0.0920		9.00	19.00	20.00
Lab 4	0.2820	0.1210	0.0057	0.0090	0.0129	0.0850	0.0057			
Lab 5	0.3470	0.0740	0.0050	0.0070	0.0102	0.1020	0.0088	10.00	38.00	
Lab 6	0.3014	0.0654	0.0058	0.0076	0.0137	0.1228	0.0099	8.00	36.00	16.00
Lab 7	0.3500	0.0648	0.0057	0.0091	0.0147	0.1020	0.0102	7.00	33.00	
Lab 8	0.2875	0.0622	0.0050	0.0072		0.1185	0.0086	6.90	33.50	12.10
Lab 9	0.2878	0.0664	0.0059	0.0065	0.0115	0.0910	0.0099	9.00	31.00	
Lab 10	0.2730	0.0672	0.0212	0.0095	0.0150	0.0820	0.0075			
Lab 11	0.2924	0.0688	0.0068	0.0020	0.0136	0.0906	0.0096	11.00	31.00	
Lab 12	0.2291	0.0474	0.0045	0.0044			0.0059			
Lab 13	0.2880		0.0060	0.0100			0.0140			
Lab 14										
Lab 15	0.2940	0.0603	0.0055	0.0068	0.0129	0.0794	0.0097			
Lab 16	0.2607	0.0637	0.0058	0.0077	0.0138	0.0765	0.0096			
Lab 17	0.2355	0.0601	0.0057	0.0002	0.0130	0.0775	0.0031	8.70	31.50	
Lab 18	0.2800	0.0540	0.0050	0.0070	0.0110	0.0950	0.0110		30.00	
Lab 19	0.2800	0.0600	<0.01	<0.01	<0.01	0.1100	0.0100			
Lab 20	0.4400	0.7300	0.0044	0.0175		0.1200			44.00	
Lab 21	0.3271	0.0711		0.0072	0.0190	0.1091	0.0099	8.58		
Lab 22	0.2856	0.0589	0.0073		0.0105	0.0874	0.0091	6.08		
Lab 23	0.3000	0.0650	0.0080	0.0060	0.0120	0.0920			30.00	
Lab 24	0.3001	0.0764	0.0058	0.0101	0.0142	0.0944	0.0134	8.00	52.00	
Lab 25	0.3151	0.0609	0.0073	0.0050	0.0060	0.1048	<LLD	6.51	<LLD	
Lab 26	0.2980	0.0756	0.0033	0.0051	<0.002	0.0974	0.0076	4.62		<0.07
Lab 27	0.6581	0.0638	0.0030	0.0088	0.0180	0.1114	0.0246		219.80	
Lab 28										
Lab 29	0.3150	0.0676	0.0062	0.0108	0.0133	0.1031	0.0107	7.96	30.83	22.80
Lab 30	0.3700	0.0700	0.0100		0.0200	0.1000				

[3] < - values are marked in Orange.

	ZnO	V_2O_5	NiO	PbO	CuO	CoO	CdO	Cr_2O_3	Sc_2O_3	BaO_2
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
x_{pt}	2.67	2.05	1.42	5.44	4.41	1.82	0.79	2.98	26.76	26.92
σ_{pt}	1.64	1.47	0.92	9.35	0.32	1.08	0.97	0.32	51.89	26.29
N	6	6	6	4	11	6	3	15	3	12

	ZnO	V_2O_5	NiO	PbO	CuO	CoO	CdO	Cr_2O_3	Sc_2O_3	BaO_2
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Lab 1	3.11	2.04	0.65	1.30	4.45	1.79	<0.1	2.20	0.29	
Lab 2		1.70	1.20		3.40			3.10		
Lab 3										70.00
Lab 4										
Lab 5										<0.001
Lab 6		2.00	1.00					3.00		
Lab 7								3.00		
Lab 8					4.30			3.00		13.60
Lab 9										94.00
Lab 10										
Lab 11										77.00
Lab 12										
Lab 13										
Lab 14										
Lab 15								3.00		15.00
Lab 16										
Lab 17	1.30		2.50		3.40	1.90		3.00		
Lab 18										
Lab 19										<0.01
Lab 20				39.00	18.00			210.00		
Lab 21					4.36	10.87	1.74	3.15		17.13
Lab 22	2.10	0.21	0.81	1.10	3.40	1.50	0.53	2.60		14.20
Lab 23										
Lab 24	4.00				5.00			3.00		17.00
Lab 25	<LLD	7.00	<LLD	<LLD	<LLD			3.00		3.00
Lab 26	<0.02	<0.006	<0.04	<0.005	4.15	0.47	<0.008	1.35	79.60	13.90
Lab 27	1.00				6.00					17.20
Lab 28										
Lab 29	4.53	2.12	2.37	1.57	4.10	1.81	0.09	2.89	0.39	17.52
Lab 30								20.00		

	LiO_2	SO_3	MoO_3	HfO_2	Nb_2O_5	ZrO_2	As_2O_3	Bi_2O_3	Sb_2O_3	SnO_2
	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
x_{pt}	63.31	13.21	0.65	40.07		0.1912	1.23	0.13	0.06	0.44
σ_{pt}		7.13	0.72	0.91		0.0217	0.35	0.04		0.23
N	1	4	2	2		11	3	2	1	2

	LiO_2	SO_3	MoO_3	HfO_2	Nb_2O_5	ZrO_2	As_2O_3	Bi_2O_3	Sb_2O_3	SnO_2
	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
Lab 1										
Lab 2										
Lab 3										
Lab 4										
Lab 5		20.00								
Lab 6										
Lab 7										
Lab 8							1.50			
Lab 9		9.00				0.1601				
Lab 10										
Lab 11		17.00								
Lab 12										
Lab 13										
Lab 14										
Lab 15						0.1796				
Lab 16						0.1840				
Lab 17						0.2000				
Lab 18										
Lab 19										
Lab 20										
Lab 21										
Lab 22			0.20			0.1800	0.90	0.15	0.06	0.58
Lab 23										
Lab 24						0.1773				
Lab 25						0.1963				
Lab 26			<0.04	39.50		0.2190	<0.008	0.10	<0.02	0.29
Lab 27			1.10			0.2785	1.30			
Lab 28										
Lab 29	63.31	6.84	<0.18	40.63	<0.46	0.2032				
Lab 30						0.1800				

	SrO	Ga_2O_3	GeO_2	Rb_2O	La_2O_3	Y_2O_3	Cl	LOI	SiO_2
	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%
x_{pt}	7.27	1.00	1.39	5.47	0.37	163.90	0.0271	0.0000	99.2738
σ_{pt}	12.00			0.59			0.0416	0.0000	0.2805
N	4	1	1	2	1	1	2	3	12

	SrO	Ga_2O_3	GeO_2	Rb_2O	La_2O_3	Y_2O_3	Cl	LOI	SiO_2
	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%
Lab 1									
Lab 2									
Lab 3									
Lab 4									
Lab 5									99.4000
Lab 6									
Lab 7									99.4400
Lab 8									
Lab 9									99.3565
Lab 10									
Lab 11									99.3607
Lab 12									
Lab 13									99.6810
Lab 14									
Lab 15									99.2000
Lab 16									
Lab 17								0.2000	
Lab 18									
Lab 19								0.3000	99.1000
Lab 20							0.0530		99.2700
Lab 21	2.20								
Lab 22	1.63				0.37				
Lab 23									99.5200
Lab 24									
Lab 25	53.00							0.1800	
Lab 26	<0.08	1.00	1.39	5.83					
Lab 27	2.10			5.10		163.90	0.0012		98.7800
Lab 28									
Lab 29									99.2498
Lab 30									98.1000

ANNEX 5.2.1. Z-SCORE SAMPLE B

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO
Lab 1	0.7	-0.2	-0.4	0.4	0.4	0.3	0.2
Lab 2	0.8	-0.1	0.3	0.5	-0.1	0.3	0.4
Lab 3	-0.5	0.9	0.2	-0.9	-1.4	-0.4	
Lab 4	-0.6	7.7	-0.1	0.6	0.0	-0.9	-2.9
Lab 5	1.3	1.1	-0.8	-0.2	-1.3	0.3	-0.6
Lab 6	0.0	-0.1	0.0	0.1	0.4	1.8	0.2
Lab 7	1.4	-0.2	-0.1	0.7	0.9	0.3	0.4
Lab 8	-0.4	-0.6	-0.8	-0.1		1.5	-0.8
Lab 9	-0.4	0.0	0.1	-0.4	-0.7	-0.5	0.2
Lab 10	-0.9	0.1	14.1	0.8	1.0	-1.1	-1.6
Lab 11	-0.3	0.3	0.9	-2.1	0.3	-0.5	-0.1
Lab 12	-2.1	-2.7	-1.2	-1.2			-2.8
Lab 13	-0.4		0.2	1.0			3.2
Lab 14							
Lab 15	-0.2	-0.8	-0.3	-0.2	0.0	-1.3	0.0
Lab 16	-1.2	-0.4	0.0	0.1	0.4	-1.5	-0.1
Lab 17	-1.9	-0.9	-0.1	-2.9	0.1	-1.5	-4.8
Lab 18	-0.7	-1.7	-0.8	-0.2	-0.9	-0.2	1.0
Lab 19	-0.7	-0.9				0.9	0.2
Lab 20	4.0	93.4	-1.3	4.0		1.6	
Lab 21	0.7	0.7		-0.1	2.9	0.8	0.2
Lab 22	-0.5	-1.0	1.3		-1.1	-0.8	-0.4
Lab 23	-0.1	-0.2	2.0	-0.6	-0.4	-0.4	
Lab 24	-0.1	1.4	0.0	1.1	0.6	-0.2	2.8
Lab 25	0.4	-0.8	1.4	-0.9	-3.2	0.5	
Lab 26	-0.1	1.3	-2.3	-0.9		0.0	-1.6
Lab 27	10.2	-0.4	-2.6	0.6	2.4	1.0	11.0
Lab 28							
Lab 29	0.4	0.2	0.4	1.4	0.2	0.4	0.7
Lab 30	1.9	0.5	3.8		3.4	0.2	

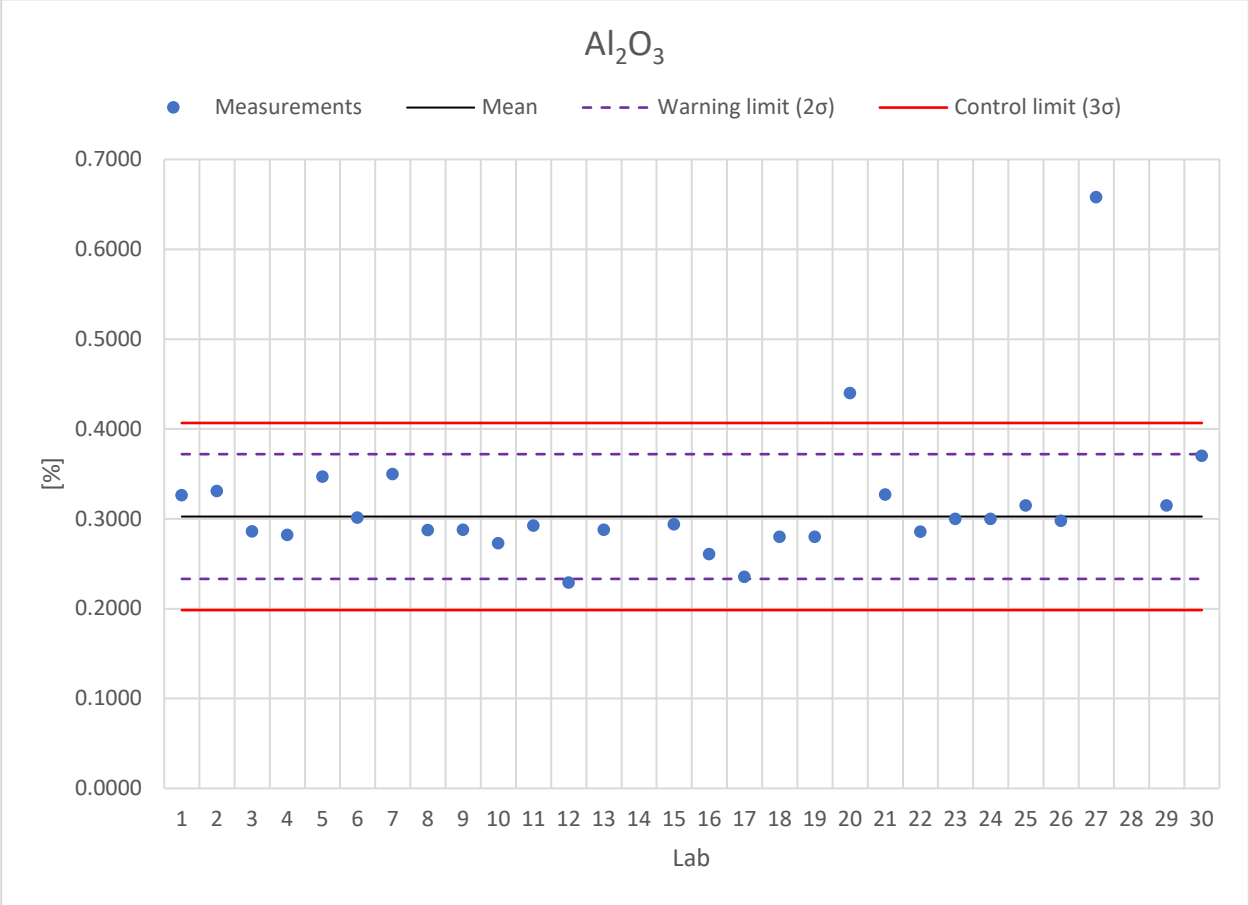
Satisfactory performance
Questionable performance
Unsatisfactory performance

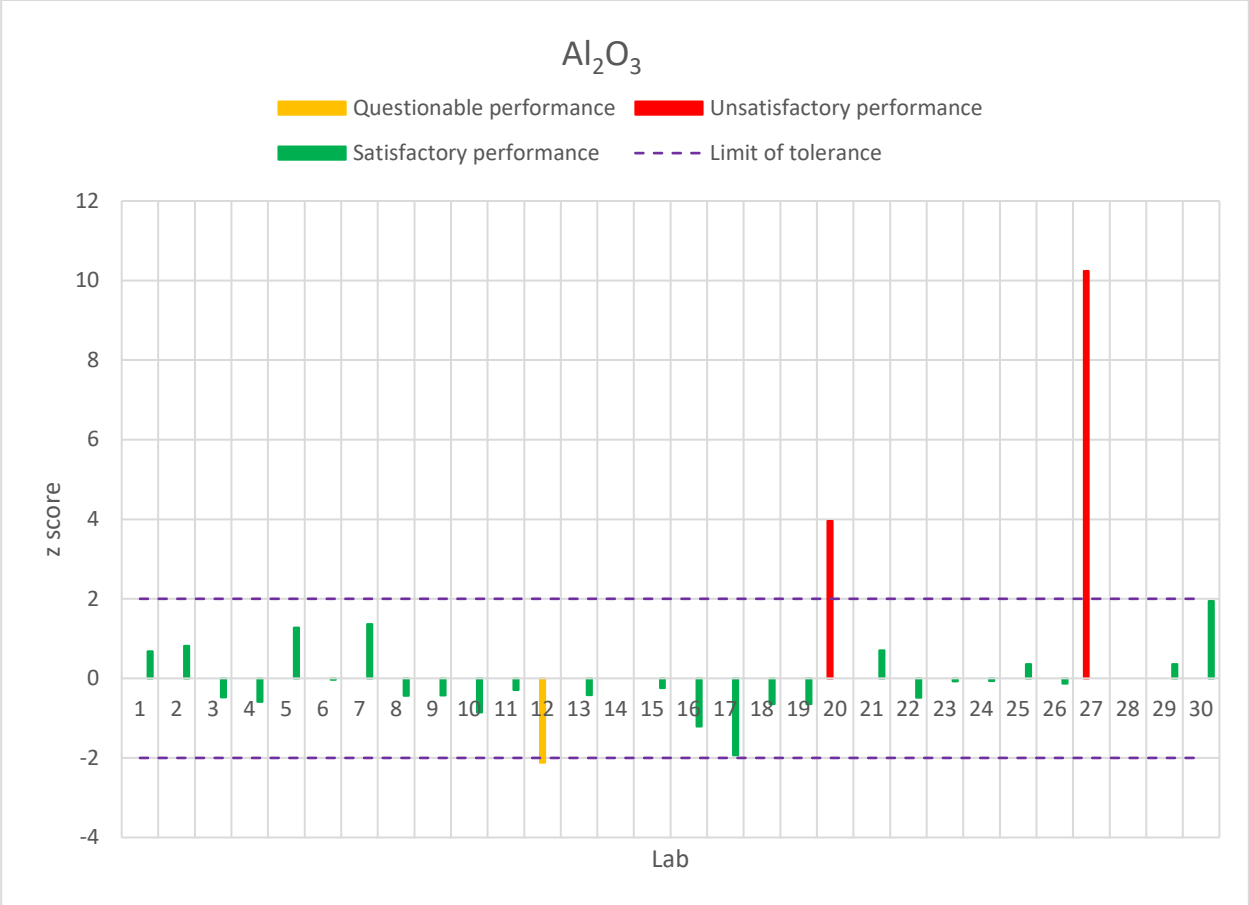
ANNEX 5.2.2. Z'-SCORE SAMPLE B

	MnO	P_2O_5	CuO	Cr_2O_3	BaO_2	SiO_2
Lab 1	-0.3	-0.6	0.1	-2.3		
Lab 2	-0.4	0.3	-2.9	0.4		
Lab 3	0.7	-2.2			1.5	
Lab 4						
Lab 5	1.4	0.6				0.4
Lab 6	0.1	0.3		0.1		
Lab 7	-0.6	-0.2		0.1		0.6
Lab 8	-0.6	-0.1	-0.3	0.1	-0.5	
Lab 9	0.7	-0.5			2.4	0.3
Lab 10						
Lab 11	2.0	-0.5			1.8	0.3
Lab 12						
Lab 13						1.4
Lab 14						
Lab 15				0.1	-0.4	-0.2
Lab 16						
Lab 17	0.5	-0.4	-2.9	0.1		
Lab 18		-0.6				
Lab 19						-0.6
Lab 20		1.4	39.5	612.1		0.0
Lab 21	0.4		-0.2	0.5	-0.4	
Lab 22	-1.2		-2.9	-1.1	-0.5	
Lab 23		-0.6				0.8
Lab 24	0.1	2.6	1.7	0.1	-0.4	
Lab 25	-0.9			0.1	-0.9	
Lab 26	-2.1		-0.8	-4.8	-0.5	
Lab 27		27.2	4.6		-0.3	-1.7
Lab 28						
Lab 29	0.0	-0.5	-0.9	-0.3	-0.3	-0.1
Lab 30				50.3		-3.9

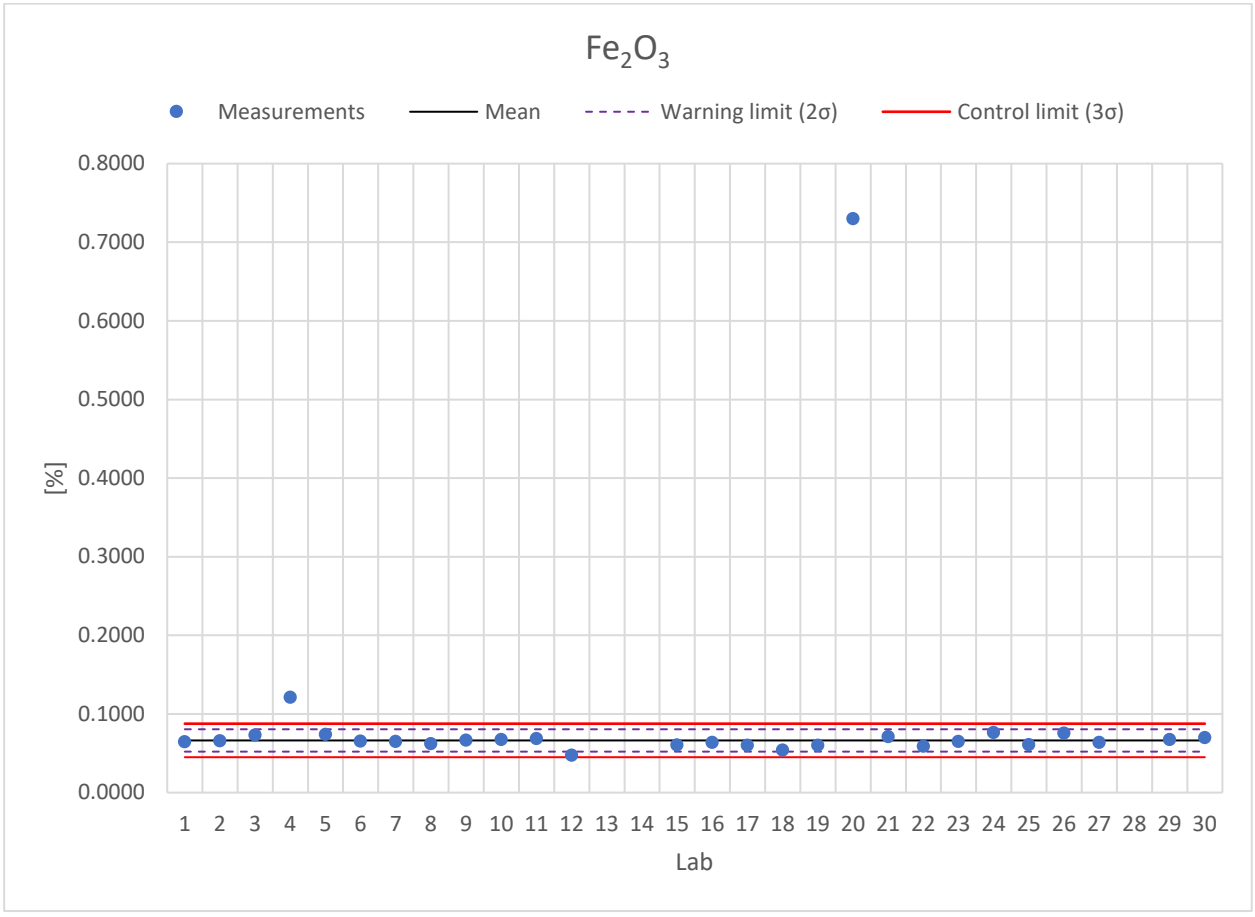
Satisfactory performance
Questionable performance
Unsatisfactory performance

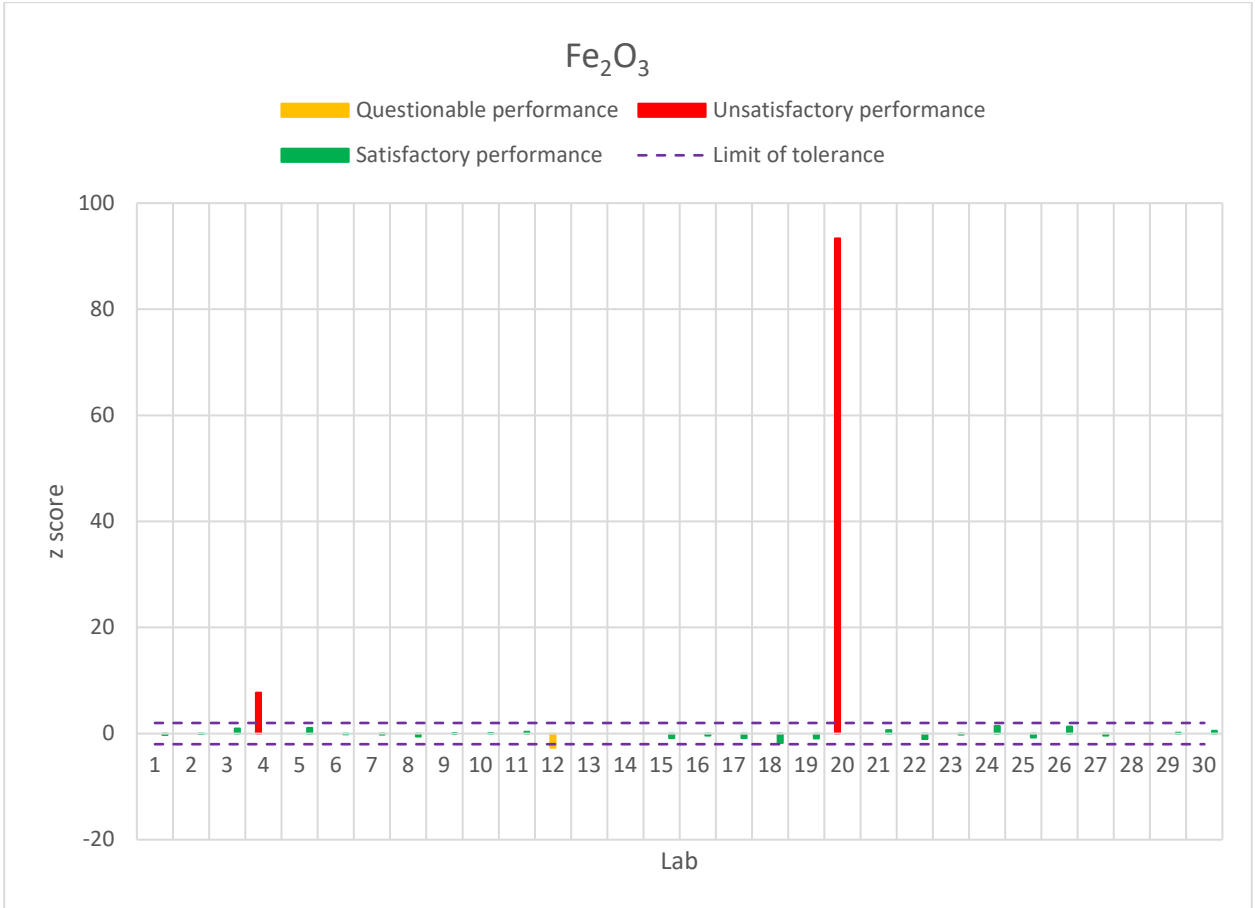
ANNEX 5.2.3. CHARTS SAMPLE B



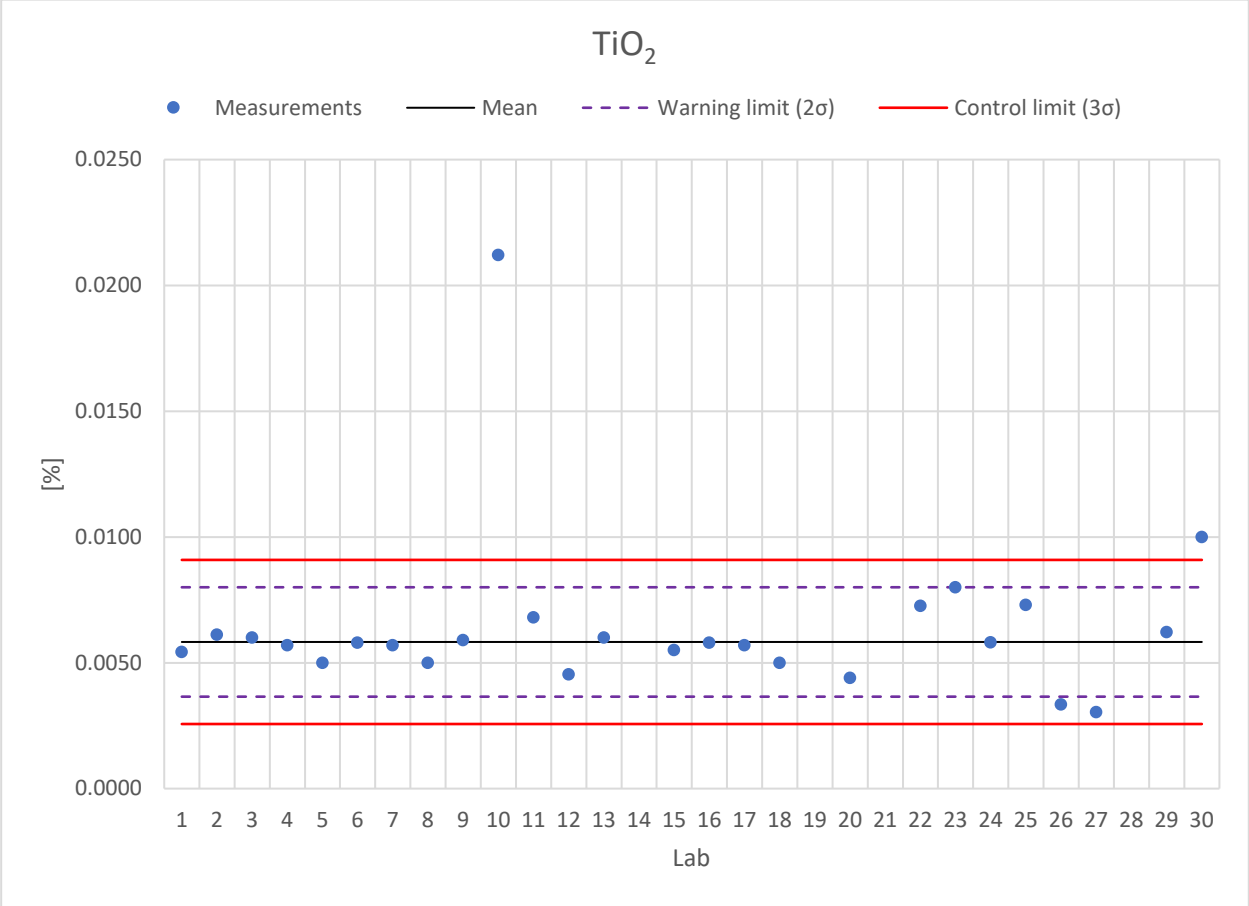


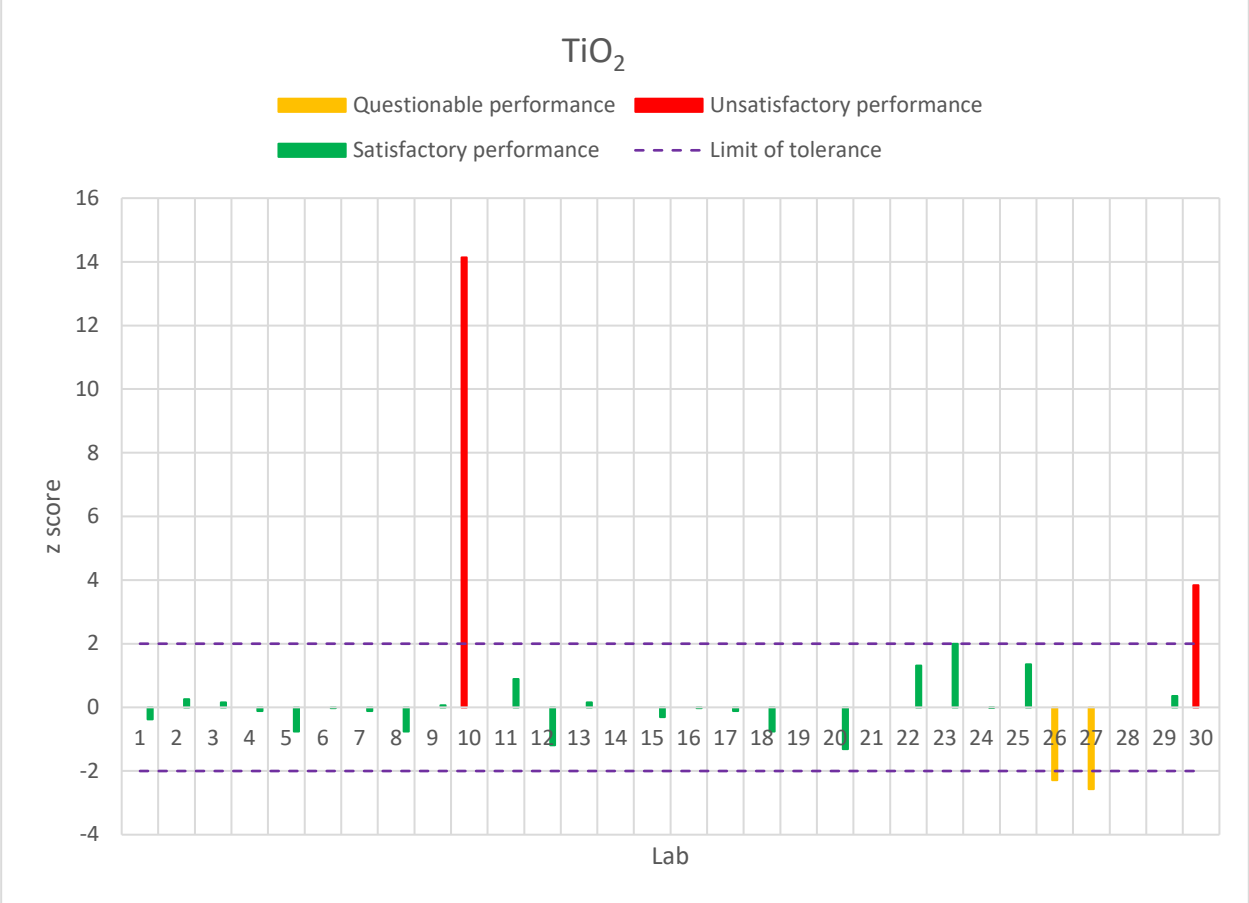
CHARTS SAMPLE B



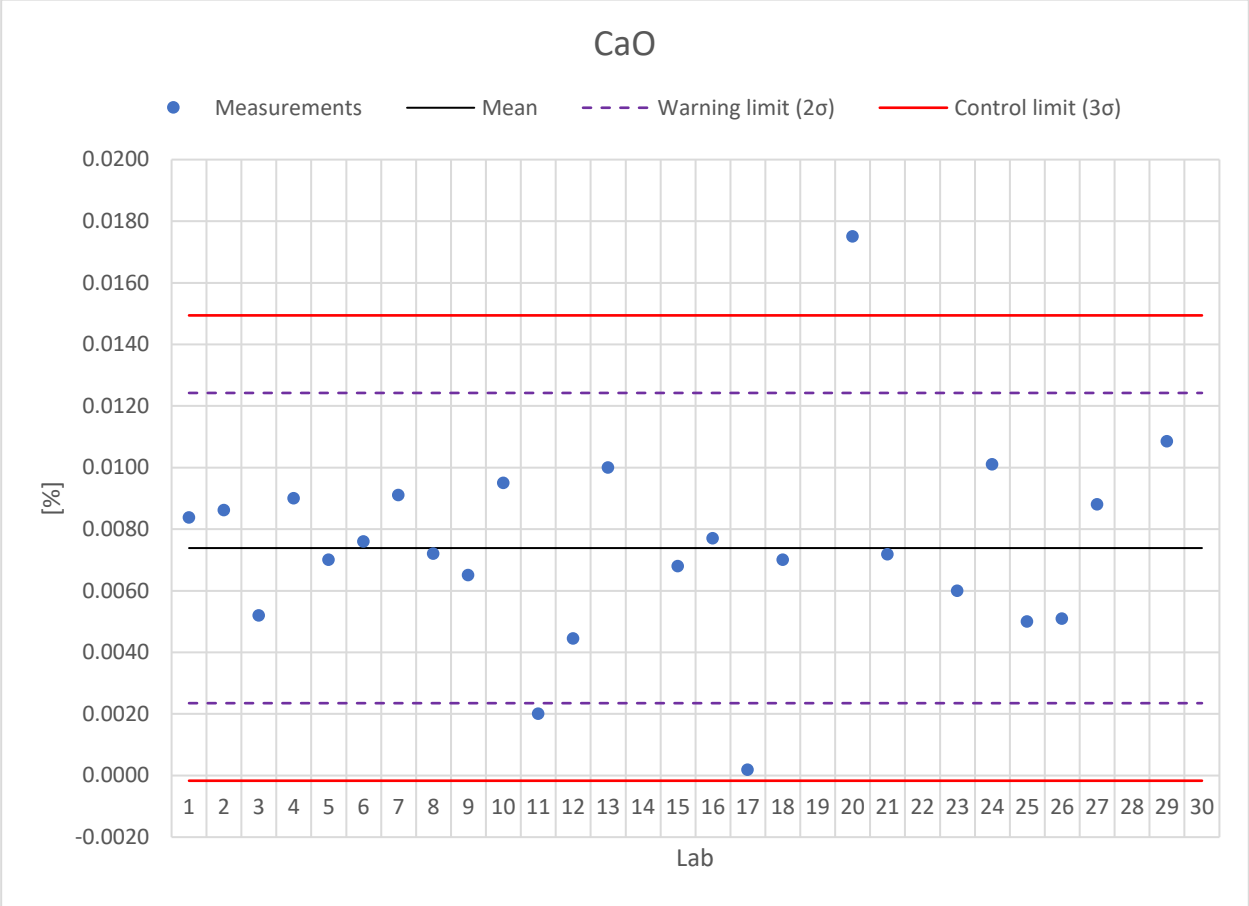


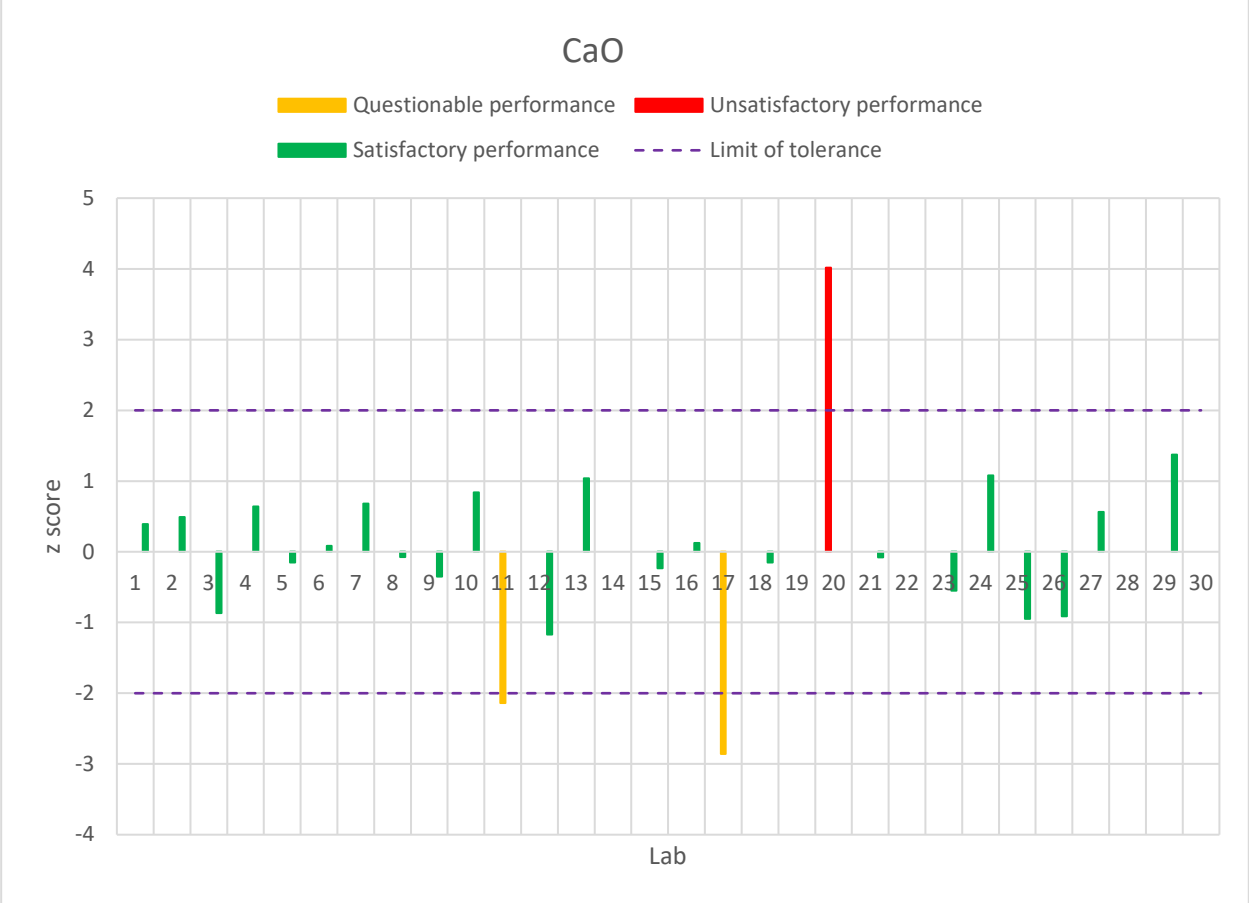
CHARTS SAMPLE B



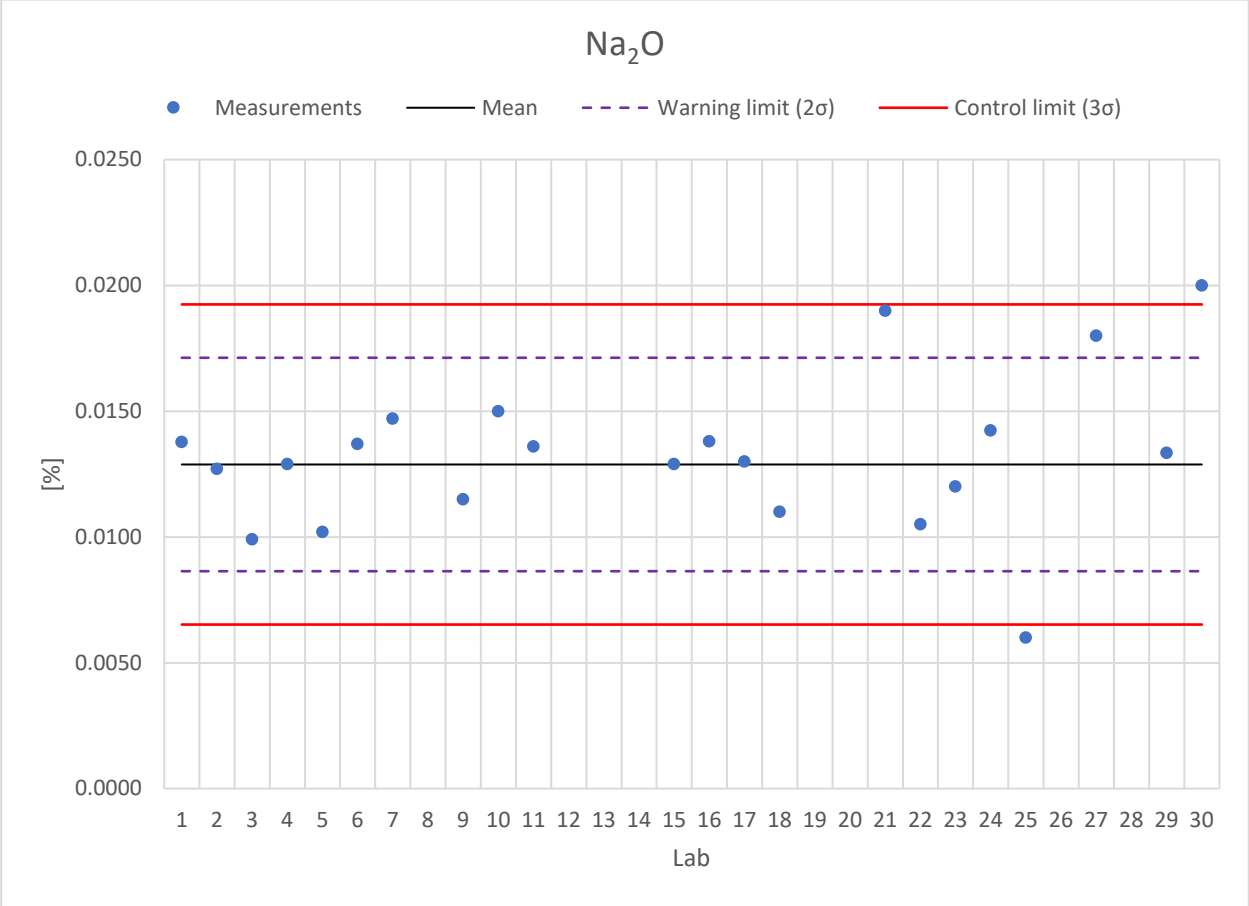


CHARTS SAMPLE B

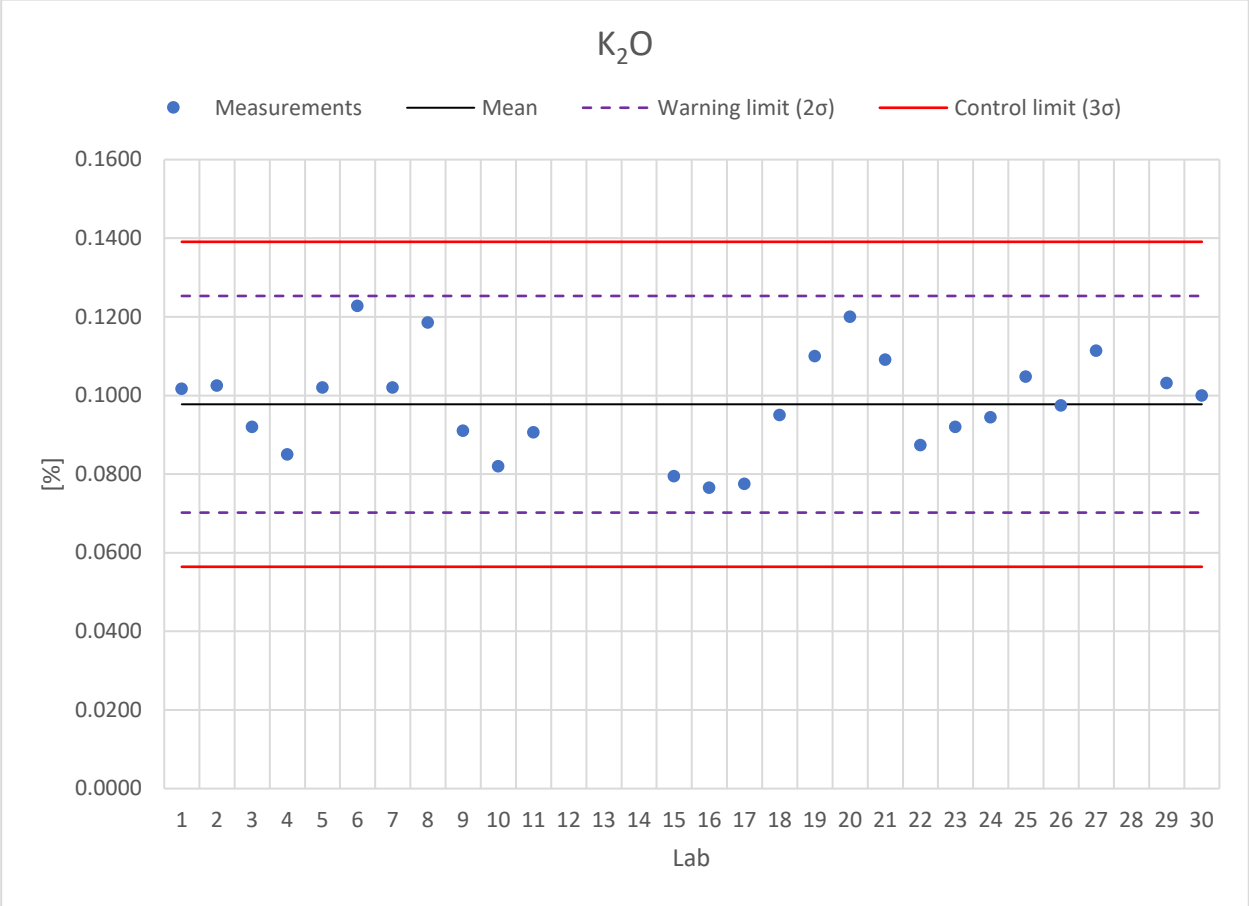


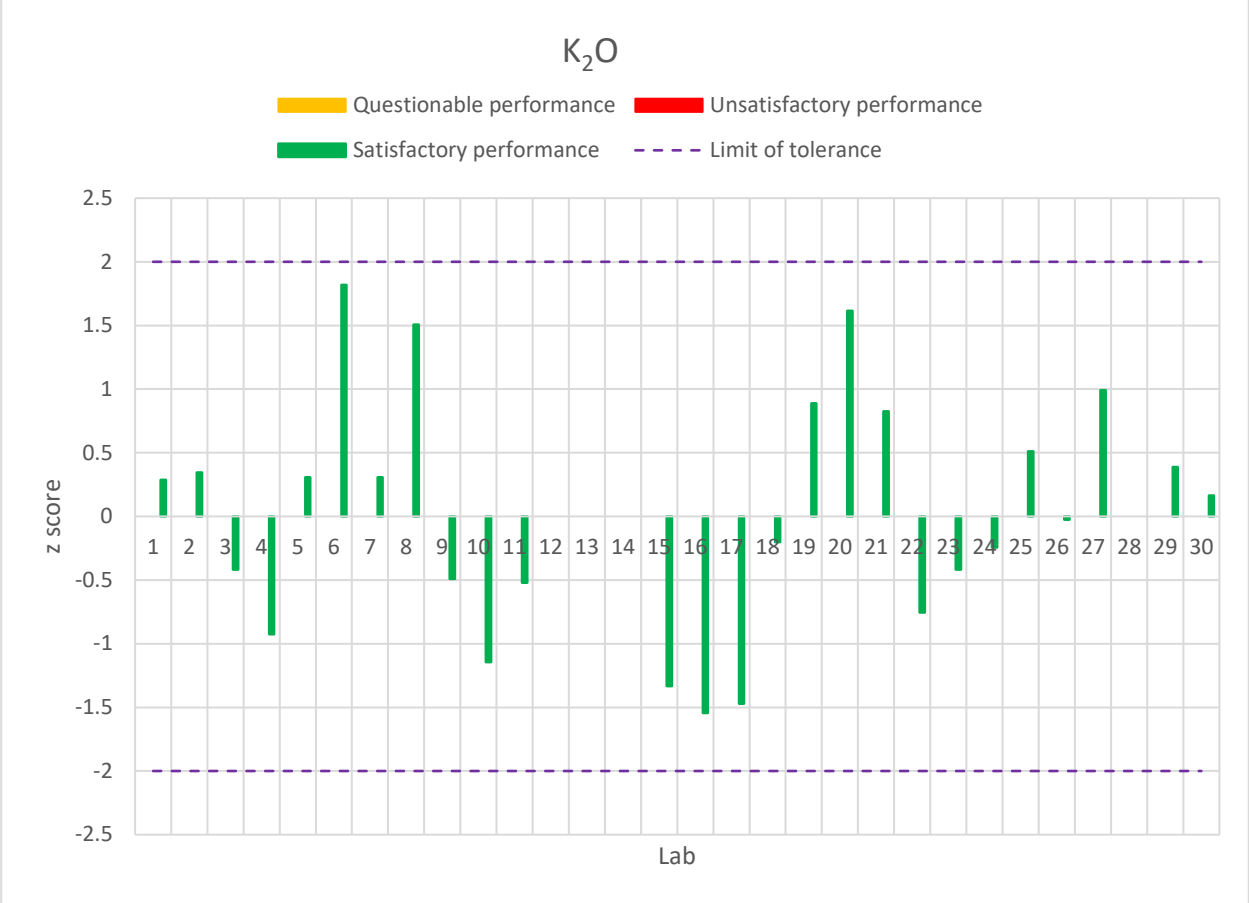


CHARTS SAMPLE B

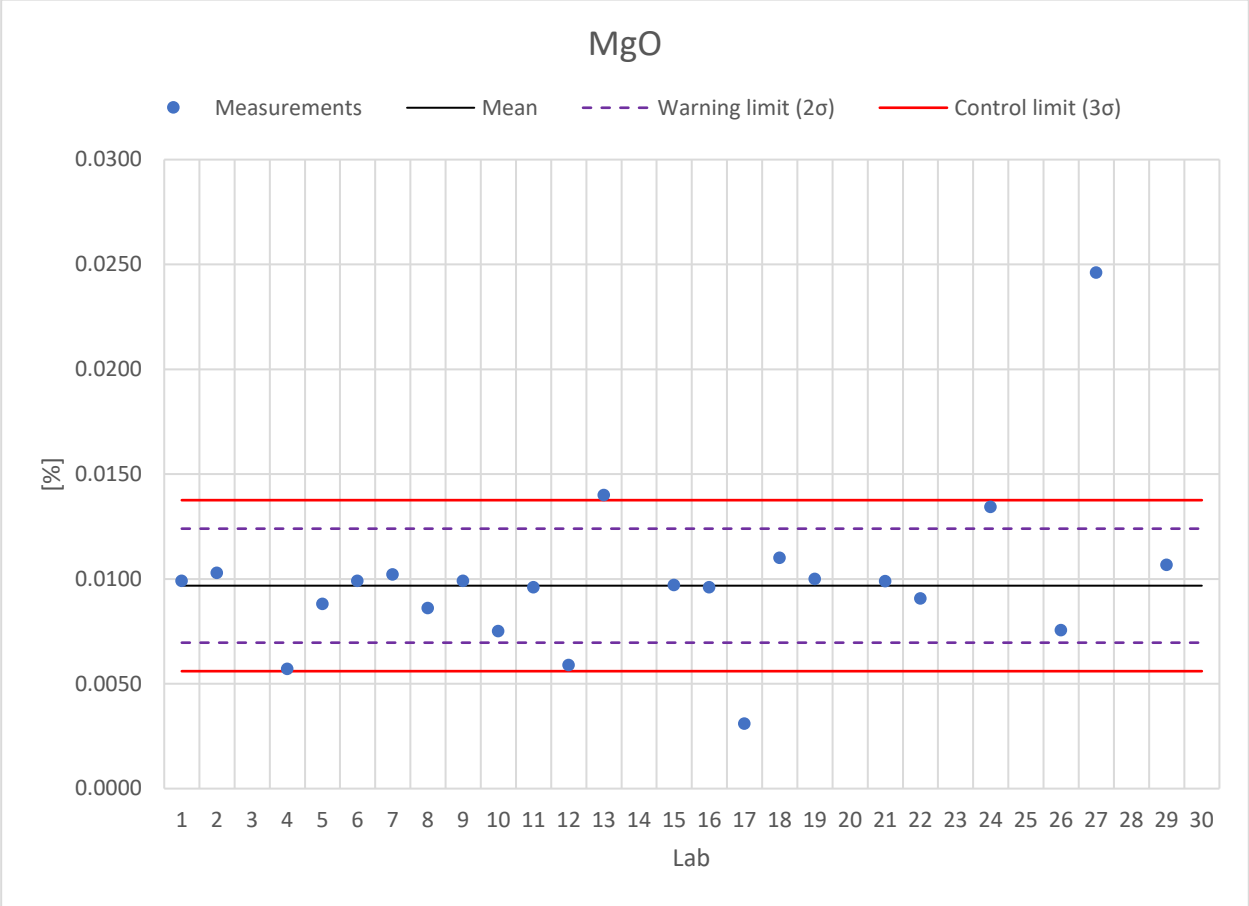


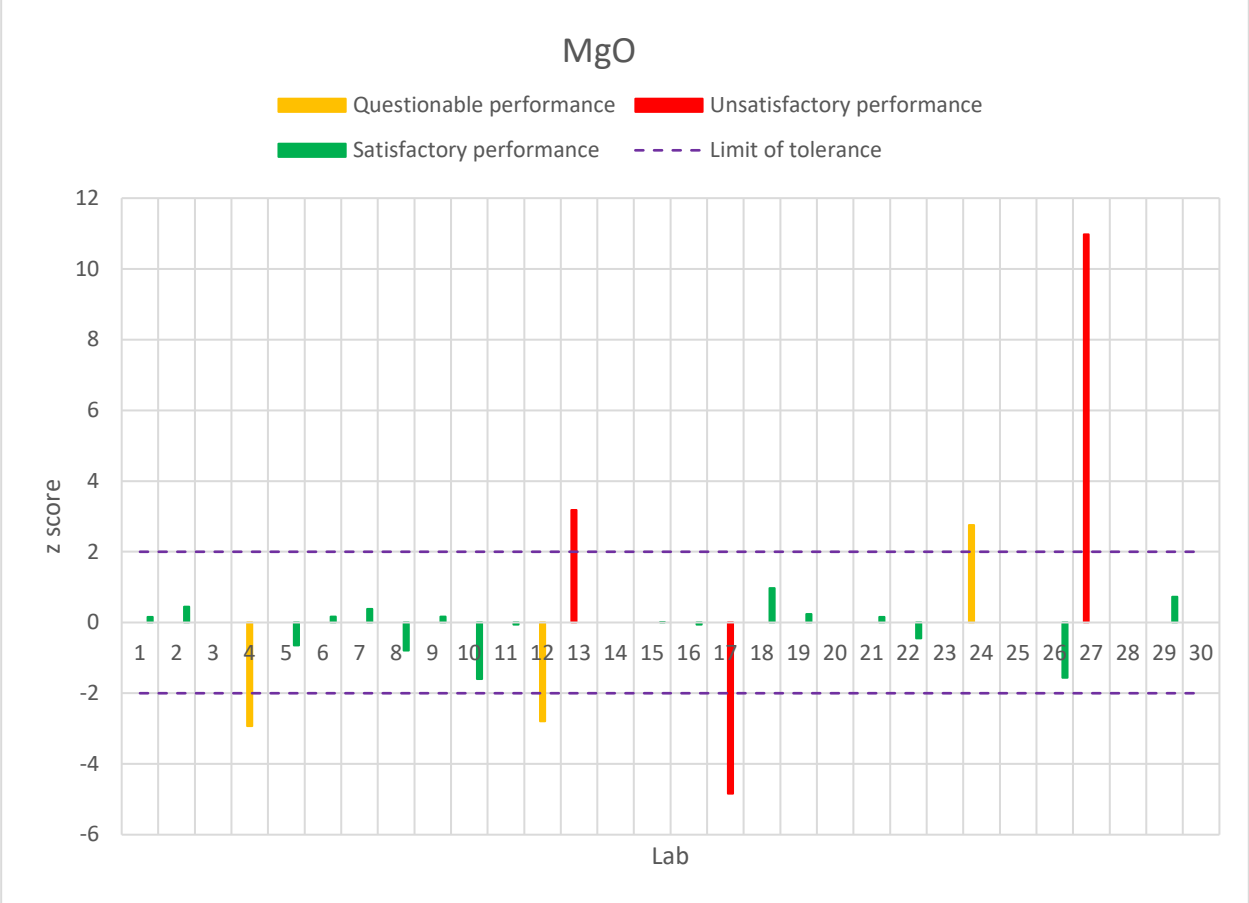
CHARTS SAMPLE B



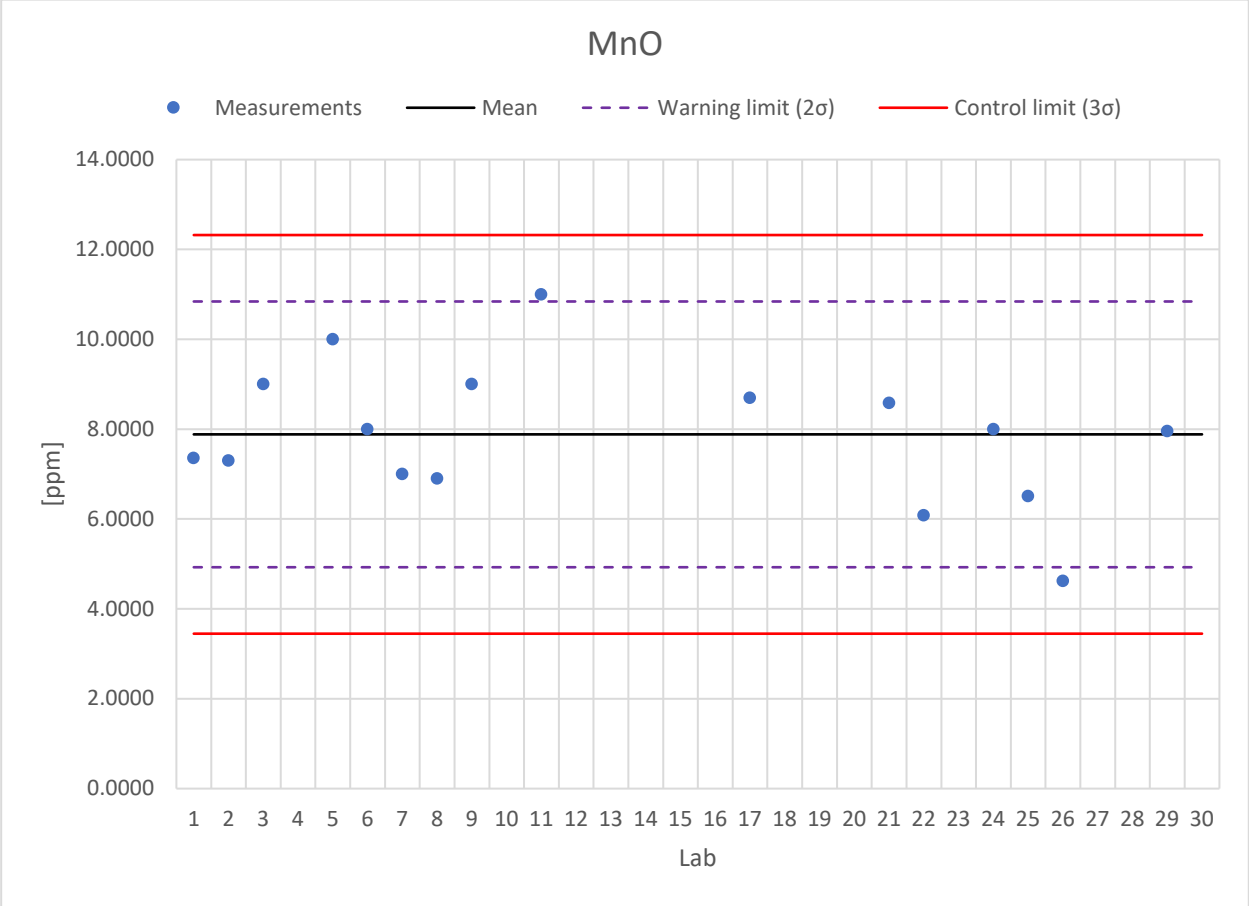


CHARTS SAMPLE B

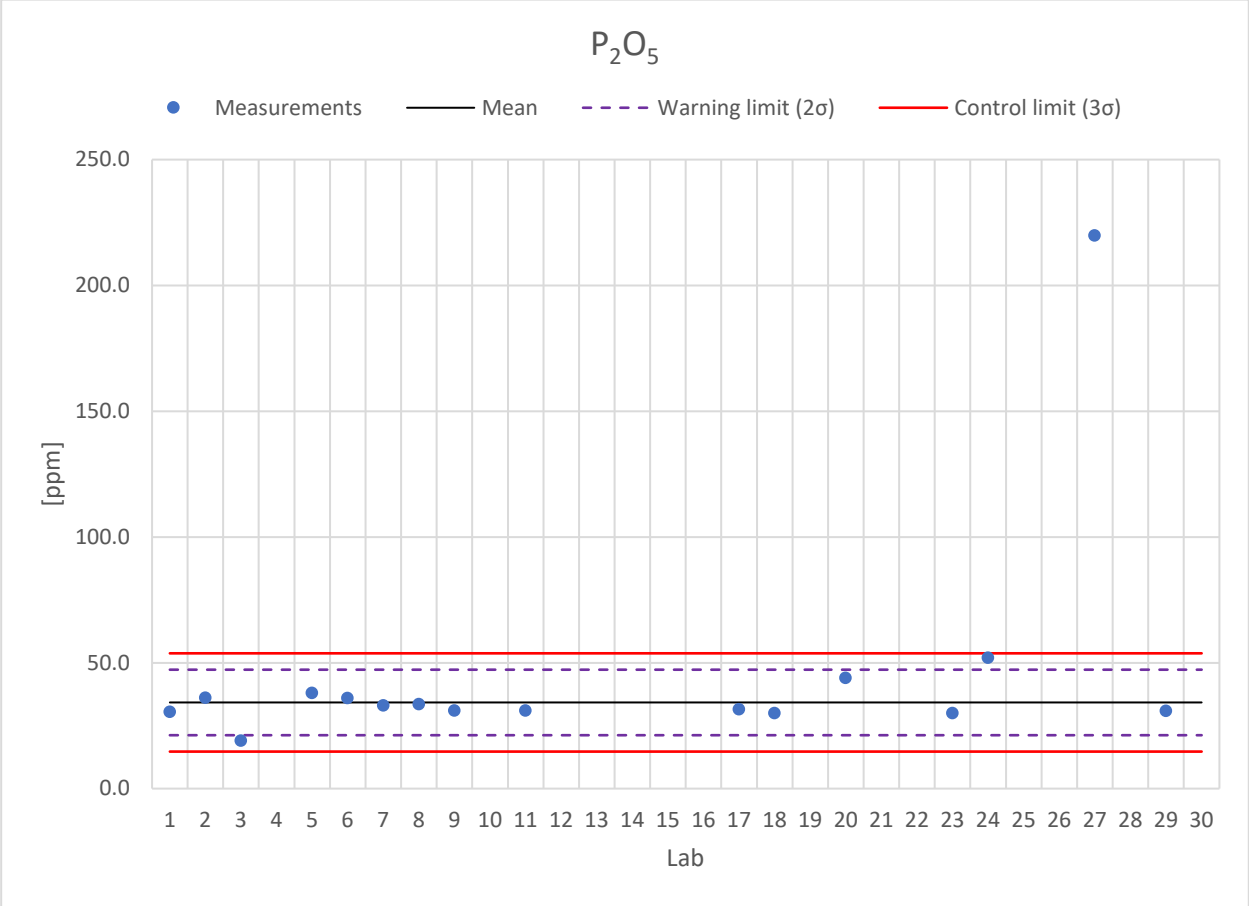


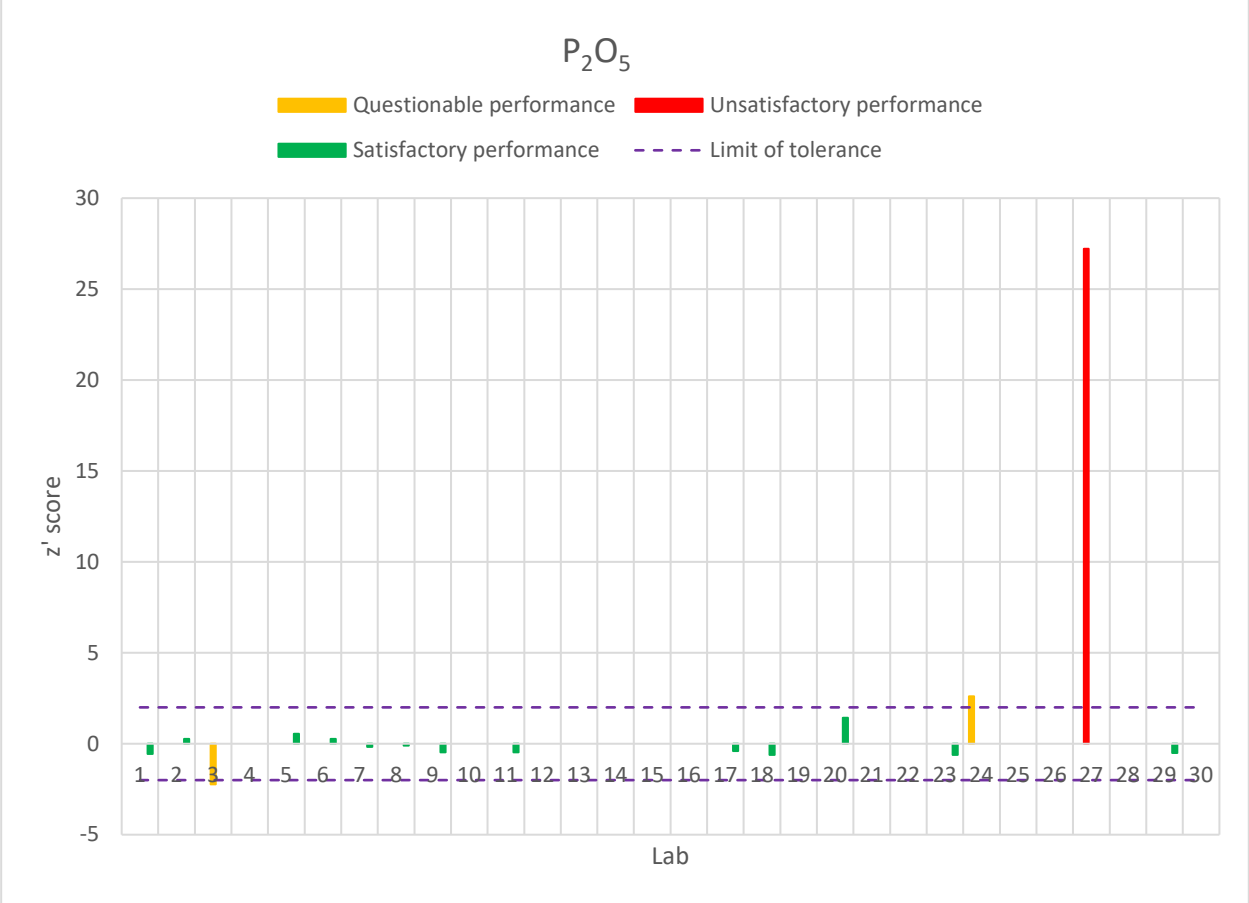


CHARTS SAMPLE B

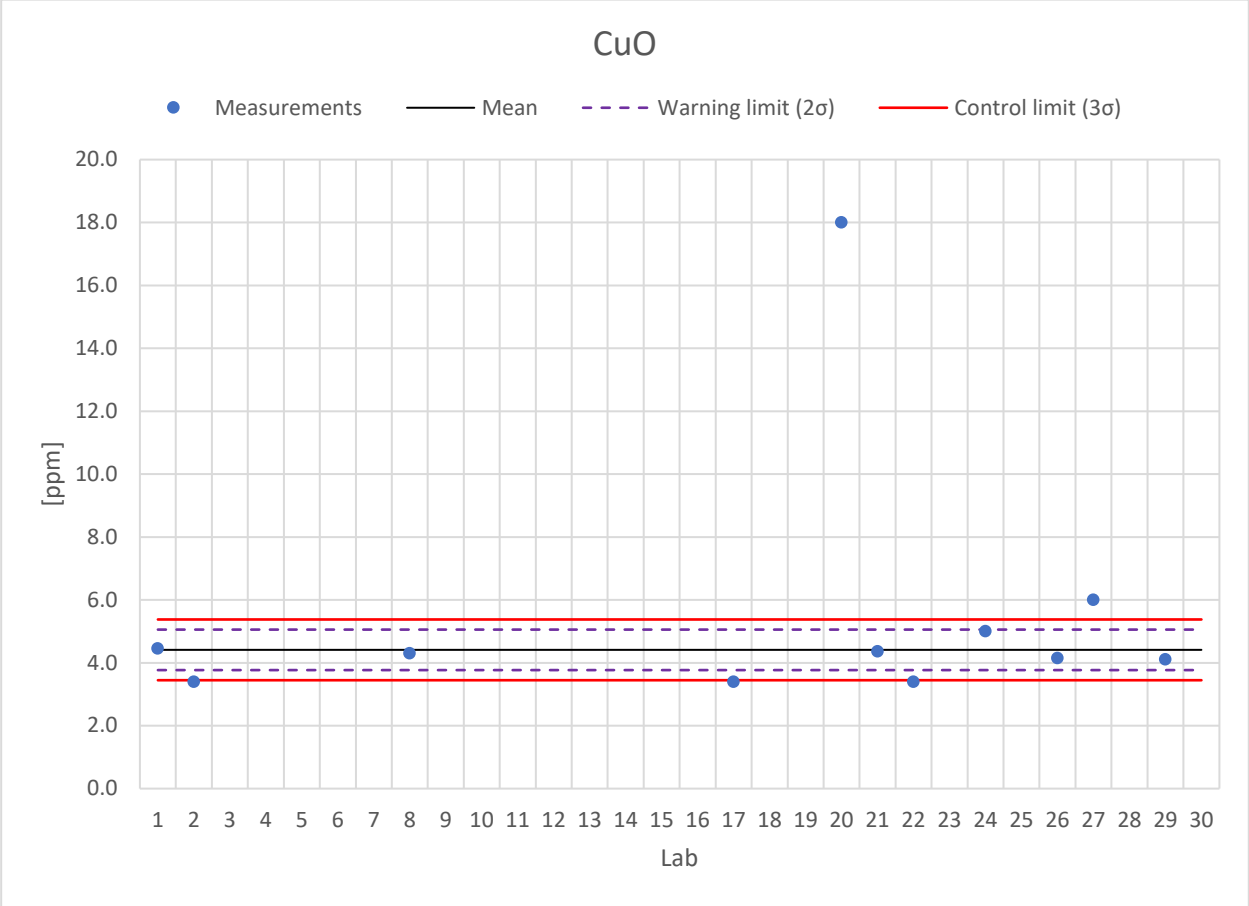


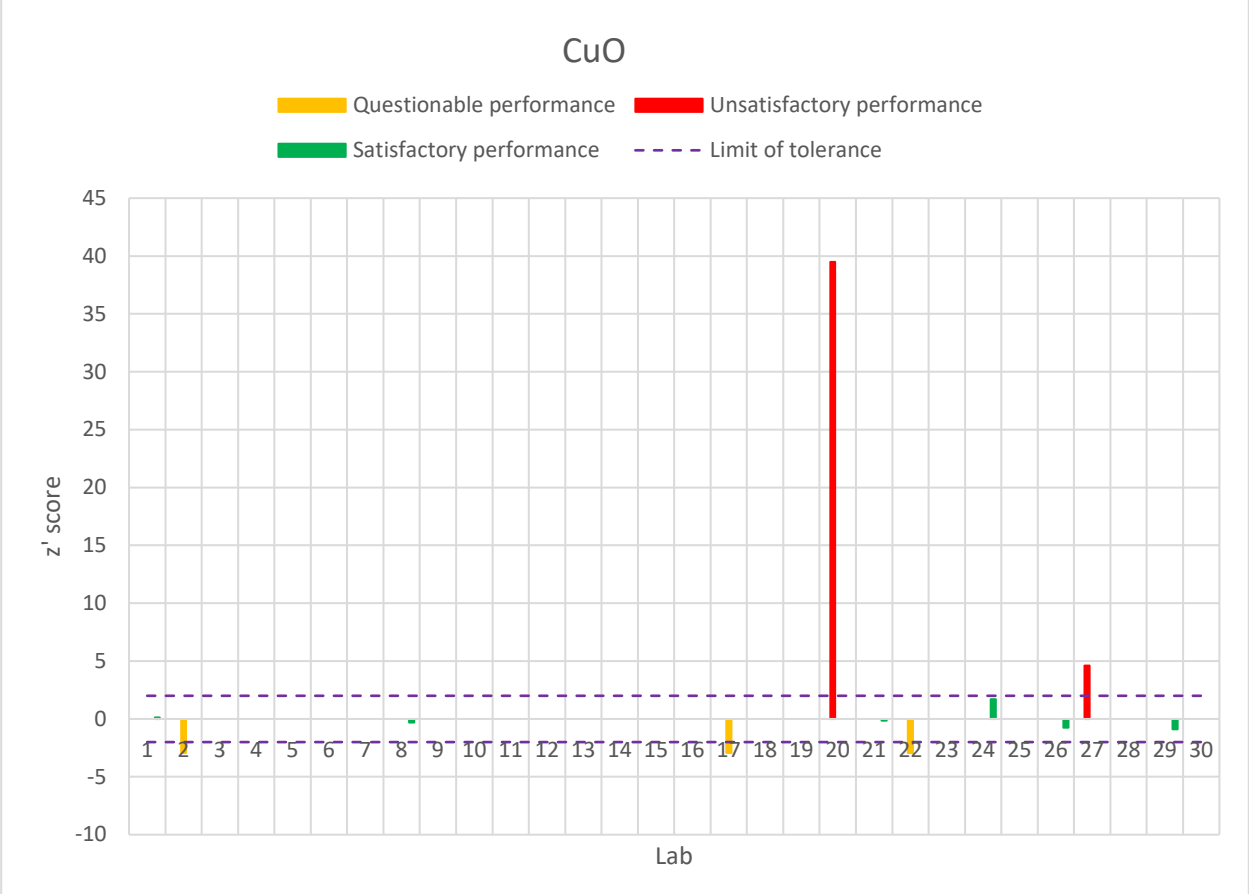
CHARTS SAMPLE B



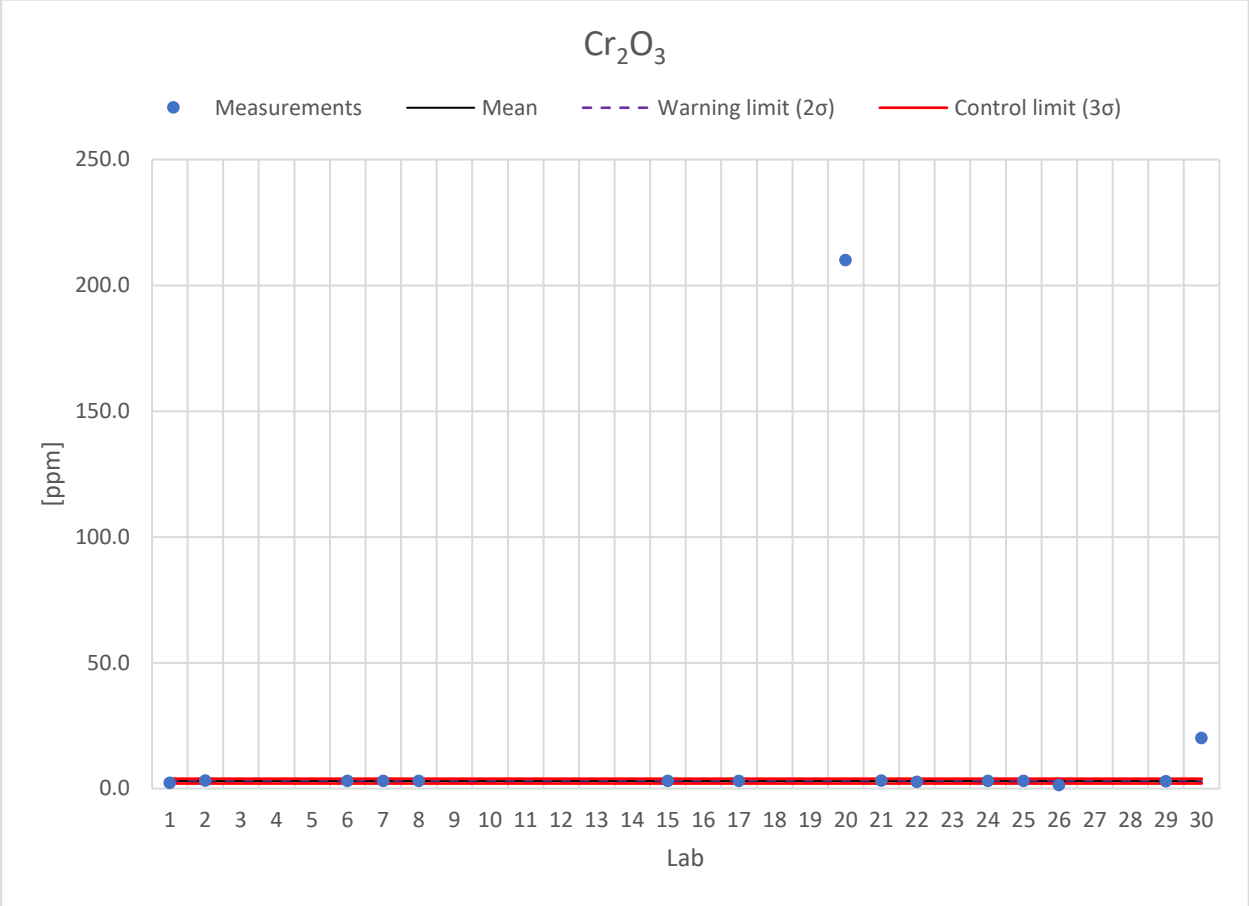


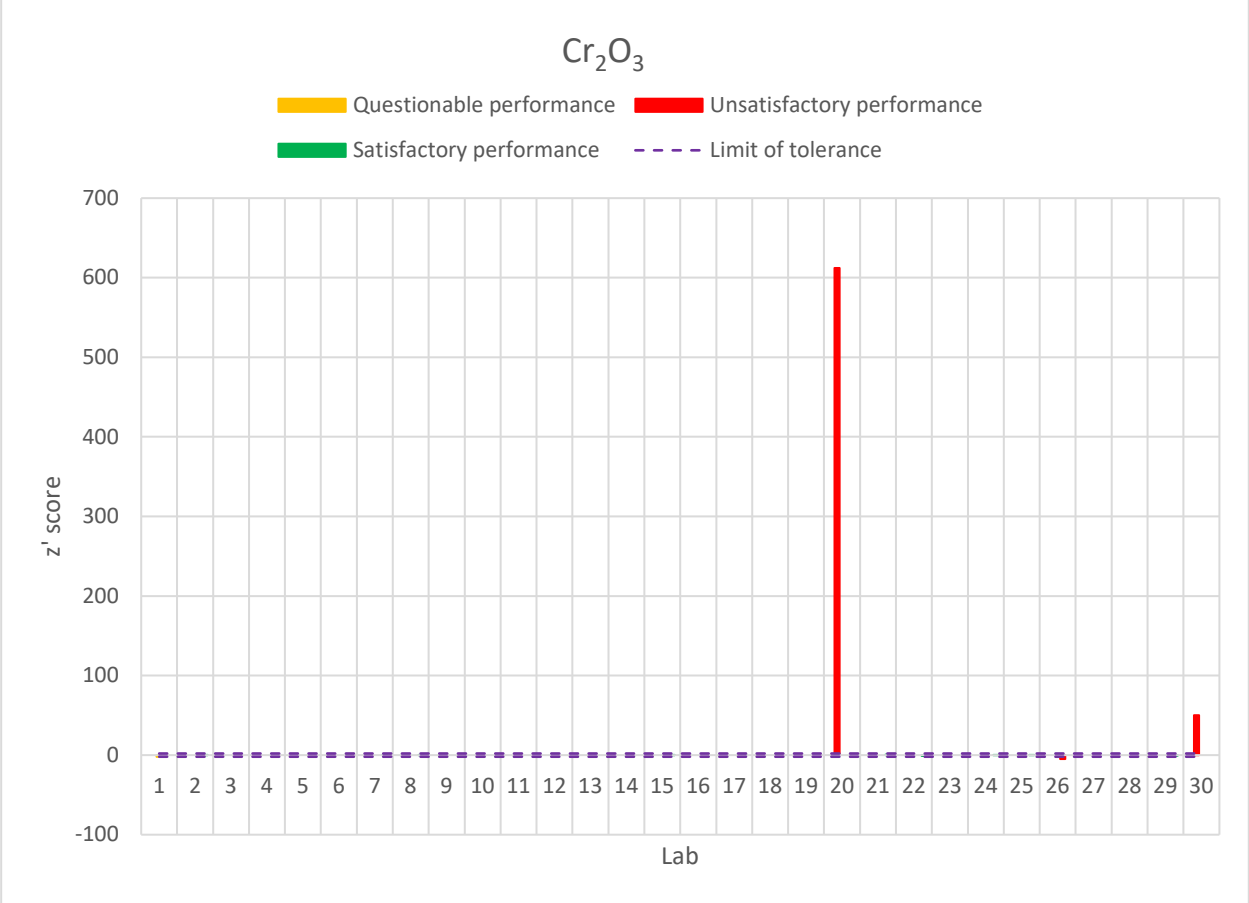
CHARTS SAMPLE B



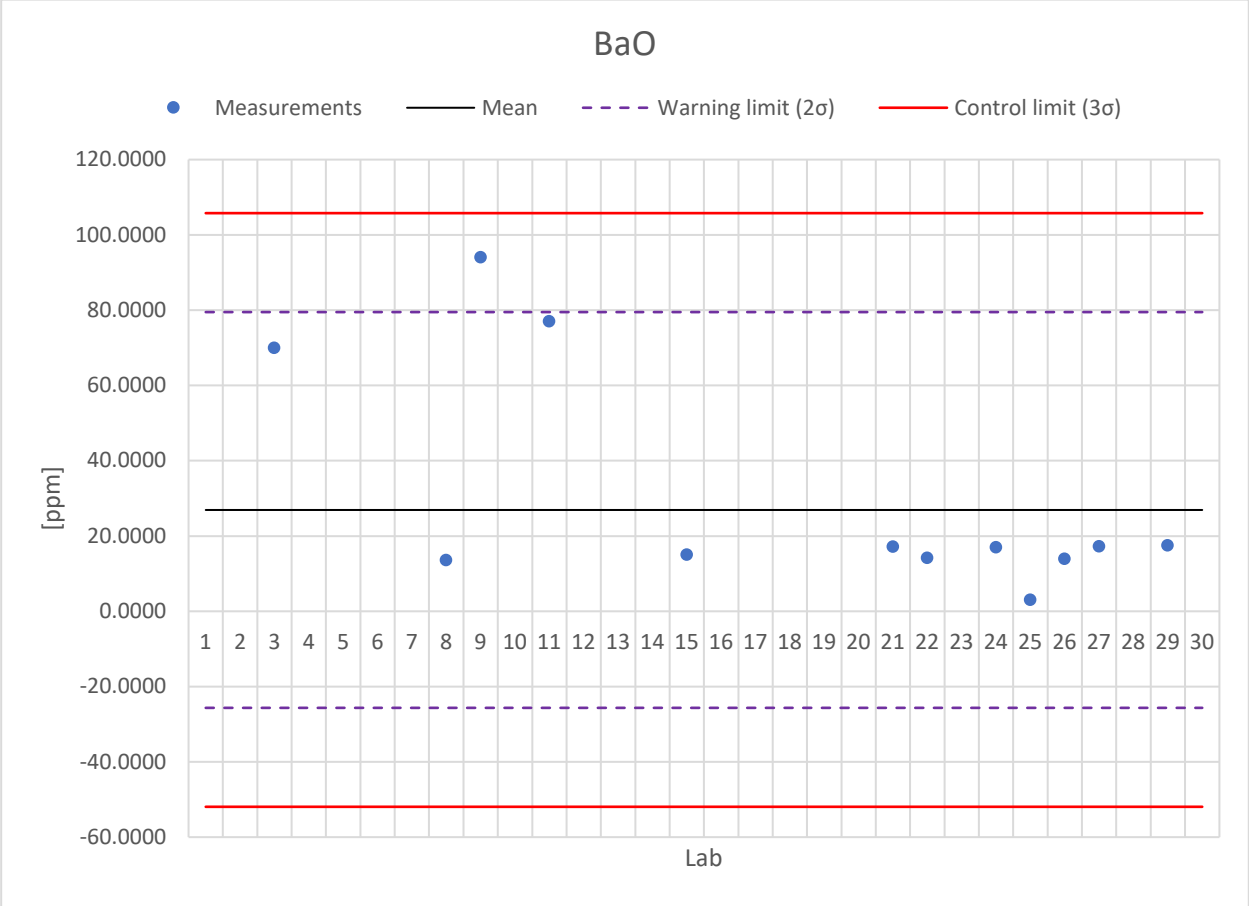


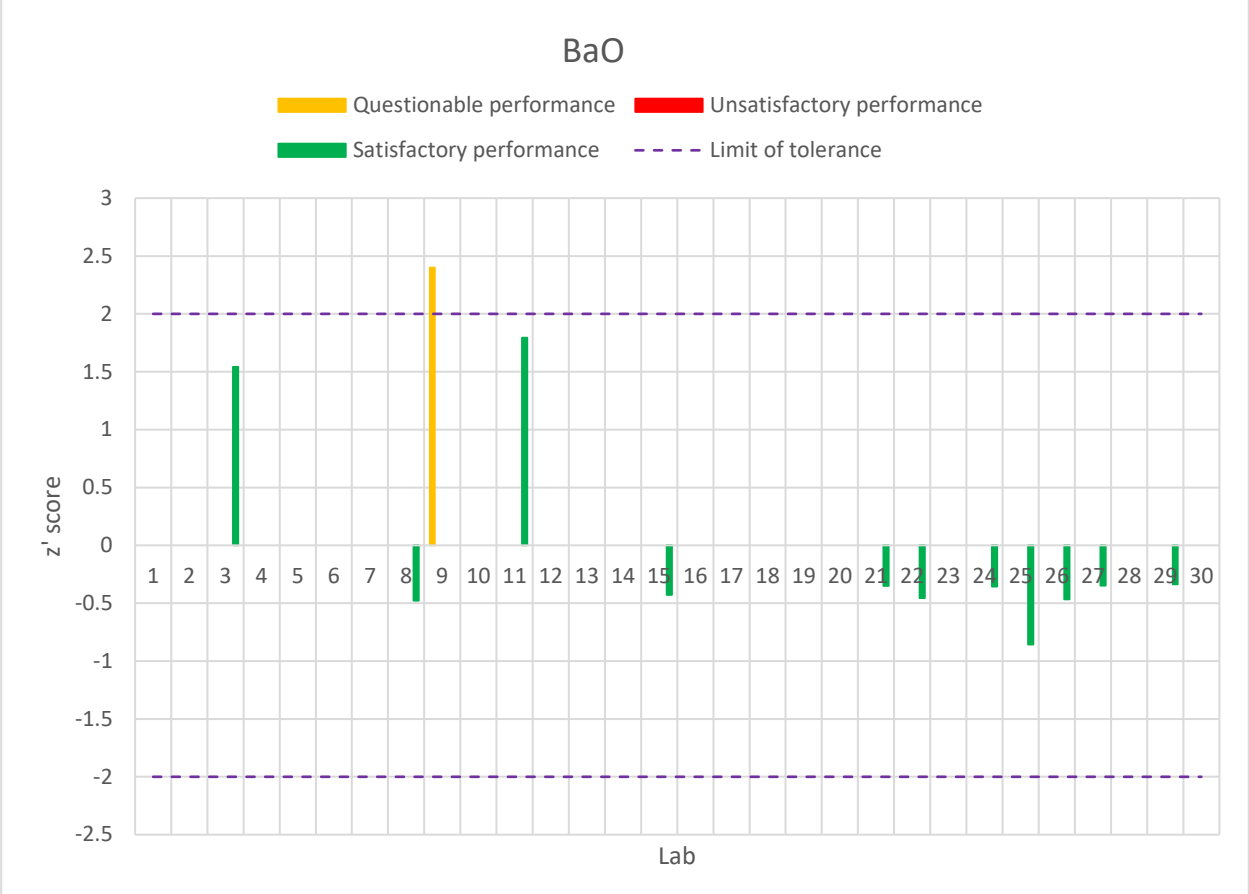
CHARTS SAMPLE B



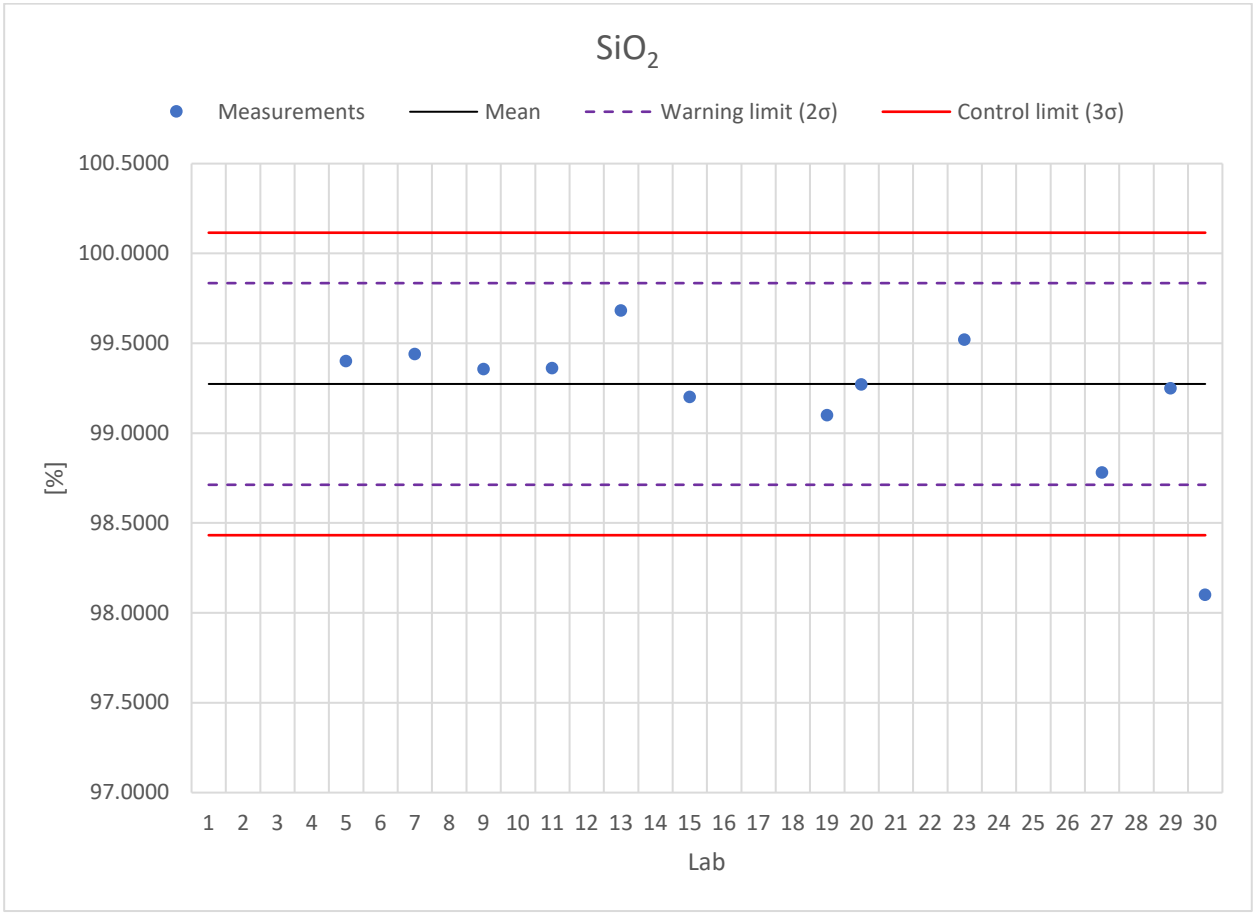


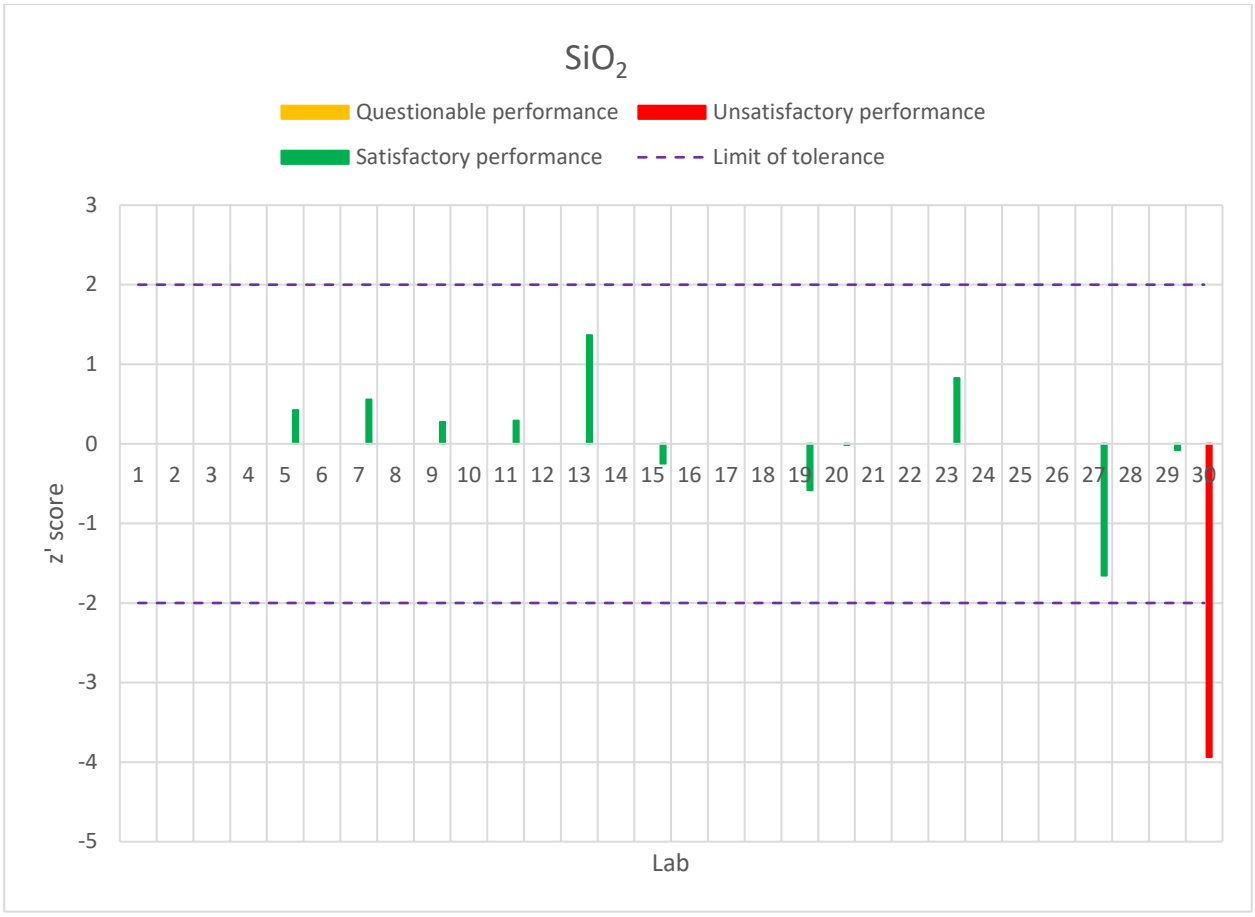
CHARTS SAMPLE B





CHARTS SAMPLE B





ANNEX 5.3. MEASUREMENTS SAMPLE C[4]

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO	MnO	P_2O_5	B_2O_3
	%	%	%	%	%	%	%	ppm	ppm	ppm
x_{pt}	0.4647	0.0478	0.0033	0.0033	0.0038	0.0768	0.0146	4.37	13.29	3.96
σ_{pt}	0.0499	0.0065	0.0006	0.0016	0.0020	0.0099	0.0037	2.50	7.05	3.50
N	28	27	25	23	20	26	23	17	15	4

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO	MnO	P_2O_5	B_2O_3
	%	%	%	%	%	%	%	ppm	ppm	ppm
Lab 1	0.4794	0.0479	0.0031	0.0039	0.0048	0.0759	0.0144	3.44	11.74	3.17
Lab 2	0.4878	0.0489	0.0036	0.0035	0.0029	0.0789	0.0148	3.40	10.10	
Lab 3	0.4740	0.0620	0.0040	0.0032	0.0045	0.0820		8.00	8.00	<3
Lab 4	0.4880	0.1040	0.0025	0.0065	0.0050	0.0750	0.0121			
Lab 5	0.5070	0.0510	0.0030	0.0027	0.0015	0.0790	0.0133	10.00	14.00	
Lab 6	0.4483	0.0472	0.0032	0.0028	0.0031	0.0922	0.0144	3.00	11.00	1.00
Lab 7	0.5010	0.0454	0.0031	0.0032	0.0033	0.0732	0.0555	3.00	4.00	
Lab 8	0.8099	0.0893	0.0051	0.0060	0.0053	0.1768	0.0245	5.80	20.90	8.30
Lab 9	0.4586	0.0447	0.0034	0.0016	0.0019	0.0735	0.0144	3.00	7.00	
Lab 10	0.4635	0.0542	0.0026	0.0063	0.0085	0.0715	0.0115			
Lab 11	0.4833	0.0524	0.0044	<0.0001	0.0009	0.0745	0.0161	7.00	<1	
Lab 12	0.3910	0.0329	0.0029	0.0010			0.0101			
Lab 13	0.4470		0.0030	0.0060			0.0180			
Lab 14										
Lab 15	0.4430	0.0455	0.0030	0.0025	0.0030	0.0621	0.0144			
Lab 16	0.4015	0.0473	0.0033	0.0029	0.0030	0.0608	0.0143			
Lab 17	0.3332	0.0440	0.0033	0.0020	0.0041	0.0620	0.0029	3.00	9.00	
Lab 18	0.4290	0.0410	0.0030	0.0030	0.0030	0.0750	0.0160		10.00	
Lab 19	0.5000	0.0400	<0.01	<0.01	<0.01	0.1000	0.0200			
Lab 20	0.6986	0.0596	0.0178	0.0125		0.1060		11.50	17.00	
Lab 21	0.4652	0.0506		0.0008		0.0824	0.0140	4.25		
Lab 22	0.4279	0.0443	0.0049		0.0015	0.0658	0.0136	2.70		
Lab 23	0.4400	0.0490	0.0043	0.0040	0.0090	0.0700			19.00	
Lab 24	0.4304	0.0543	0.0031	0.0061	0.0051	0.0806	0.0182	4.00	26.00	
Lab 25	0.4571	0.0432	0.0149	0.0003	<LLD	0.0777	<LLD	2.79	<LLD	
Lab 26	0.4170	0.0387	0.0012	<0.0002	<0.0002	0.0740	0.0080	0.87		<0.07
Lab 27	1.2370	0.0470	0.0007	0.0028		0.0996	0.0493		235.40	
Lab 28										
Lab 29	0.4253	0.0490	0.0034	0.0041	0.0030	0.0778	0.0106	3.84	9.91	3.38
Lab 30	0.5400	0.0400			0.0100	0.0700				

[4] < - values are marked in Orange.

	ZnO	V_2O_5	NiO	PbO	CuO	CoO	CdO	Cr_2O_3	Sc_2O_3	BaO_2
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
x_{pt}	5.20	5.11	2.33	1.03	5.26	0.36	0.68	13.32	26.60	28.71
σ_{pt}	6.55	2.11	0.92	0.58	2.25	0.41	0.86	5.40	51.56	40.04
N	7	8	9	3	11	5	5	16	3	10

	ZnO	V_2O_5	NiO	PbO	CuO	CoO	CdO	Cr_2O_3	Sc_2O_3	BaO_2
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Lab 1	3.08	4.87	1.89	1.42	4.74	0.39	0.69	7.61	0.32	
Lab 2		4.40	2.60		4.10			12.20		
Lab 3										70.00
Lab 4										
Lab 5										<0.001
Lab 6		5.00	2.00					12.00		
Lab 7								12.00		
Lab 8	16.00	8.20	3.50		11.40	0.10	0.10	19.60		5.30
Lab 9										88.00
Lab 10										
Lab 11										60.00
Lab 12										
Lab 13										
Lab 14										
Lab 15								13.00		4.00
Lab 16										
Lab 17	1.00		2.30		4.00	<0.1		11.90		
Lab 18										
Lab 19										<0.01
Lab 20	11.90				8.00			164.00		72.00
Lab 21					4.07	10.23	1.94	12.65		4.37
Lab 22	1.50	2.70	1.60	0.45	4.10	0.10	0.57	11.40		2.90
Lab 23										
Lab 24	<0.2				6.00			13.00		4.00
Lab 25	<LLD	7.00	<LLD	<LLD	<LLD			20.00		<LLD
Lab 26	<0.02	3.00	0.57	<0.005	2.29	<0.007	<0.008	10.30	79.10	2.08
Lab 27	1.00		3.10		7.40			6.90		
Lab 28										
Lab 29	2.86	5.69	3.01	1.22	4.55	0.22	0.10	7.79	0.37	3.12
Lab 30								30.00		

	LiO_2	SO_3	MoO_3	HfO_2	Nb_2O_5	ZrO_2	As_2O_3	Bi_2O_3	Sb_2O_3	SnO_2
	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
x_{pt}	42.81	12.01	0.45	39.42		0.1954	1.11	0.28	0.61	1.03
σ_{pt}		8.62	0.31	1.64		0.0285	0.41	0.31	0.45	1.39
N	1	4	2	2		12	3	3	2	2

	LiO_2	SO_3	MoO_3	HfO_2	Nb_2O_5	ZrO_2	As_2O_3	Bi_2O_3	Sb_2O_3	SnO_2
	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
Lab 1										
Lab 2										
Lab 3										
Lab 4										
Lab 5		20.00								
Lab 6										
Lab 7										
Lab 8						0.4692	1.50	0.60		1.90
Lab 9		6.00				0.1590				
Lab 10										
Lab 11		17.00								
Lab 12										
Lab 13										
Lab 14										
Lab 15						0.1810				
Lab 16						0.1850				
Lab 17						0.1999				
Lab 18										
Lab 19										
Lab 20										
Lab 21										
Lab 22			0.64			0.1795	1.04	0.12	0.89	0.16
Lab 23										
Lab 24						0.1720				
Lab 25						0.1904				
Lab 26			<0.04	38.40		0.2210	0.78	0.13	0.32	<0.03
Lab 27						0.2799				
Lab 28										
Lab 29	42.81	5.04	0.26	40.44	<0.46	0.2018				
Lab 30						0.1800				

	SrO	Ga_2O_3	GeO_2	Rb_2O	La_2O_3	Y_2O_3	Cl	LOI	SiO_2
	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%
x_{pt}	1.07	0.54	0.25	5.52	0.19	164.90	0.0074	0.4000	99.1008
σ_{pt}	0.73			0.34			0.0042	0.0000	0.3599
N	5	1	1	2	1	1	2	3	12

	SrO	Ga_2O_3	GeO_2	Rb_2O	La_2O_3	Y_2O_3	Cl	LOI	SiO_2
	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%
Lab 1									
Lab 2									
Lab 3									
Lab 4									
Lab 5									99.300
Lab 6									
Lab 7									99.310
Lab 8	1.10								
Lab 9									99.243
Lab 10									
Lab 11									99.225
Lab 12									
Lab 13									99.526
Lab 14									
Lab 15									99.100
Lab 16									
Lab 17								0.4000	
Lab 18									
Lab 19								0.4000	98.800
Lab 20							0.0100		98.950
Lab 21	0.79								
Lab 22	0.51				0.19				
Lab 23									99.420
Lab 24									
Lab 25	47.00							0.3367	
Lab 26	<0.08	0.54	0.25	5.73					
Lab 27	0.80			5.30		164.90	0.0048		98.230
Lab 28									
Lab 29									99.212
Lab 30									97.970

ANNEX 5.3.1. Z-SCORE SAMPLE C

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO
Lab 1	0.3	0.0	-0.3	0.4	0.5	-0.1	-0.1
Lab 2	0.5	0.2	0.5	0.1	-0.5	0.2	0.0
Lab 3	0.2	2.2	1.2	-0.1	0.4	0.5	
Lab 4	0.5	8.6	-1.3	2.0	0.6	-0.2	-0.7
Lab 5	0.8	0.5	-0.5	-0.4	-1.2	0.2	-0.4
Lab 6	-0.3	-0.1	-0.1	-0.3	-0.3	1.5	-0.1
Lab 7	0.7	-0.4	-0.3	-0.1	-0.2	-0.4	11.0
Lab 8	6.9	6.4	3.1	1.7	0.8	10.1	2.6
Lab 9	-0.1	-0.5	0.2	-1.1	-1.0	-0.3	-0.1
Lab 10	0.0	1.0	-1.2	1.9	2.4	-0.5	-0.8
Lab 11	0.4	0.7	1.9		-1.5	-0.2	0.4
Lab 12	-1.5	-2.3	-0.7	-1.5			-1.2
Lab 13	-0.4		-0.5	1.7			0.9
Lab 14							
Lab 15	-0.4	-0.4	-0.5	-0.5	-0.4	-1.5	-0.1
Lab 16	-1.3	-0.1	0.0	-0.3	-0.4	-1.6	-0.1
Lab 17	-2.6	-0.6	0.0	-0.8	0.2	-1.5	-3.1
Lab 18	-0.7	-1.0	-0.5	-0.2	-0.4	-0.2	0.4
Lab 19	0.7	-1.2				2.3	1.4
Lab 20	4.7	1.8	24.6	5.8		2.9	
Lab 21	0.0	0.4		-1.6		0.6	-0.2
Lab 22	-0.7	-0.5	2.7		-1.2	-1.1	-0.3
Lab 23	-0.5	0.2	1.7	0.4	2.6	-0.7	
Lab 24	-0.7	1.0	-0.3	1.8	0.7	0.4	1.0
Lab 25	-0.2	-0.7	19.7	-1.9		0.1	
Lab 26	-1.0	-1.4	-3.6			-0.3	-1.8
Lab 27	15.5	-0.1	-4.3	-0.4		2.3	9.3
Lab 28							
Lab 29	-0.8	0.2	0.2	0.5	-0.4	0.1	-1.1
Lab 30	1.5	-1.2			3.1	-0.7	

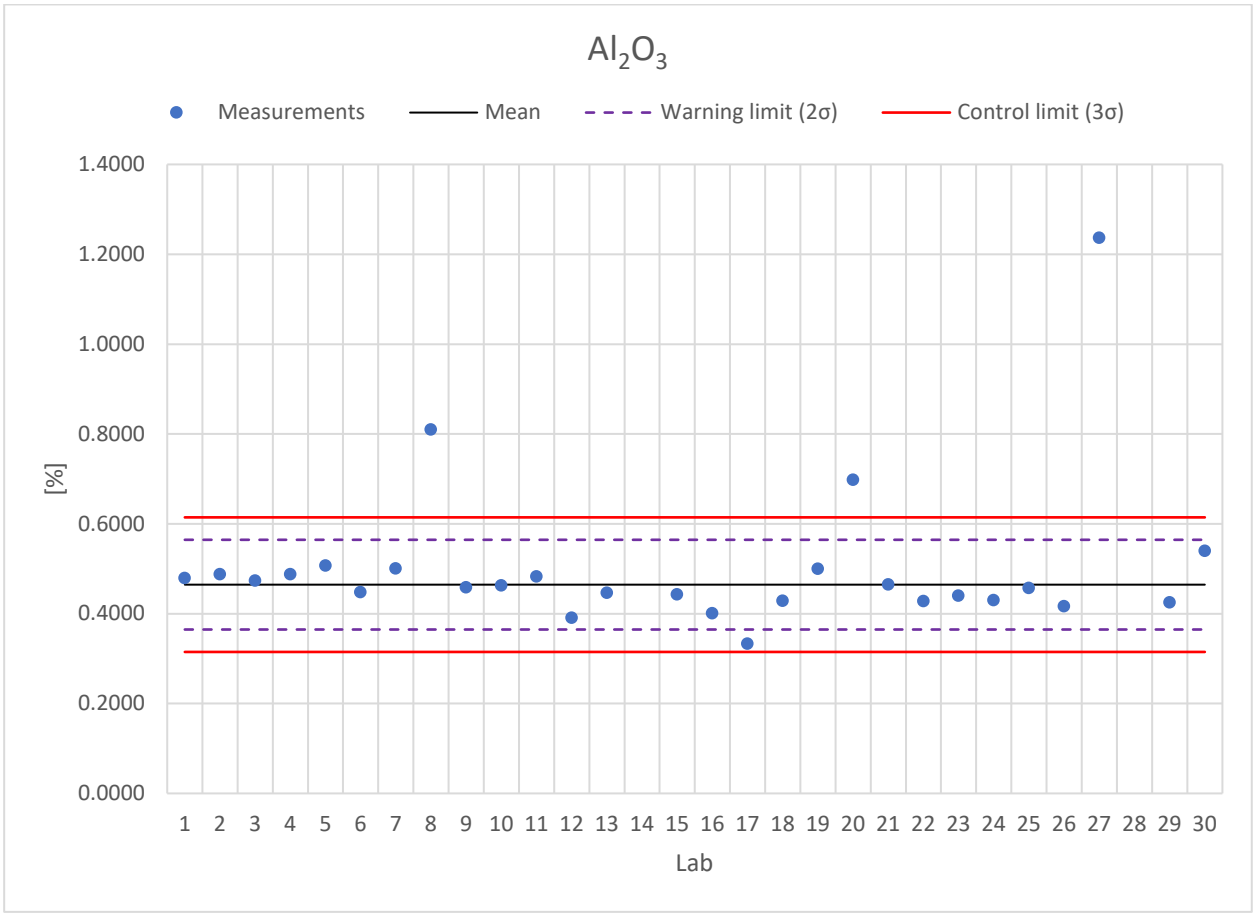
Satisfactory performance
Questionable performance
Unsatisfactory performance

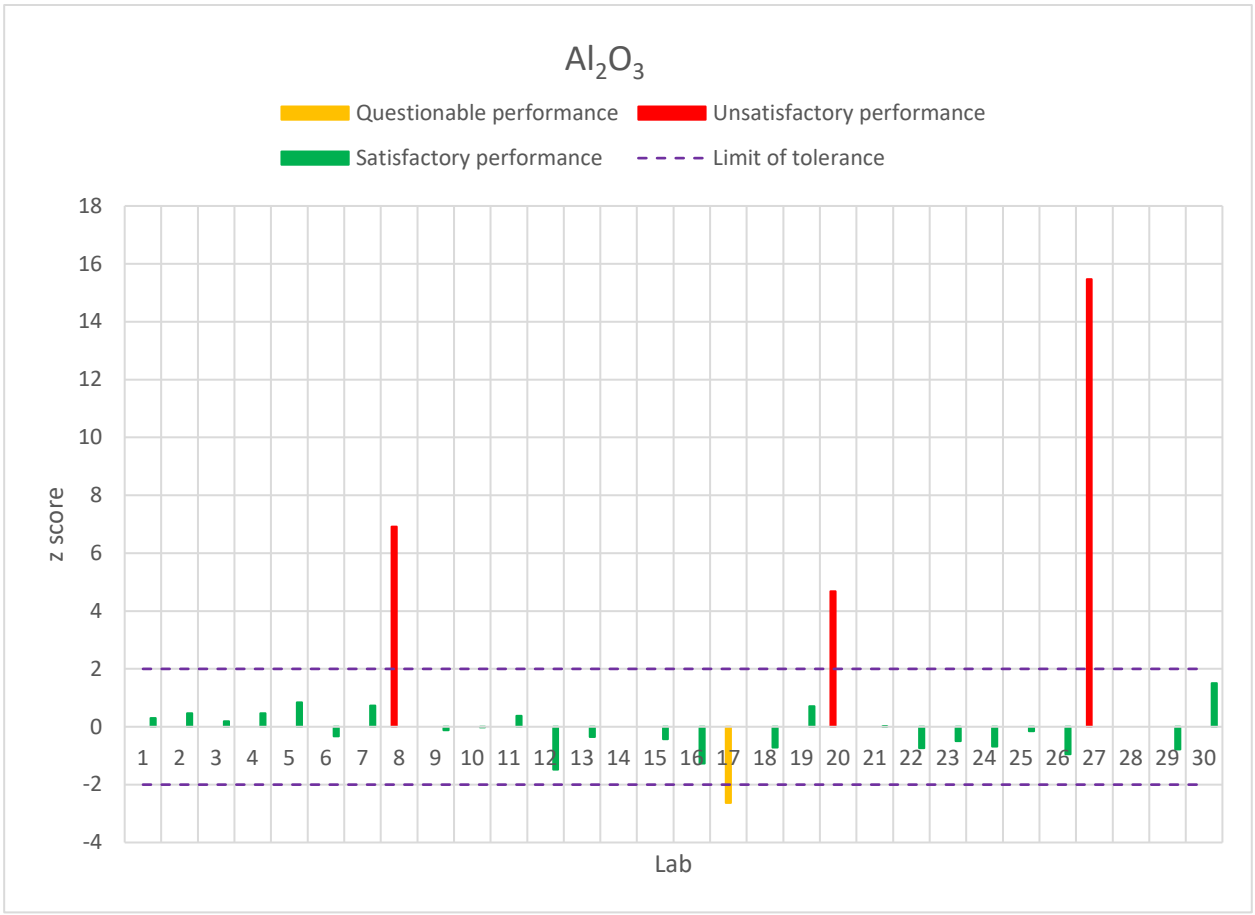
ANNEX 5.3.2. Z'-SCORE SAMPLE C

	MnO	P_2O_5	V_2O_5	NiO	CuO	Cr_2O_3	BaO_2	SiO_2
Lab 1	-0.4	-0.2	-0.1	-0.4	-0.2	-1.0		
Lab 2	-0.4	-0.4	-0.3	0.3	-0.5	-0.2		
Lab 3	1.4	-0.7					1.0	
Lab 4								
Lab 5	2.2	0.1						0.5
Lab 6	-0.5	-0.3	0.0	-0.3		-0.2		
Lab 7	-0.5	-1.3				-0.2		0.5
Lab 8	0.5	1.0	1.3	1.2	2.6	1.1	-0.5	
Lab 9	-0.5	-0.8					1.4	0.4
Lab 10								
Lab 11	1.0						0.7	0.3
Lab 12								
Lab 13								1.1
Lab 14								
Lab 15						-0.1	-0.6	0.0
Lab 16								
Lab 17	-0.5	-0.6		0.0	-0.5	-0.3		
Lab 18		-0.4						
Lab 19								-0.8
Lab 20	2.7	0.5			1.1	26.6	1.0	-0.4
Lab 21	0.0				-0.5	-0.1	-0.6	
Lab 22	-0.6		-1.0	-0.7	-0.5	-0.3	-0.6	
Lab 23		0.8						0.8
Lab 24	-0.1	1.7			0.3	-0.1	-0.6	
Lab 25	-0.6		0.8			1.2		
Lab 26	-1.3		-0.9	-1.8	-1.2	-0.5	-0.6	
Lab 27		30.0		0.8	0.9	-1.1		-2.3
Lab 28								
Lab 29	-0.2	-0.5	0.3	0.7	-0.3	-1.0	-0.6	0.3
Lab 30						2.9		-3.0

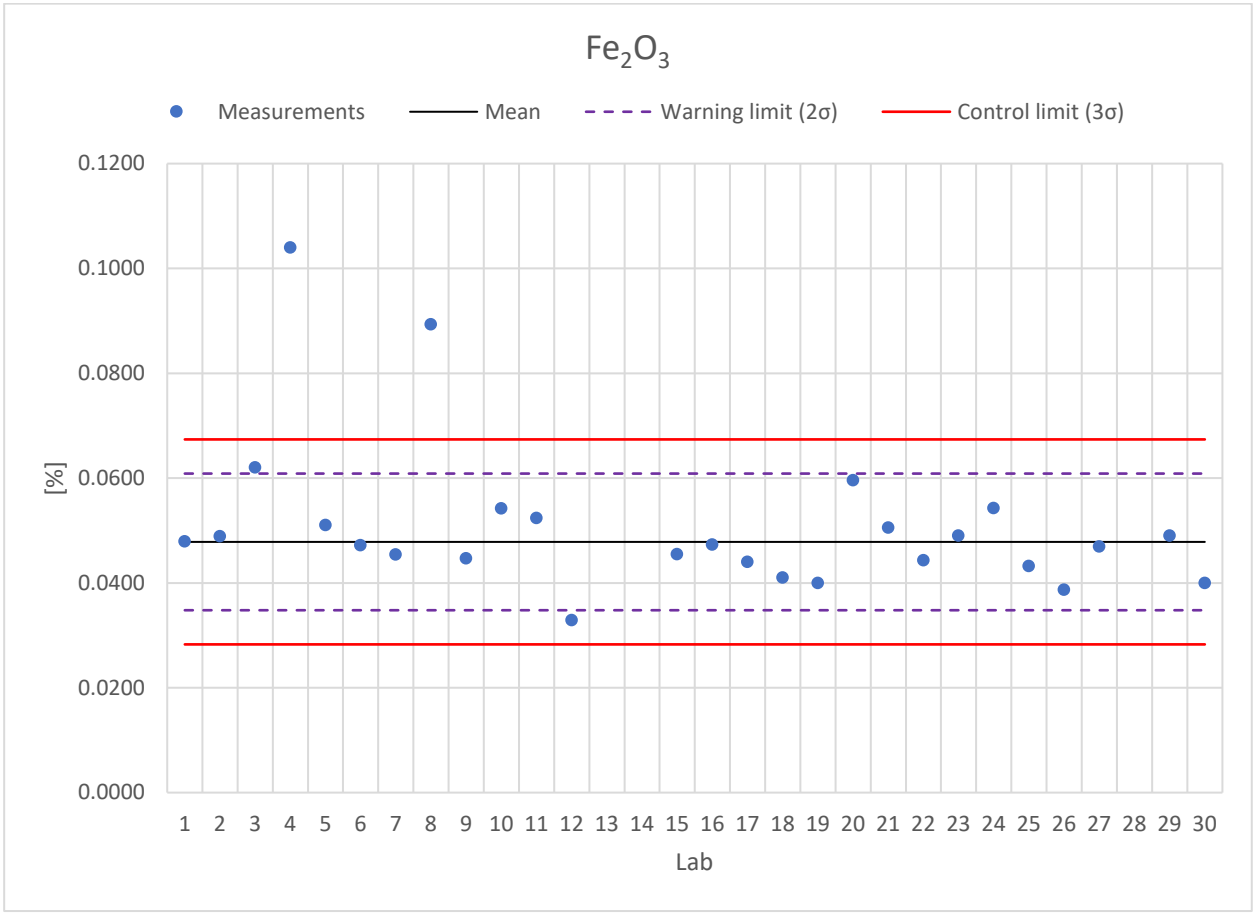
Satisfactory performance
Questionable performance
Unsatisfactory performance

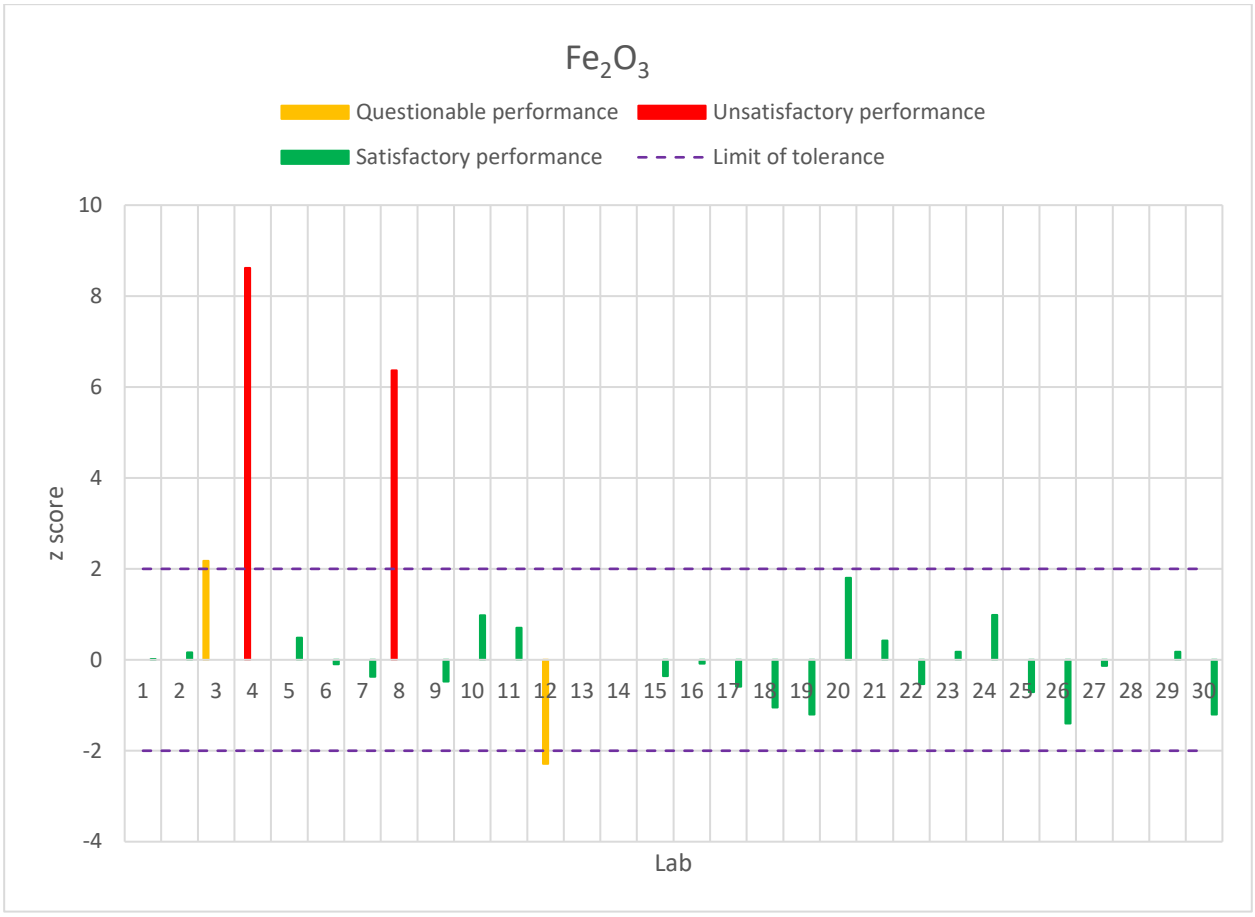
ANNEX 5.3.3. CHARTS SAMPLE C



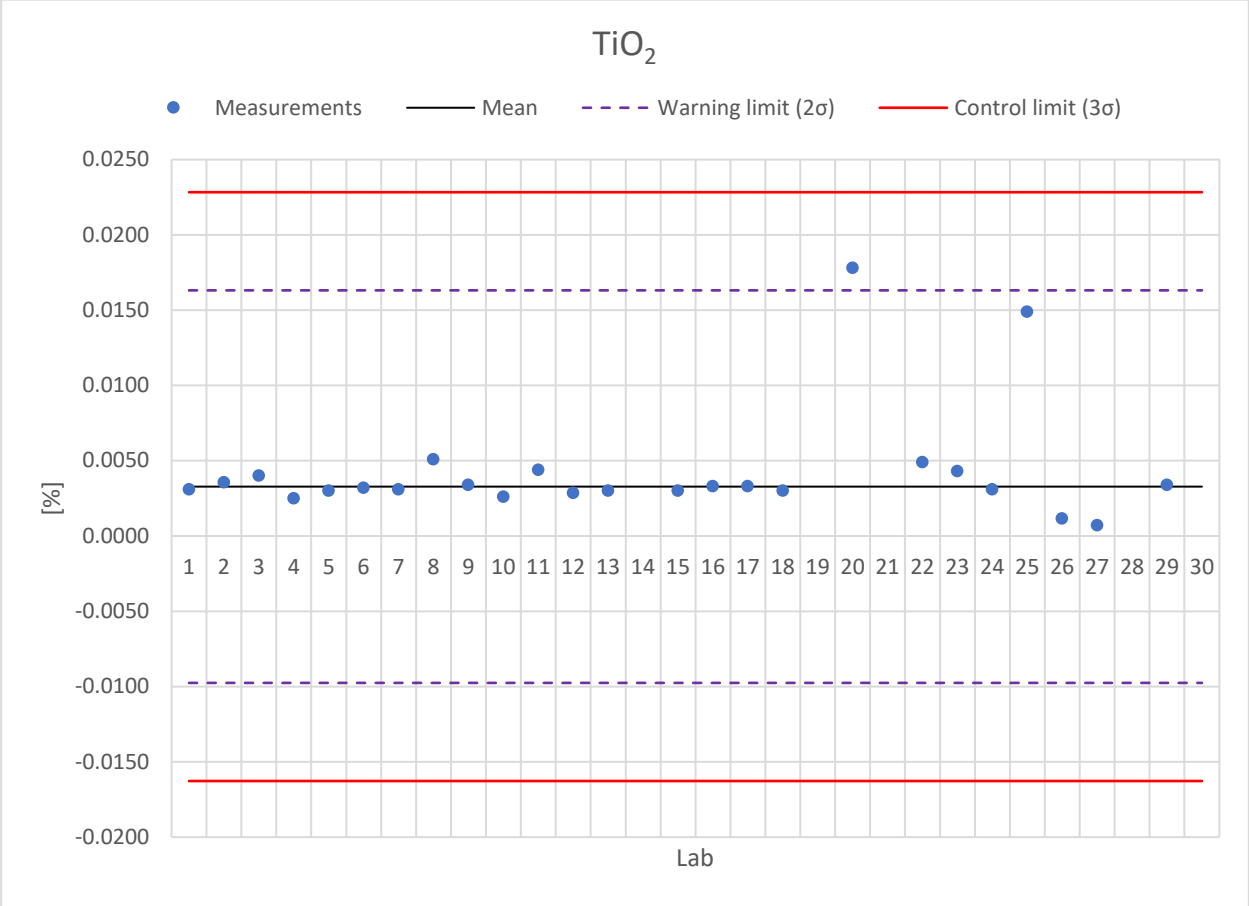


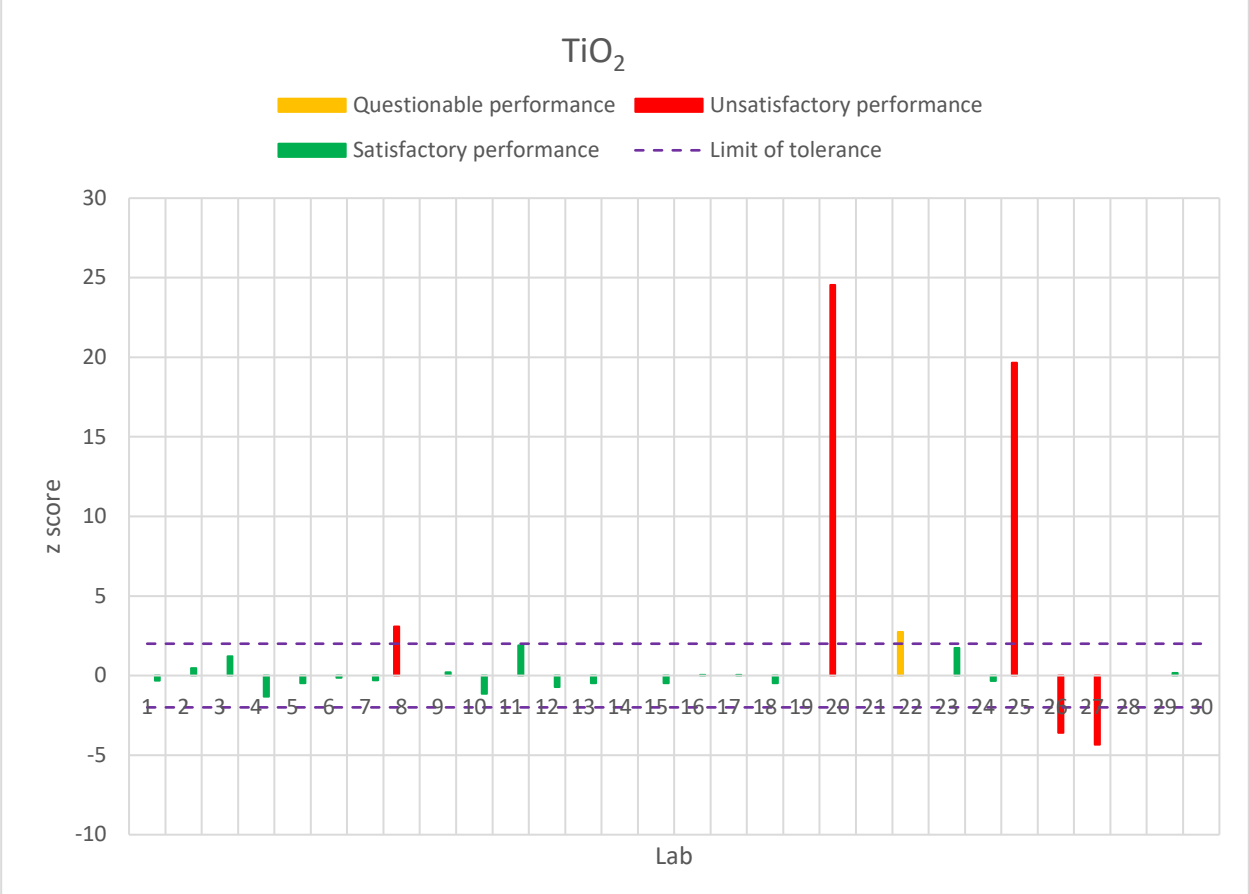
CHARTS SAMPLE C



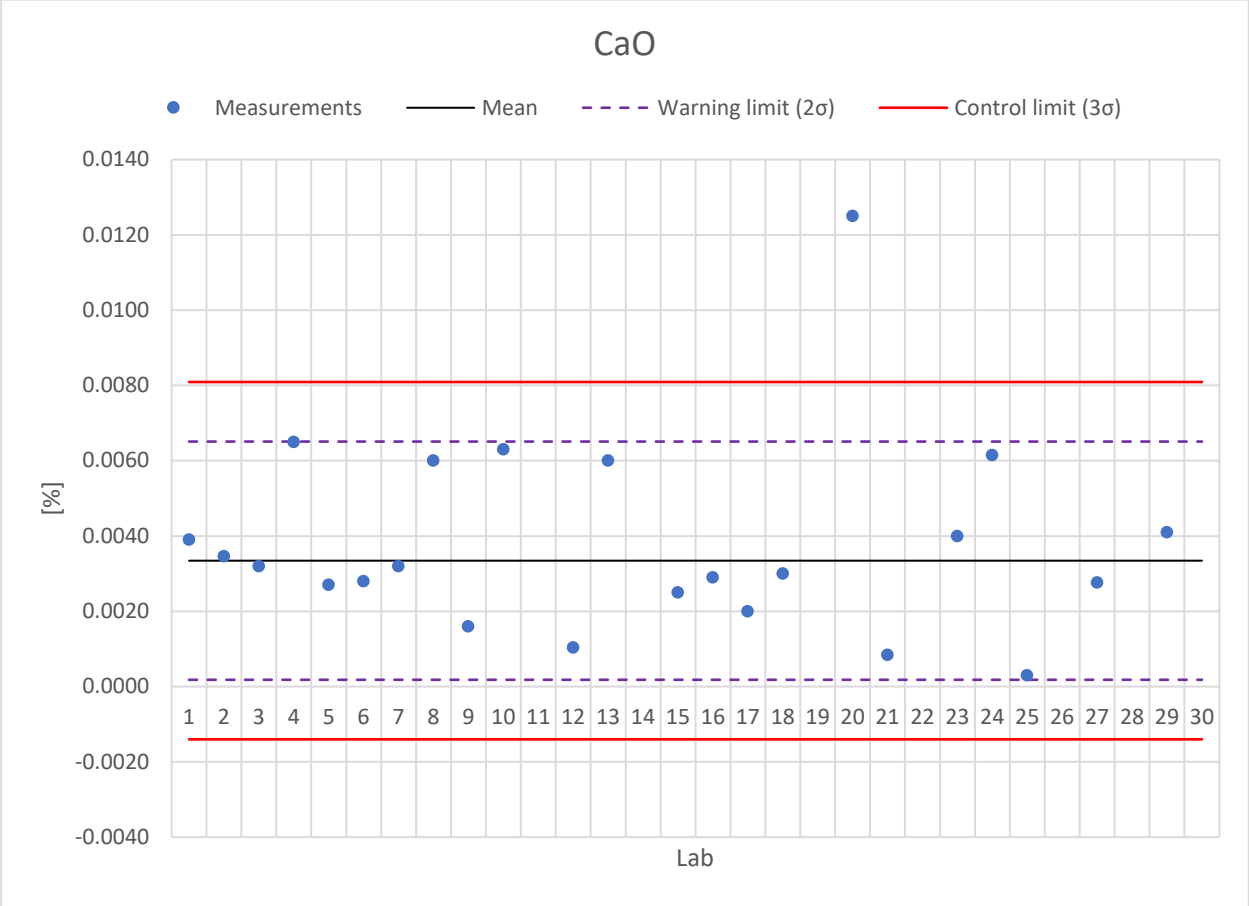


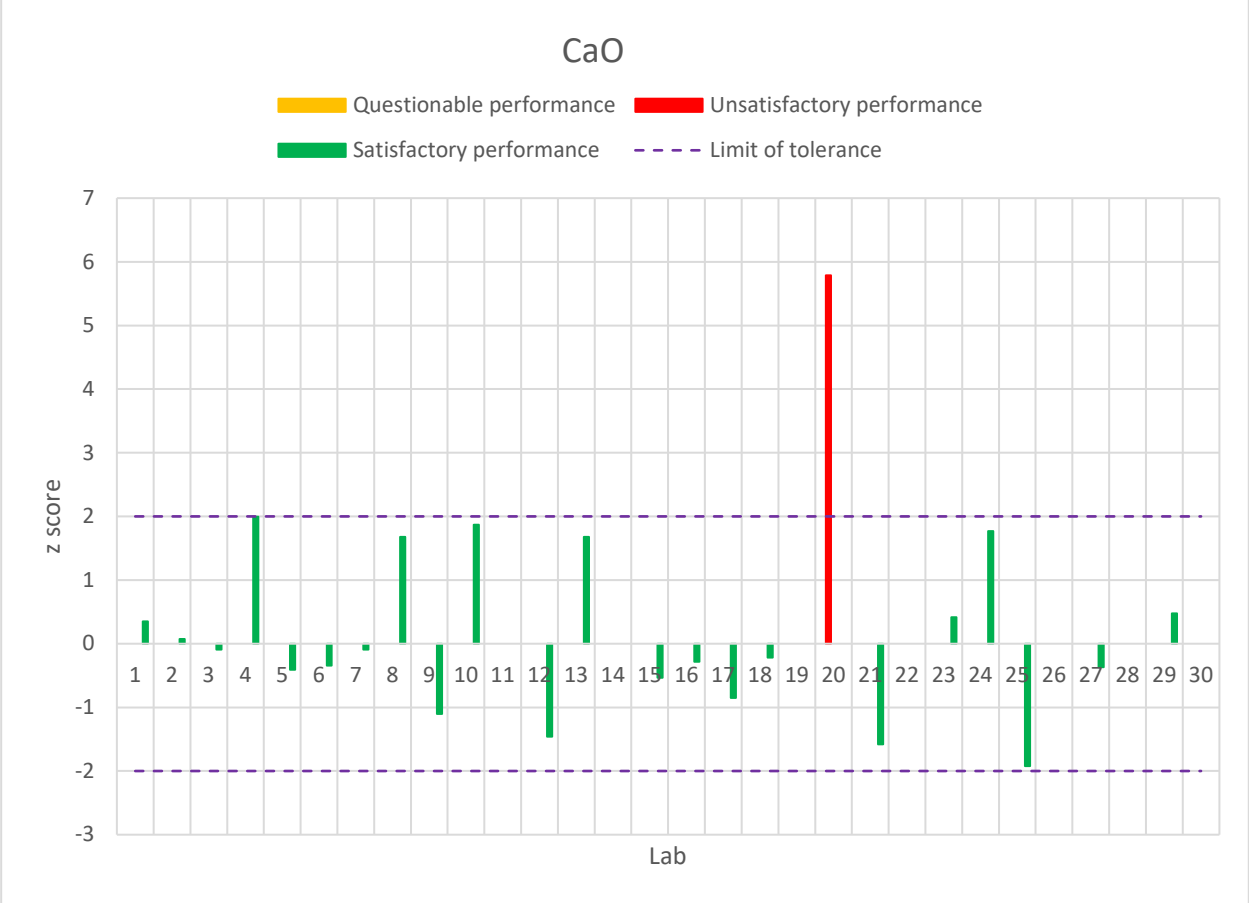
CHARTS SAMPLE C



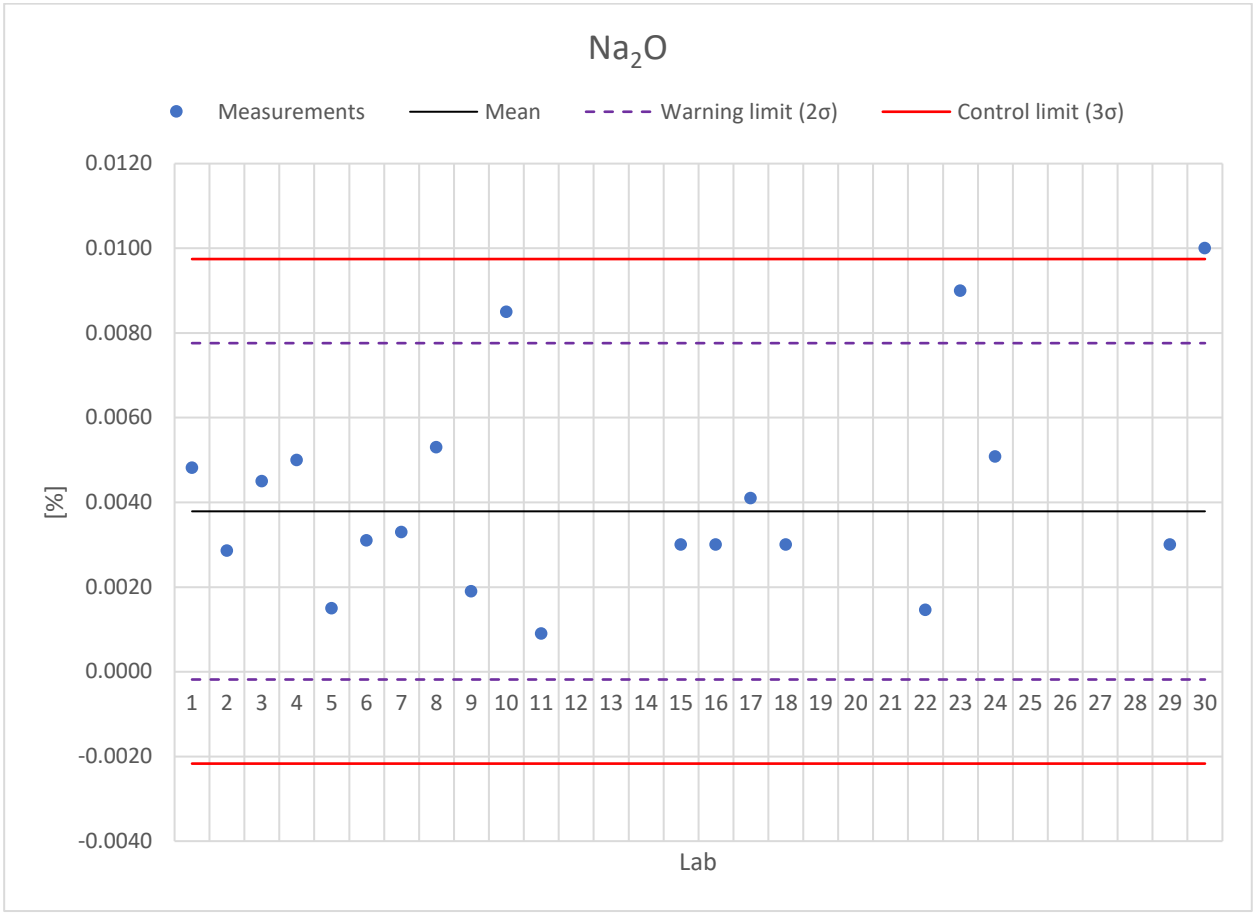


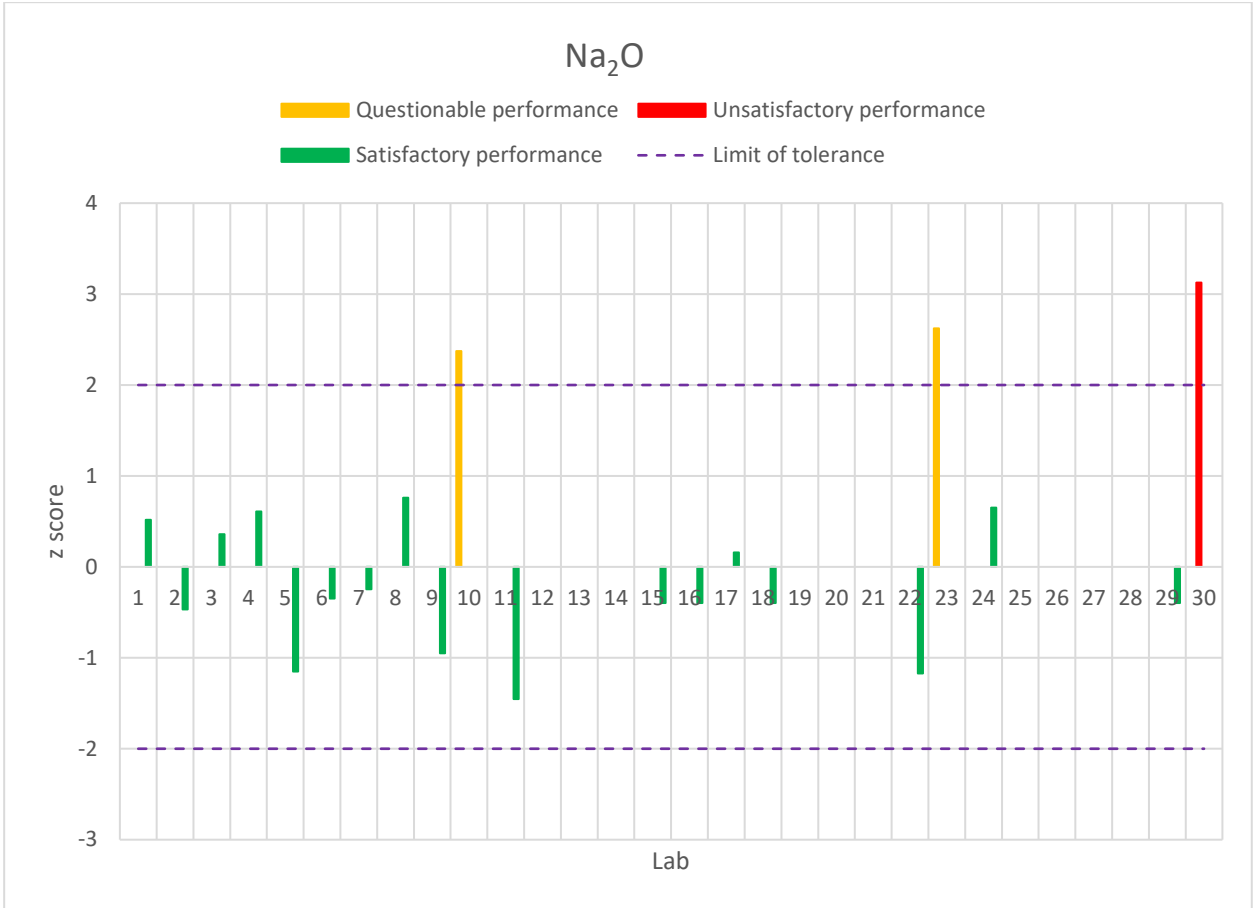
CHARTS SAMPLE C



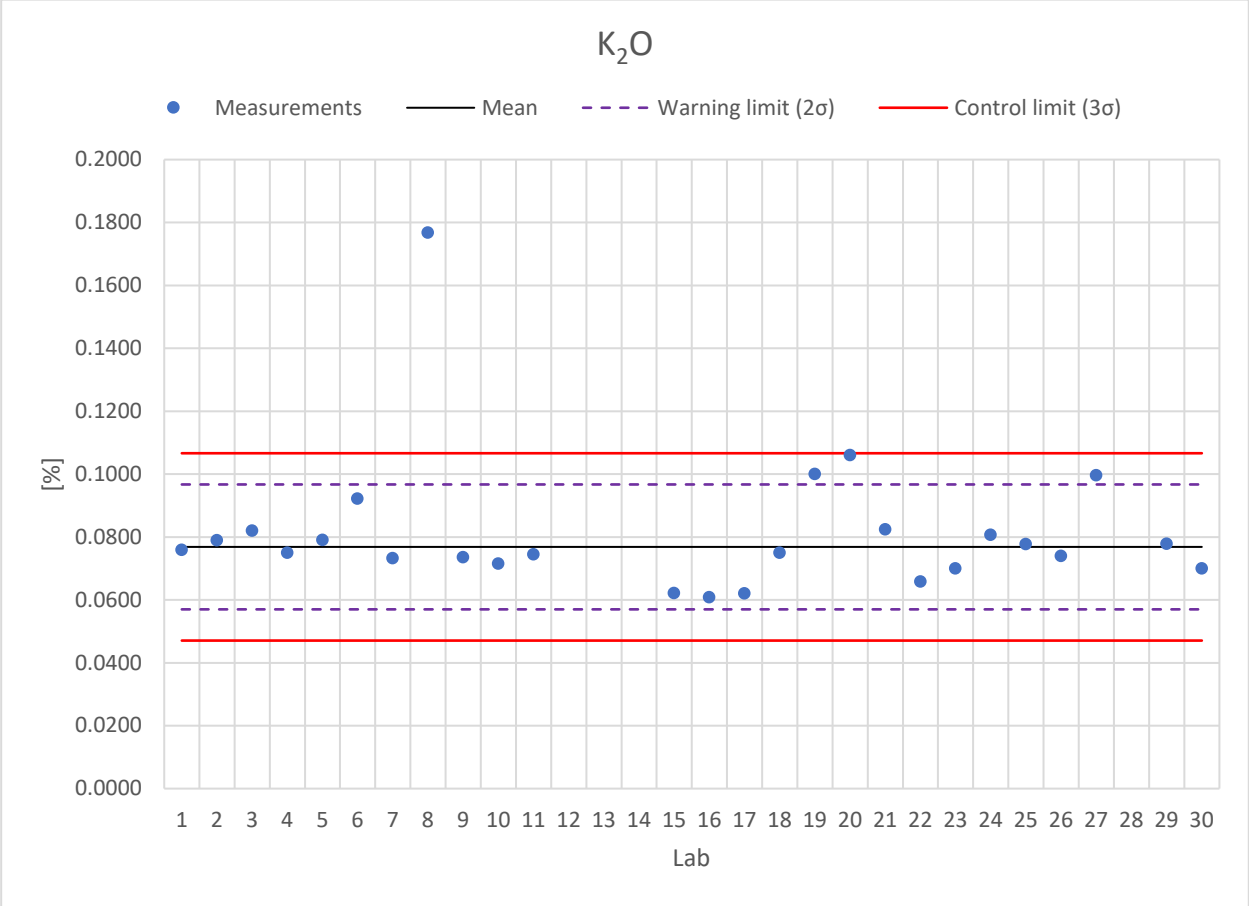


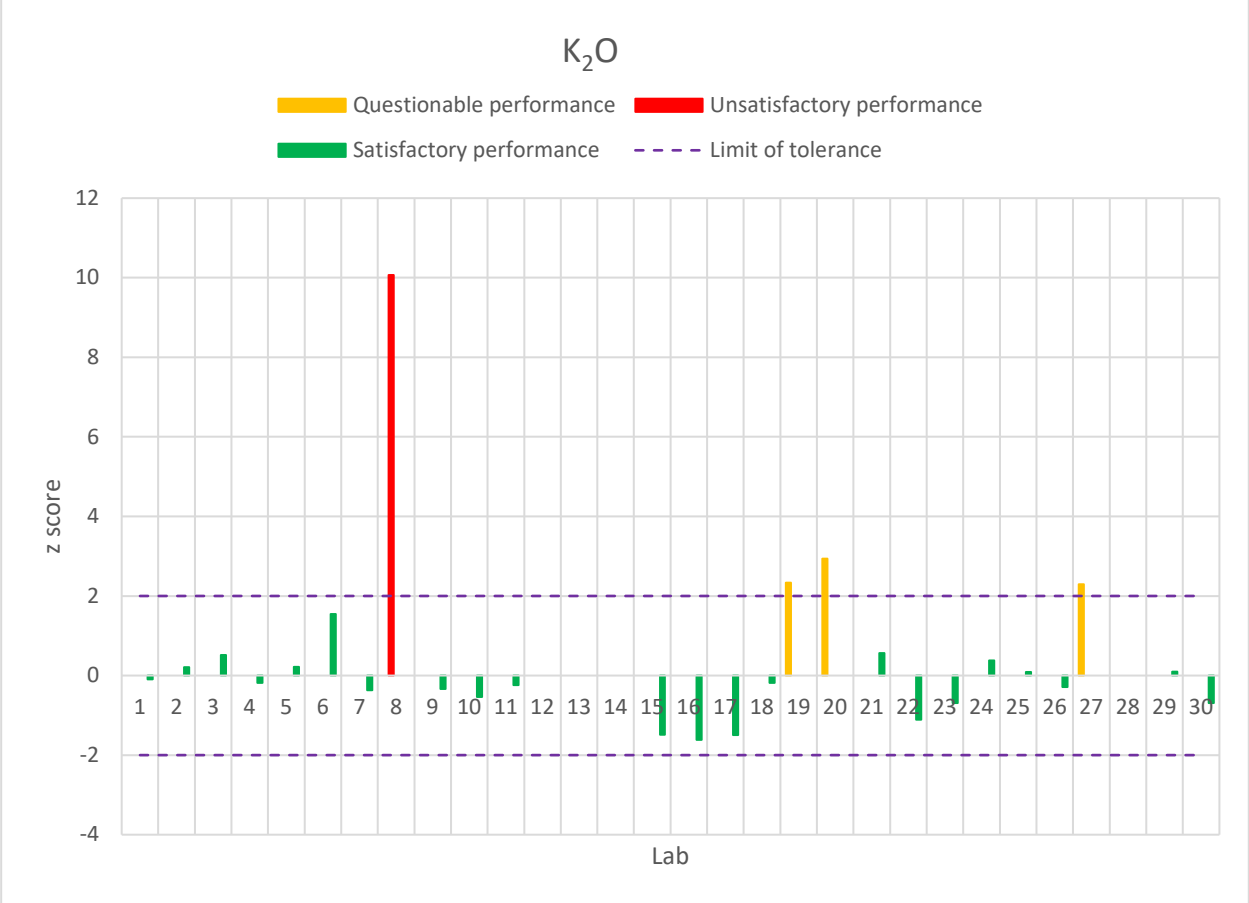
CHARTS SAMPLE C



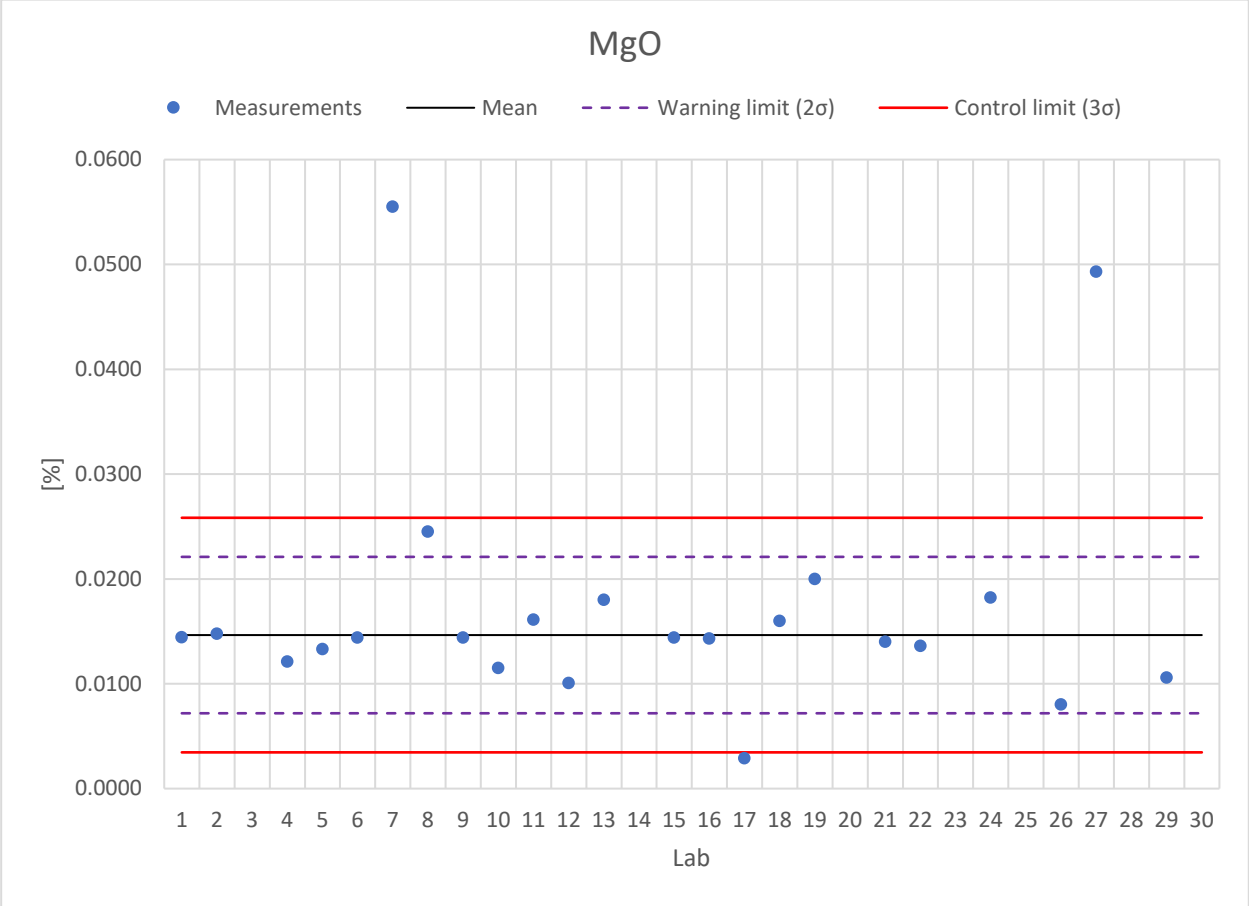


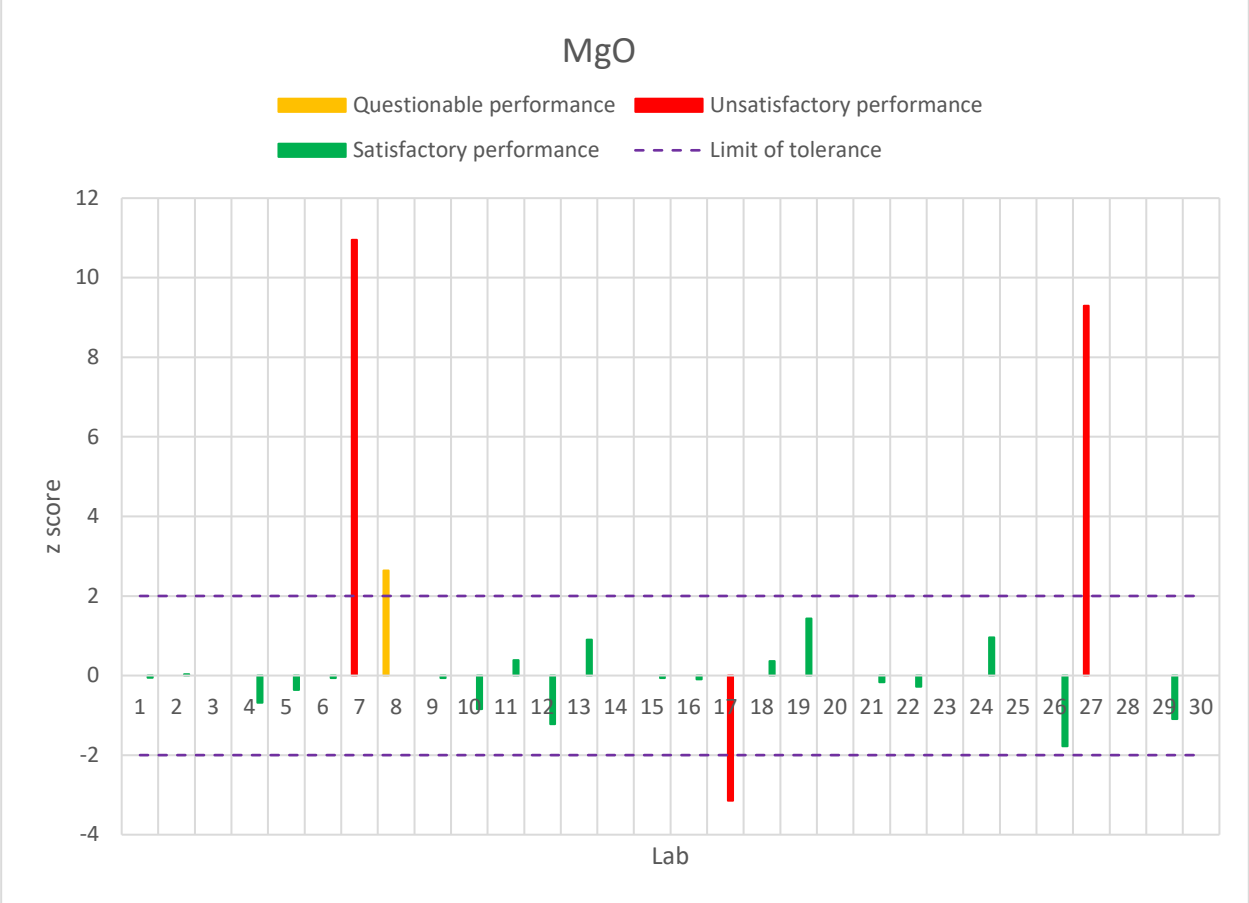
CHARTS SAMPLE C



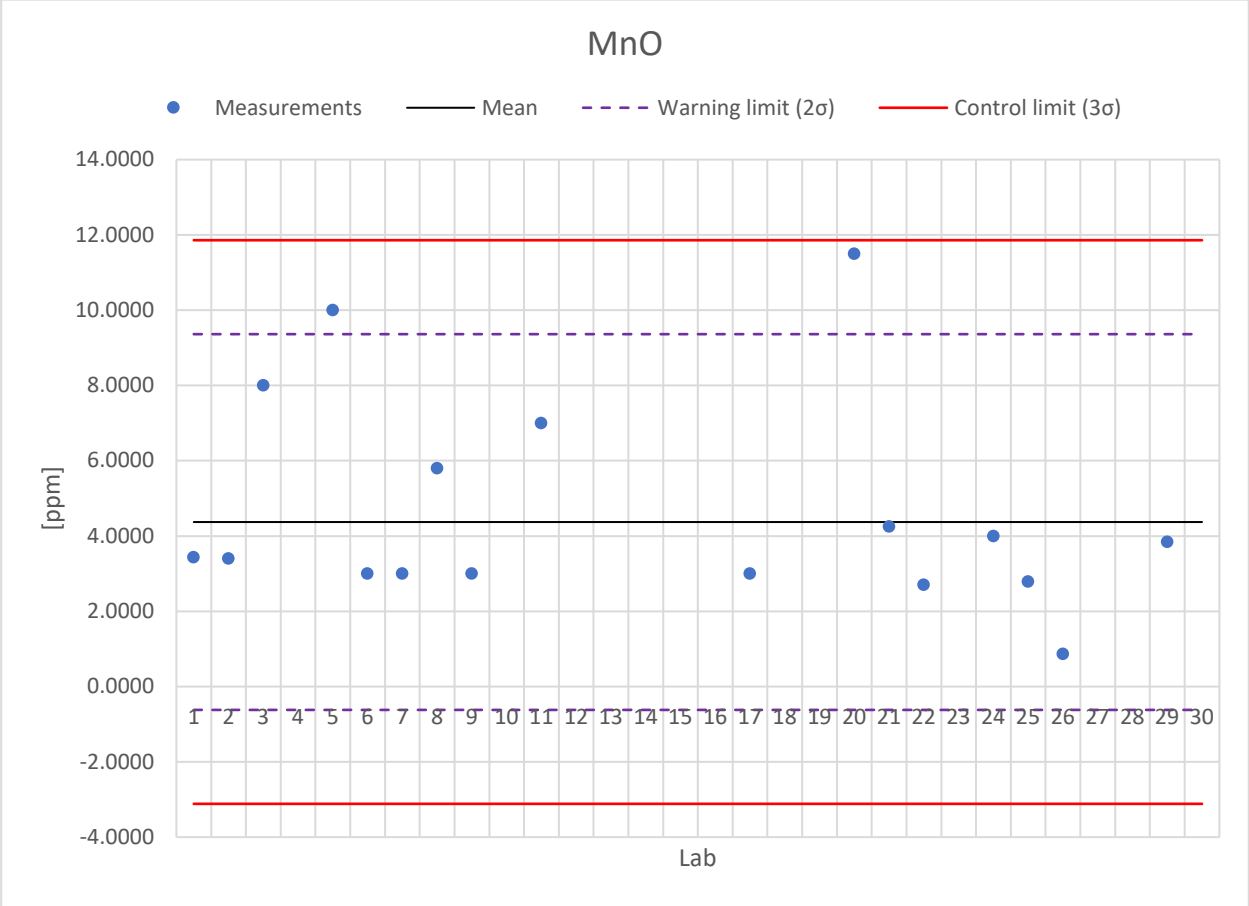


CHARTS SAMPLE C

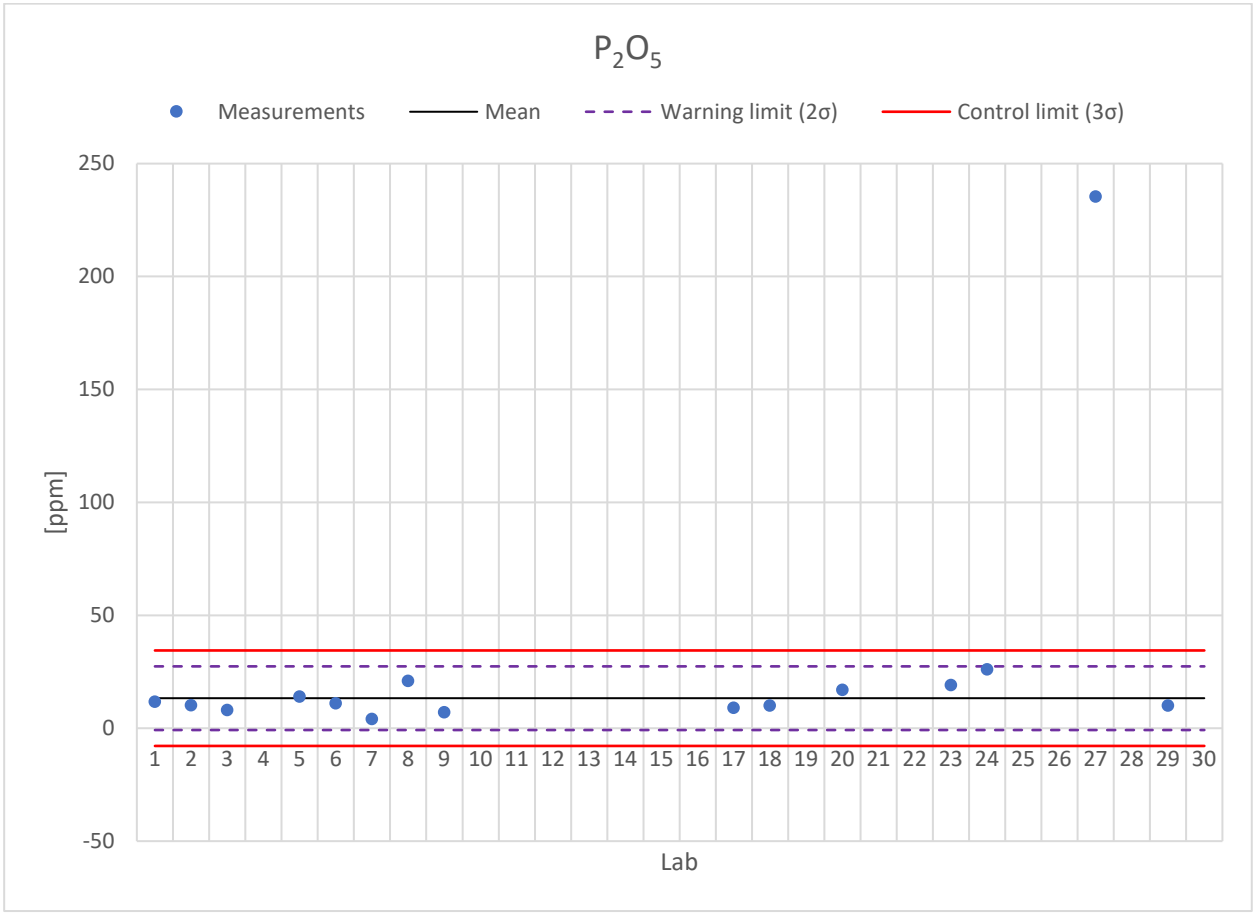


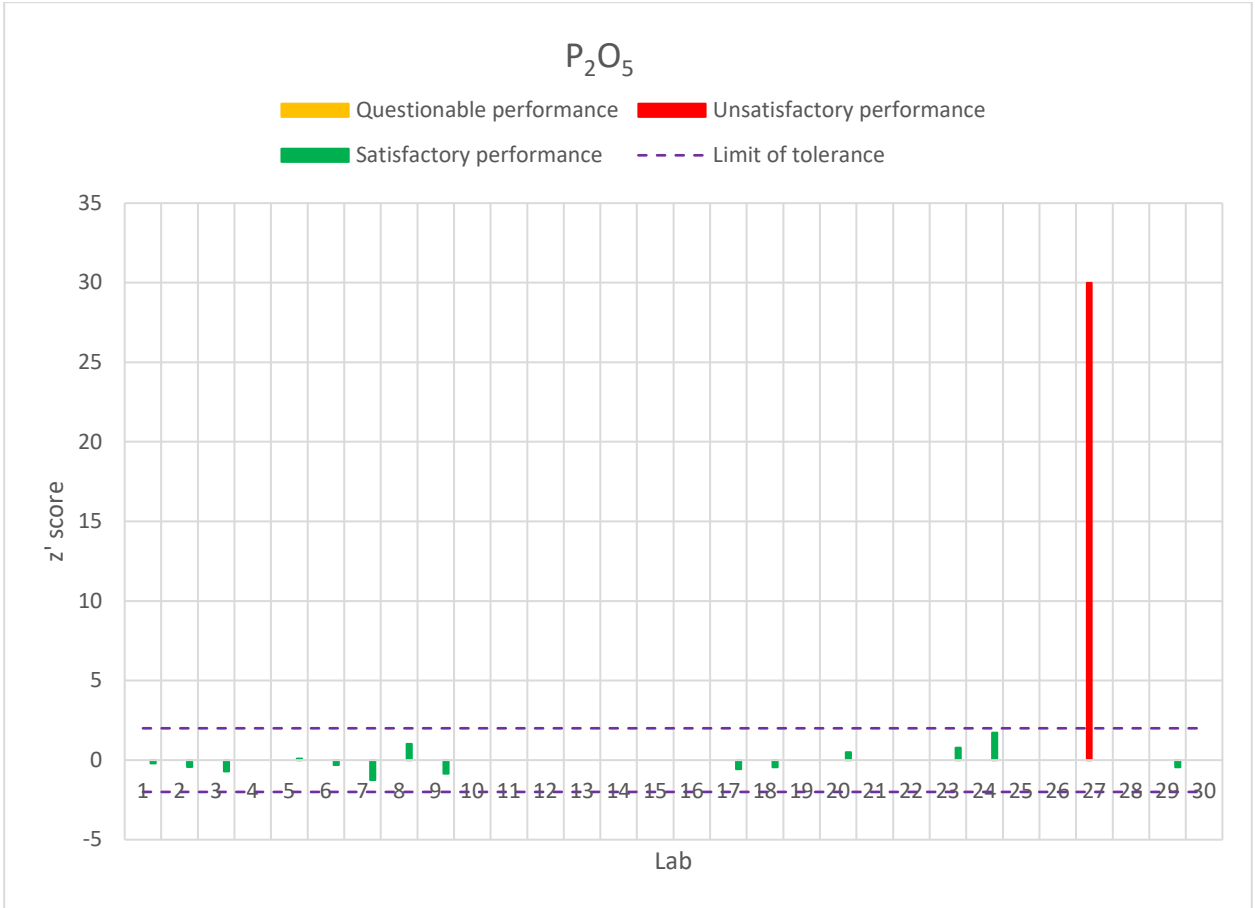


CHARTS SAMPLE C

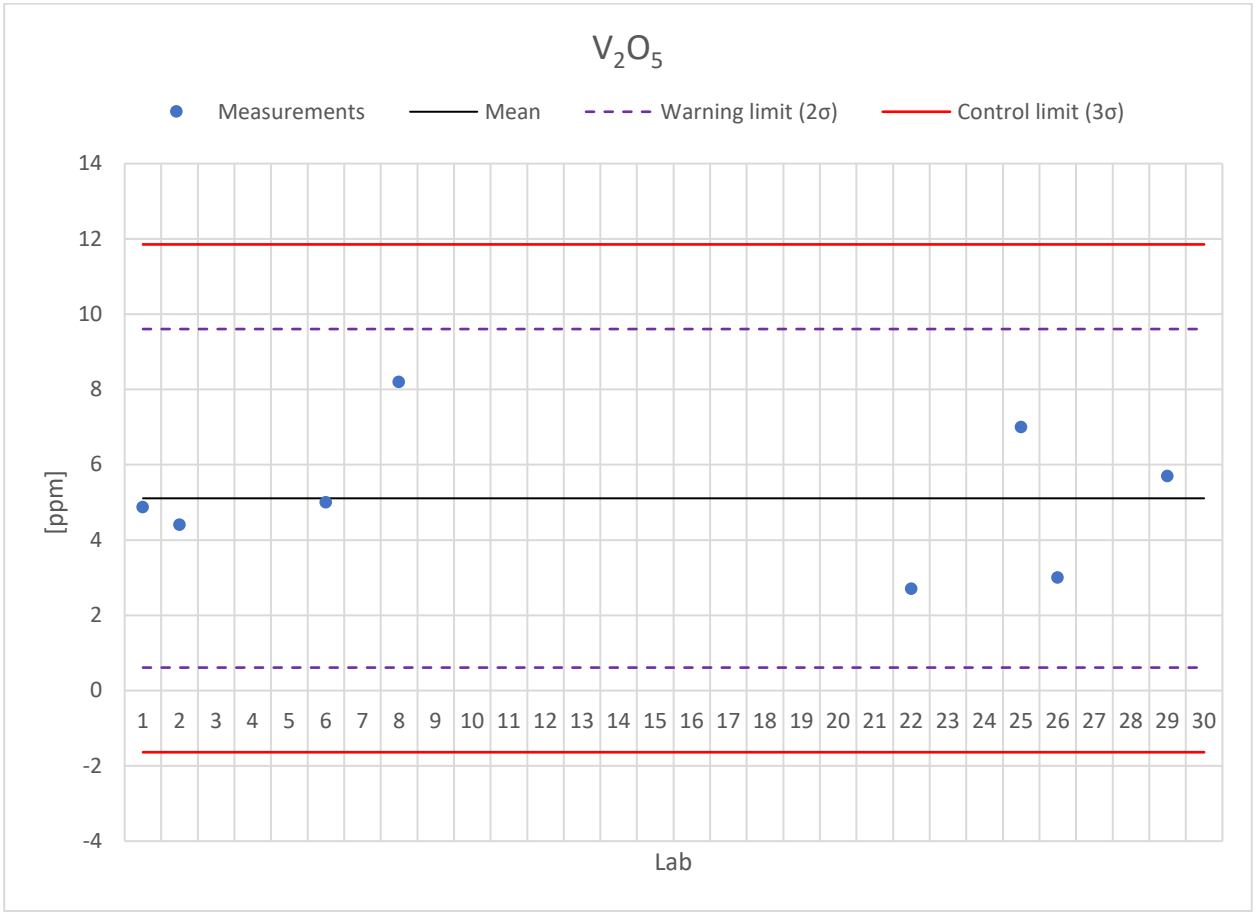


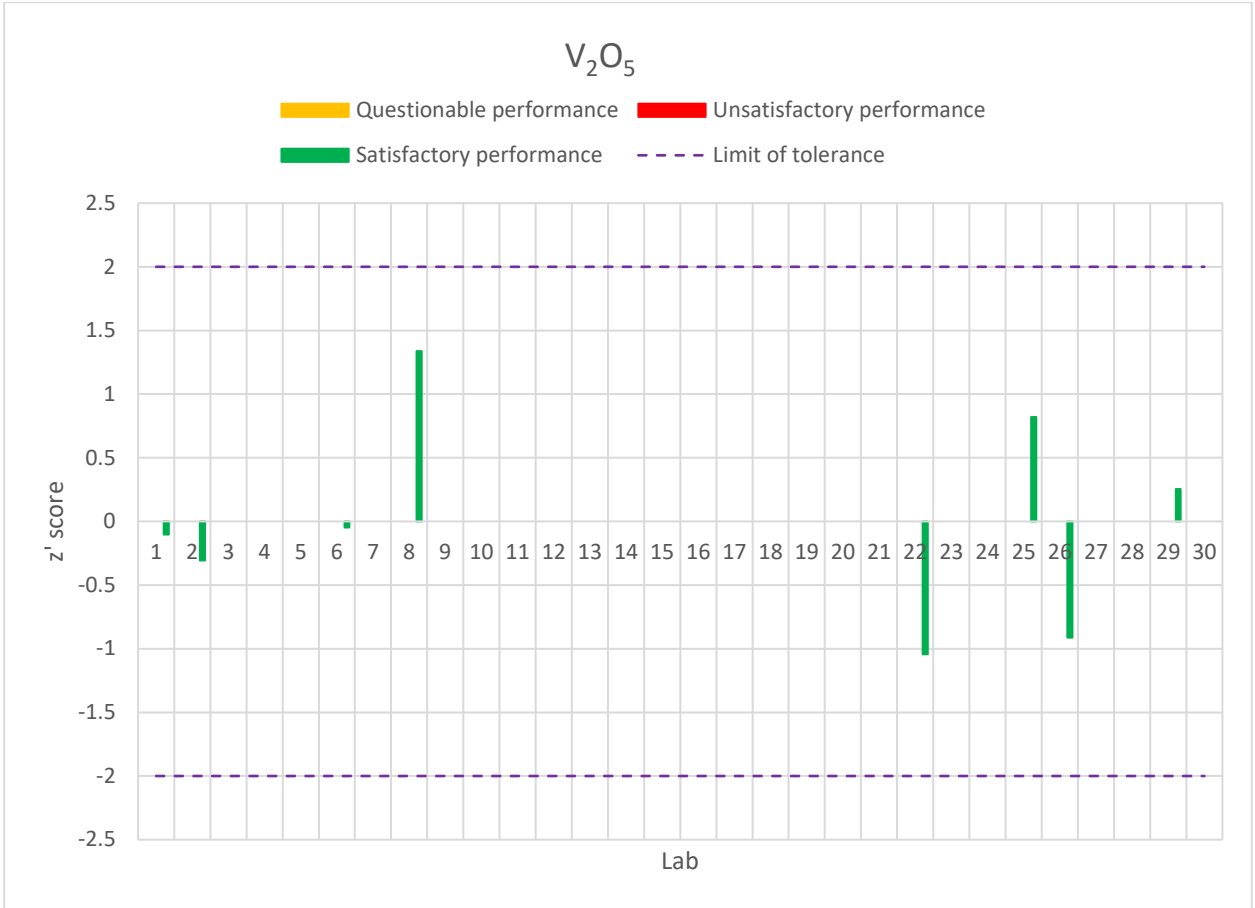
CHARTS SAMPLE C



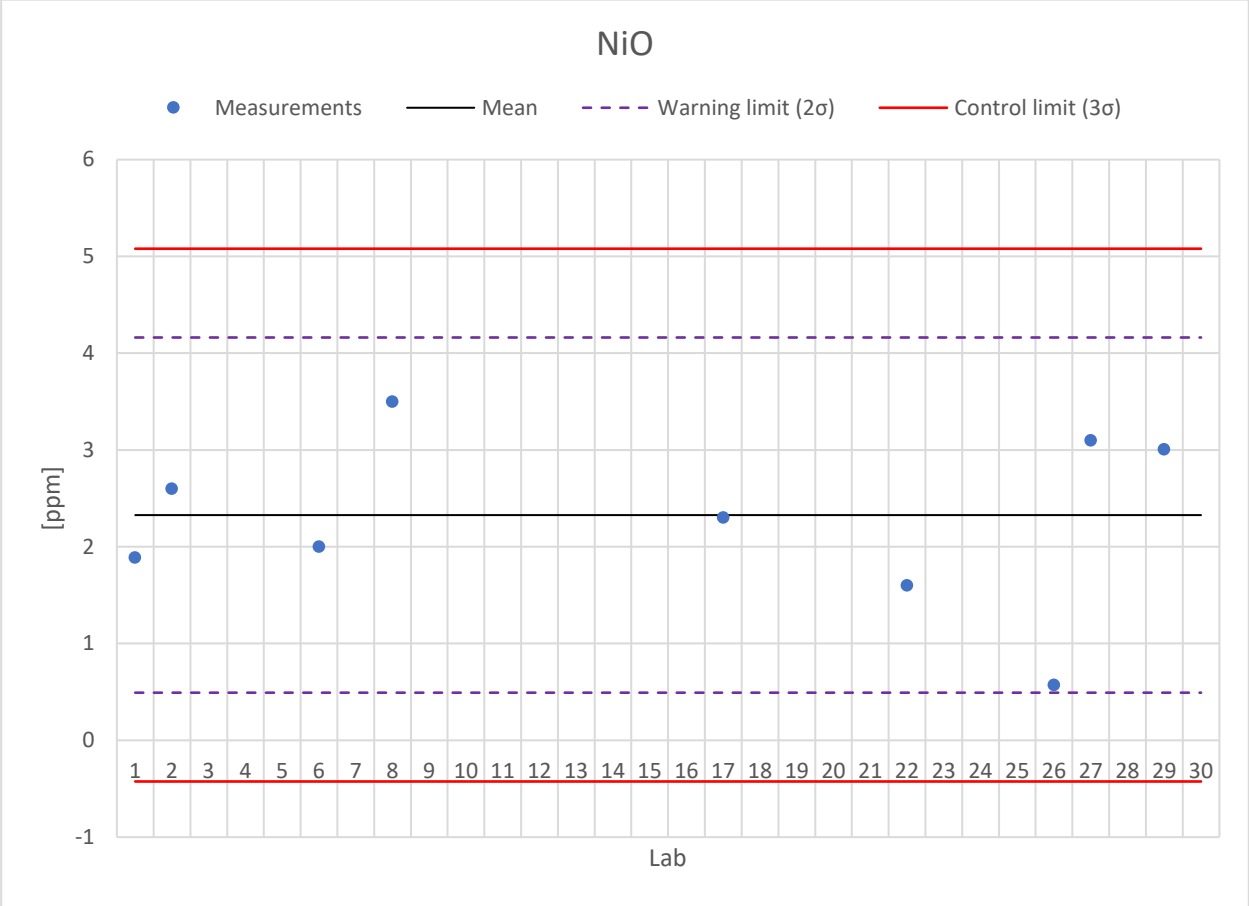


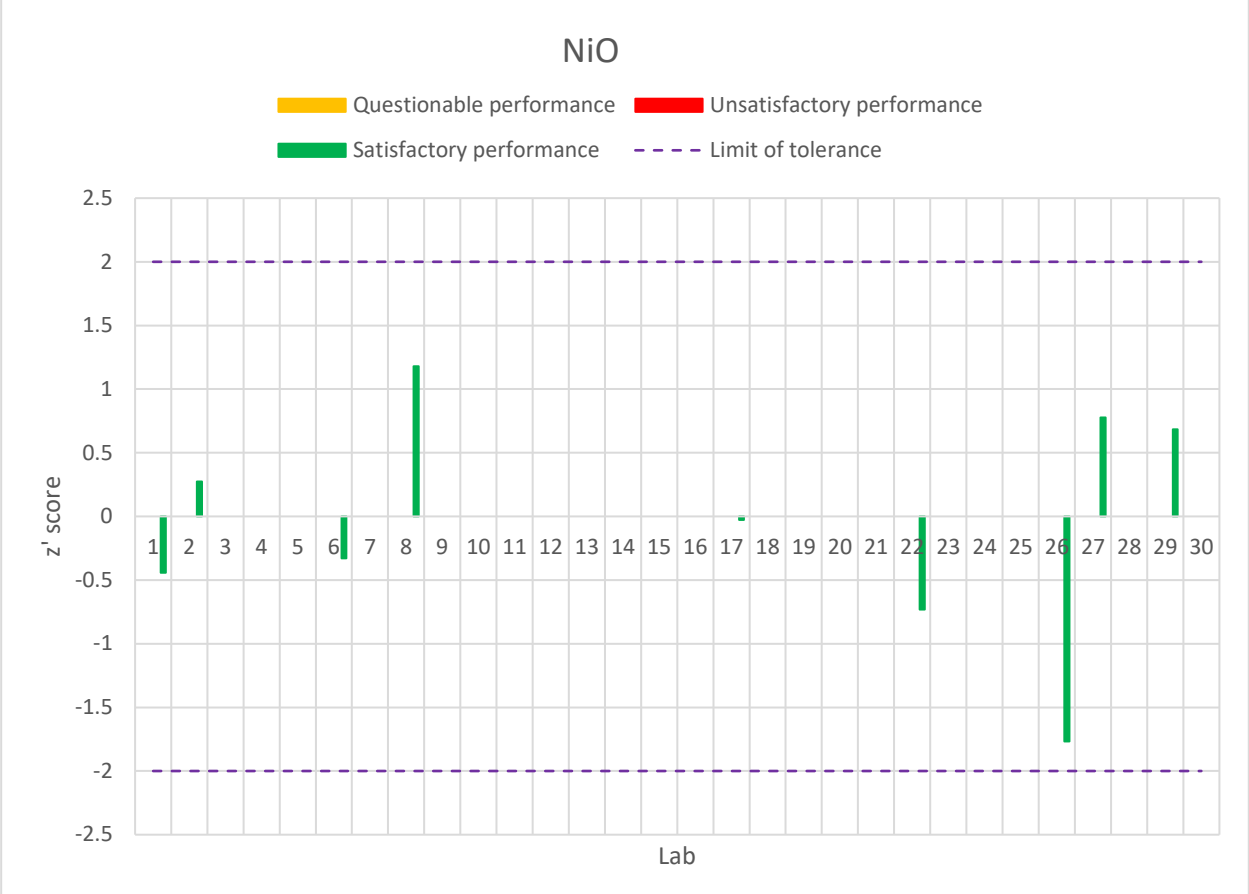
CHARTS SAMPLE C



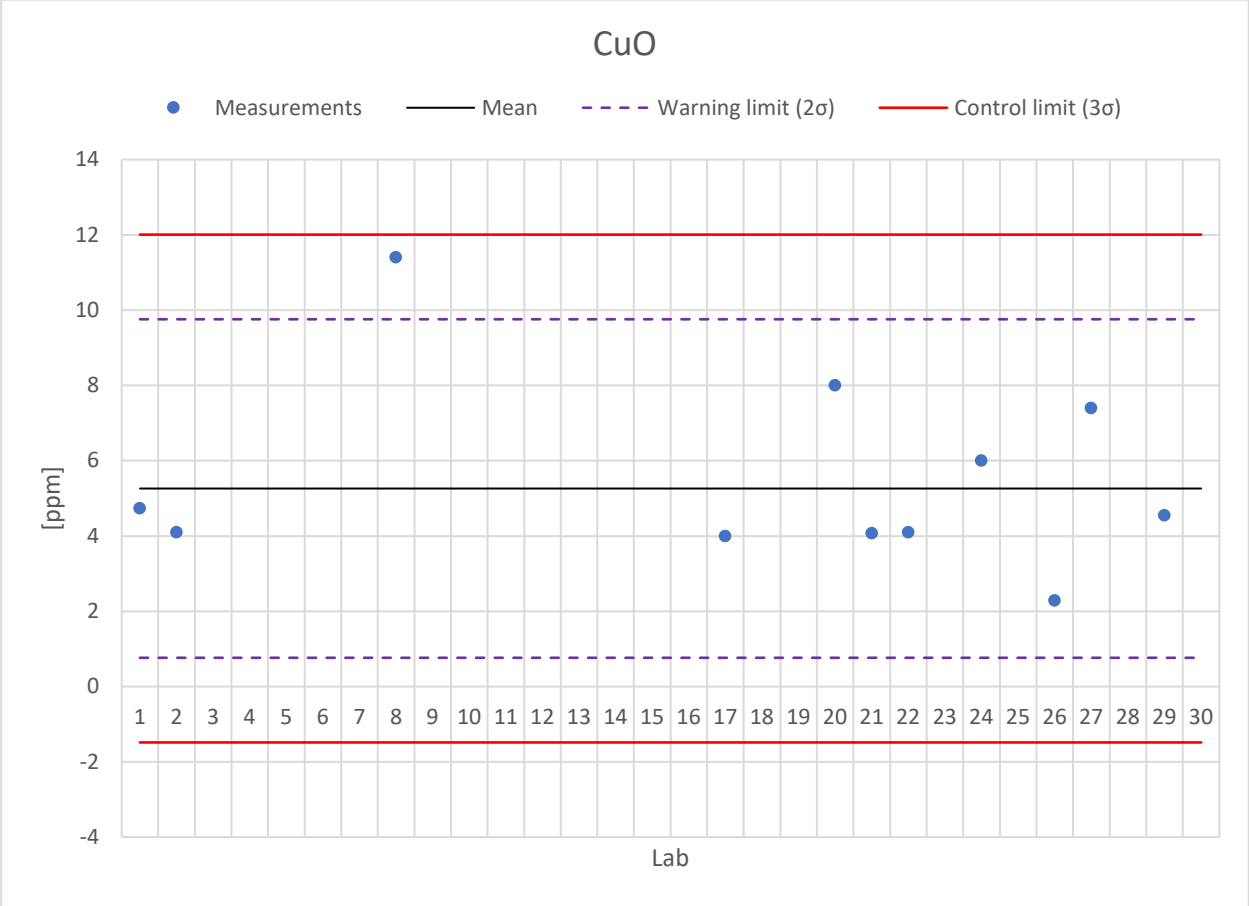


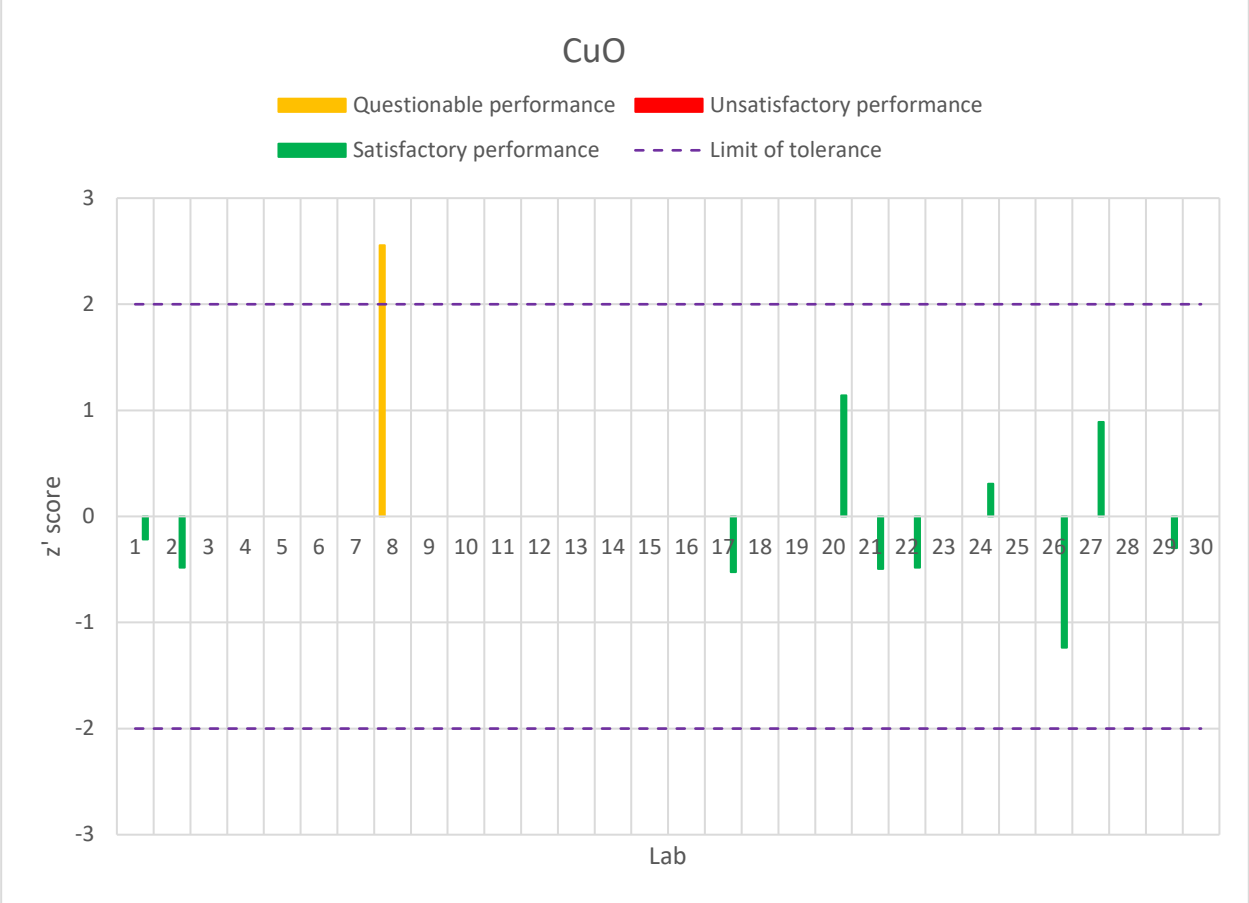
CHARTS SAMPLE C



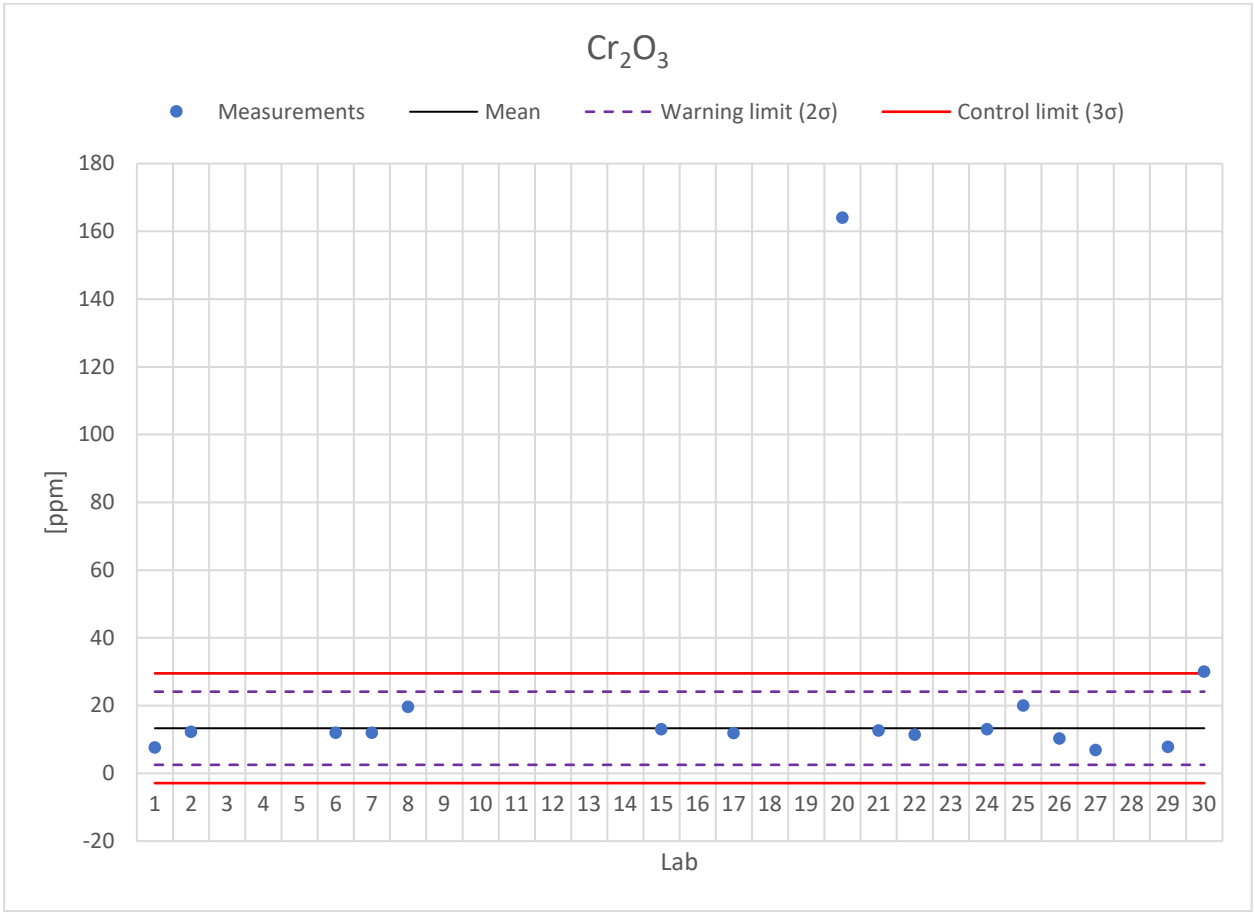


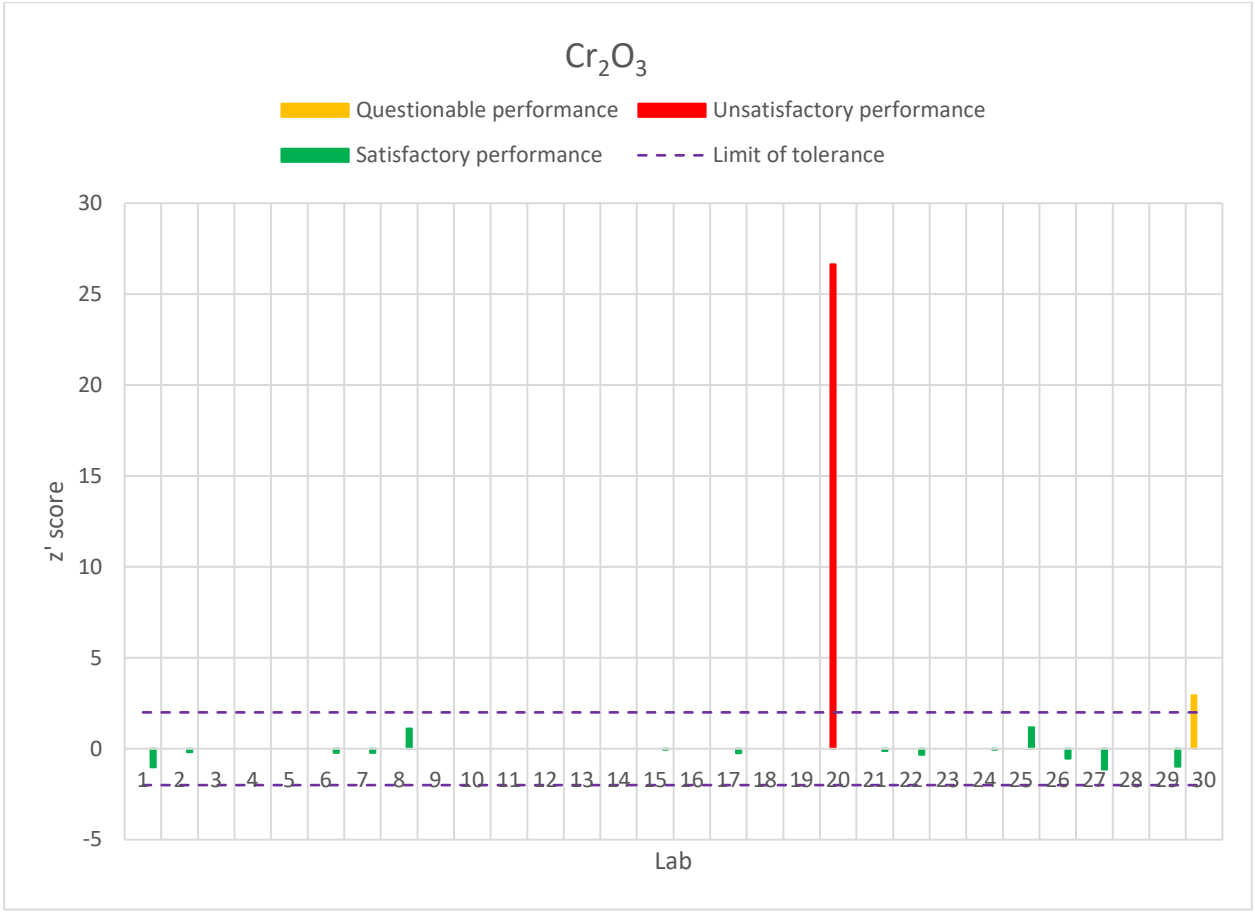
CHARTS SAMPLE C



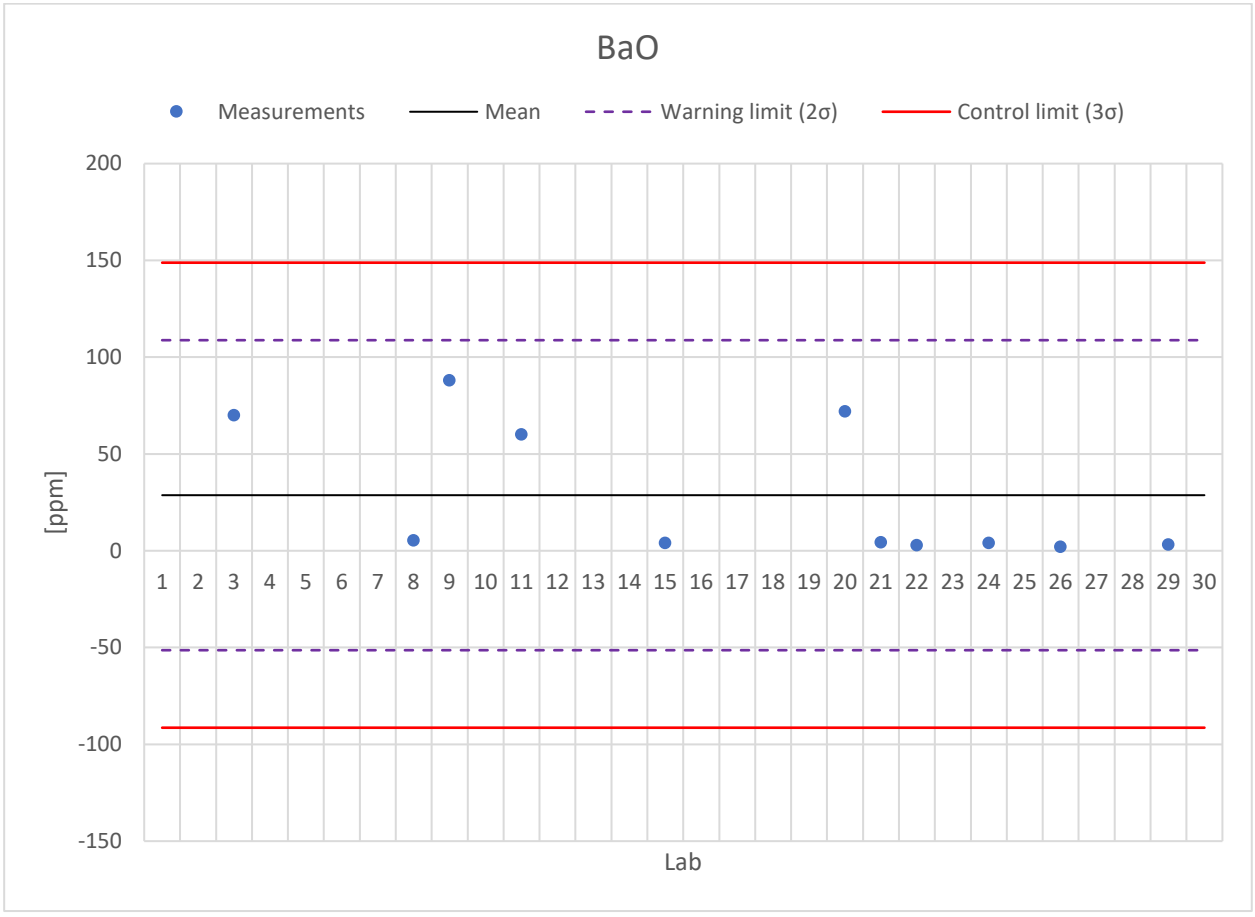


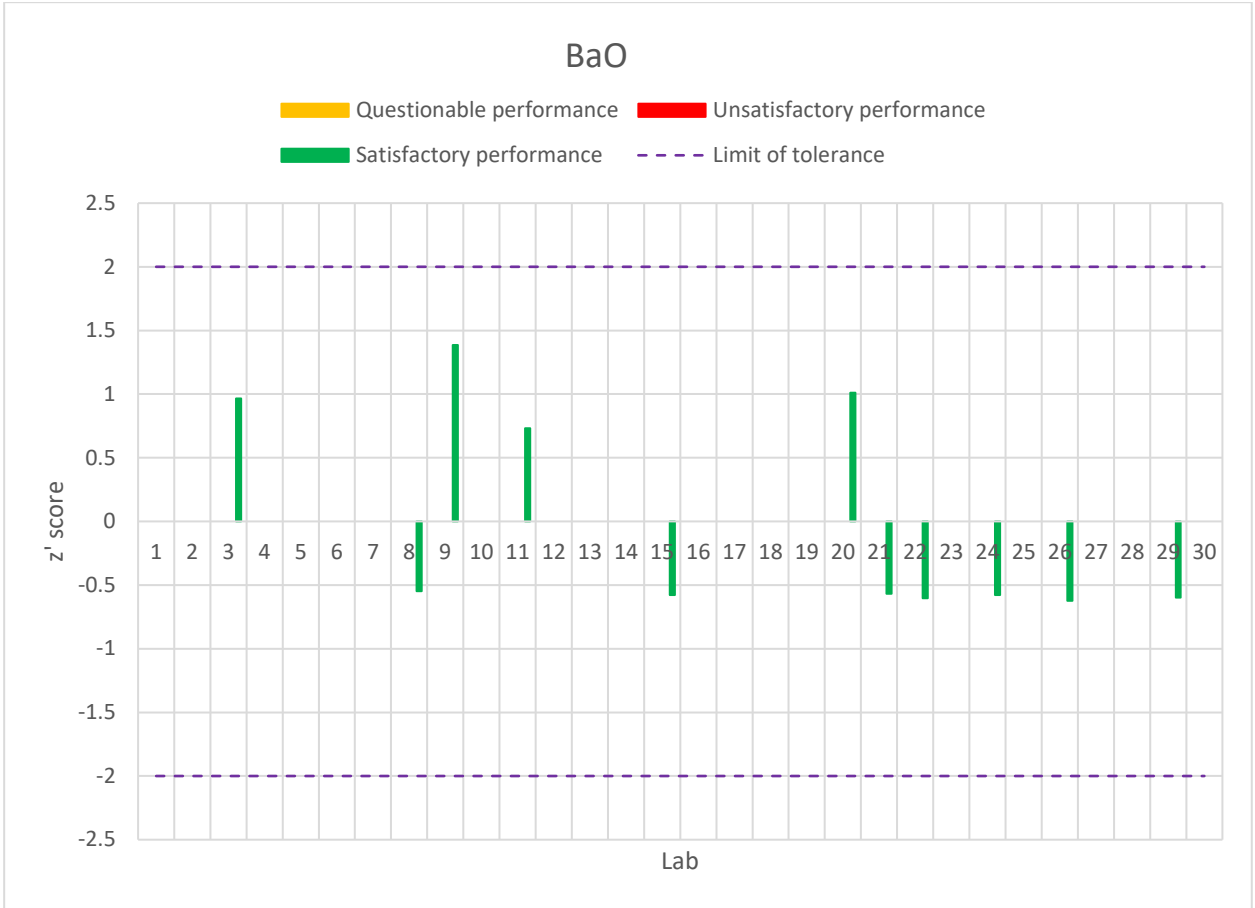
CHARTS SAMPLE C



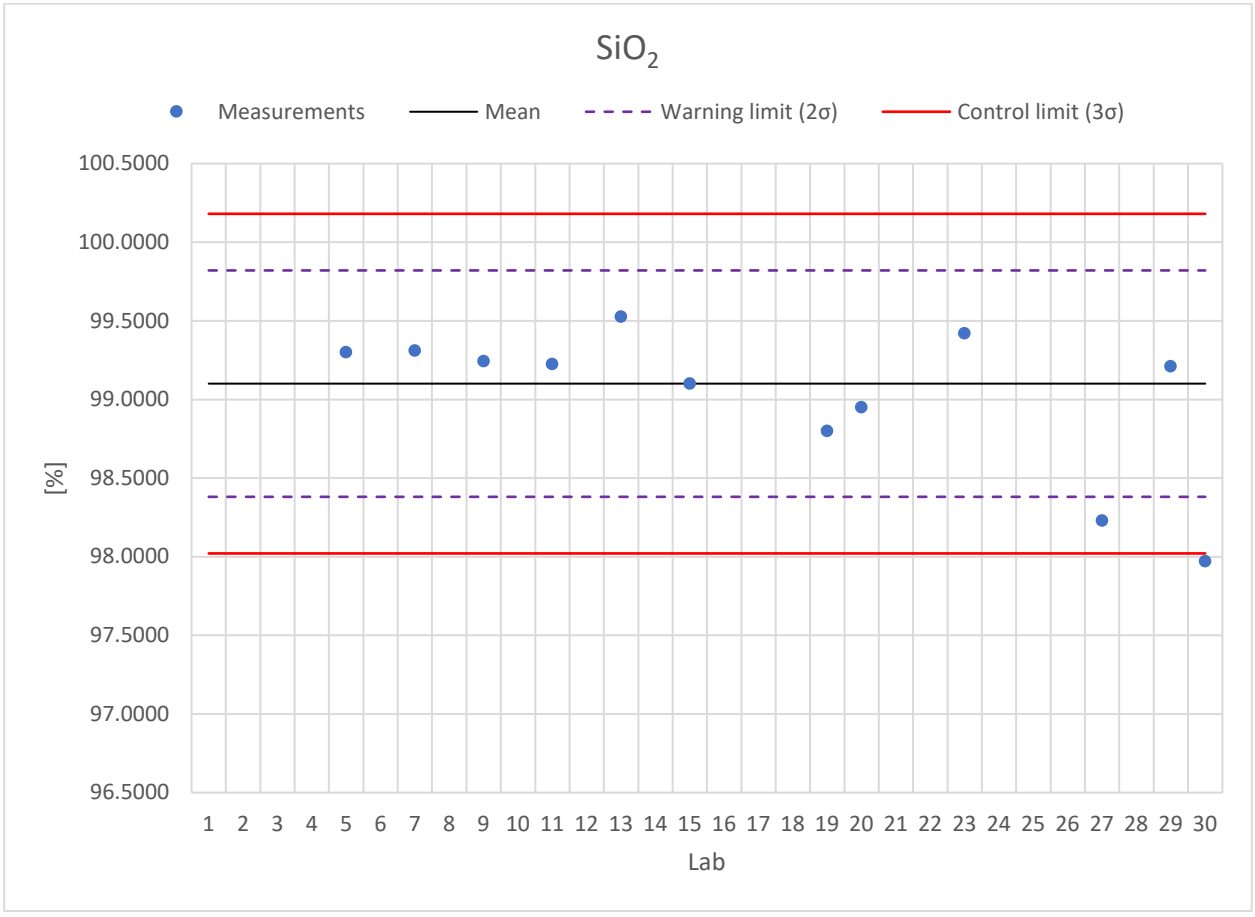


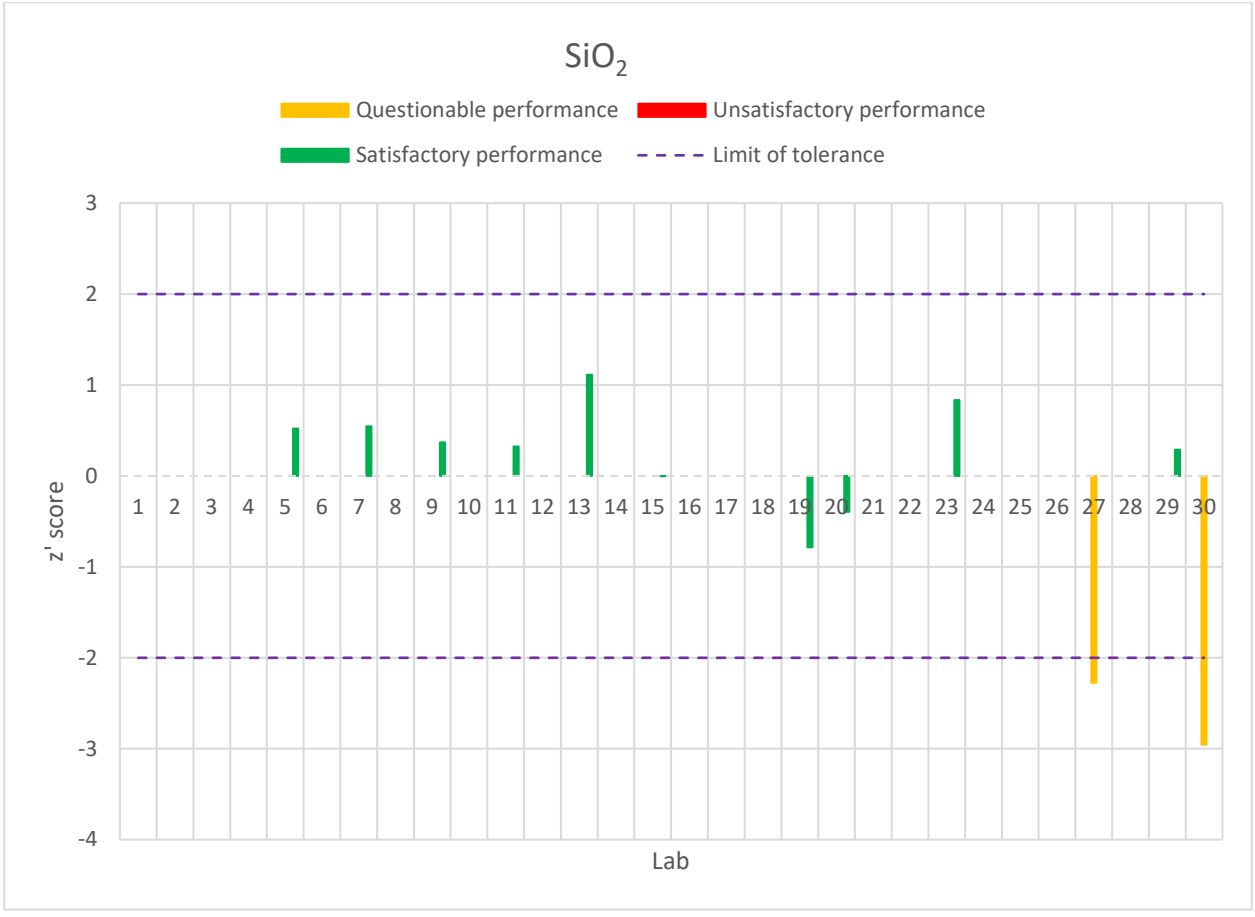
CHARTS SAMPLE C





CHARTS SAMPLE C





ANNEX 5.4. MEASUREMENTS SAMPLE D[5]

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO	MnO	P_2O_5	B_2O_3
	%	%	%	%	%	%	%	ppm	ppm	ppm
x_{pt}	0.1706	0.0668	0.0042	0.0092	0.0168	0.0195	0.0112	8.34	16.52	6.35
σ_{pt}	0.0358	0.0084	0.0006	0.0036	0.0025	0.0035	0.0023	2.17	8.53	2.74
N	28	27	25	25	23	26	23	18	16	5

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO	MnO	P_2O_5	B_2O_3
	%	%	%	%	%	%	%	ppm	ppm	ppm
Lab 1	0.1556	0.0679	0.0039	0.0082	0.0133	0.0187	0.0106	7.37	14.83	5.79
Lab 2	0.1629	0.0696	0.0044	0.0101	0.0165	0.0180	0.0117	7.70	11.50	
Lab 3	0.2200	0.0760	0.0030	0.0057	0.0133	0.0270		10.00	6.00	4.00
Lab 4	0.1820	0.0800	0.0039	0.0130	0.0169	0.0200	0.0095			
Lab 5	0.2100	0.0730	0.0030	0.0082	0.0151	0.0200	0.0100	10.00	21.00	
Lab 6	0.1514	0.0676	0.0044	0.0099	0.0193	0.0209	0.0115	7.00	15.00	5.00
Lab 7	0.1670	0.0658	0.0040	0.0113	0.0192	0.0199	0.0125	7.00	11.00	
Lab 8	0.2752	0.1303	0.0071	0.0177	0.0266	0.0409	0.0205	13.40	28.60	10.30
Lab 9	0.1606	0.0631	0.0042	0.0078	0.0174	0.0176	0.0104	8.00	12.00	
Lab 10	0.1460	0.0318	0.0032	0.0140	0.0175	0.0145	0.0095			
Lab 11	0.1652	0.0700	0.0055	0.0029	0.0183	0.0173	0.0100	8.00	7.00	
Lab 12	0.1446	0.0480	0.0030	0.0046			0.0067			
Lab 13	0.1630		0.0040	0.0110			0.0160			
Lab 14										
Lab 15	0.1360	0.0630	0.0039	0.0080	0.0177	0.0160	0.0110			
Lab 16	0.1219	0.0673	0.0042	0.0092	0.0176	0.0189	0.0109			
Lab 17	0.1098	0.0626	0.0041	0.0069	0.0163	0.0167	0.0052	7.80	12.70	
Lab 18	0.1220	0.0540	0.0040	0.0080	0.0160	0.0160	0.0120		10.00	
Lab 19	0.1700	0.0600	<0.01	<0.01	0.0100	0.0300	0.0200			
Lab 20	0.2586	0.0752	0.0181	0.0180		0.0287		11.70	24.00	
Lab 21	0.1942	0.0734		0.0069	0.0071	0.0202	0.0108	9.06		
Lab 22	0.1813	0.0619	0.0060	0.0044	0.0159	0.0128	0.0104	6.27		
Lab 23	0.1500	0.0650	0.0050	0.0070	0.0170	0.0180			23.00	
Lab 24	0.1457	0.0771	0.0044	0.0122	0.0194	0.0201	0.0159	8.00	25.00	
Lab 25	0.1783	0.0595	0.0120	0.0060	0.0083	0.0210	<LLD	6.51	<LLD	
Lab 26	0.1650	0.0566	0.0017	<0.0002	<0.0002	0.0120	0.0062	5.09		<0.07
Lab 27	0.3542	0.0689	0.0050	0.0108	0.0240	0.0243	0.0179	13.10	335.00	
Lab 28										
Lab 29	0.1869	0.0680	0.0041	0.0132	0.0183	0.0199	0.0118	7.62	13.41	6.68
Lab 30	0.2100	0.0700				0.0200				

[5] < - values are marked in Orange.

	ZnO	V_2O_5	NiO	PbO	CuO	CoO	CdO	Cr_2O_3	Sc_2O_3	BaO_2
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
x_{pt}	5.71	1.87	1.69	1.41	2.45	1.66	0.60	4.37	26.41	22.79
σ_{pt}	5.54	1.26	0.71	1.11	1.54	1.15	0.81	1.53	51.16	26.63
N	7	7	7	5	9	8	4	16	3	13

	ZnO	V_2O_5	NiO	PbO	CuO	CoO	CdO	Cr_2O_3	Sc_2O_3	BaO_2
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Lab 1	2.69	2.16	1.03	1.59	2.63	1.58	<0.1	3.59	0.33	
Lab 2		1.70	1.50		0.90			3.60		
Lab 3										50.00
Lab 4										
Lab 5										<0.001
Lab 6		3.00	2.00					4.00		
Lab 7								4.00		
Lab 8	10.70	3.20	2.10		3.30	2.50	0.10	6.80		9.20
Lab 9										99.00
Lab 10										
Lab 11										50.00
Lab 12										
Lab 13										
Lab 14										
Lab 15								4.00		6.00
Lab 16										
Lab 17	1.40		1.40		10.00	0.90		4.00		
Lab 18										
Lab 19										<0.01
Lab 20	11.70				4.00			157.00		57.00
Lab 21						11.11	1.61	3.83		6.48
Lab 22	1.90	0.28	1.04	0.82	0.89	1.34	0.60	3.54		4.63
Lab 23										
Lab 24	<0.2				2.00			4.00		7.00
Lab 25	<LLD	<LLD	<LLD	3.00	<LLD			3.00		3.00
Lab 26	<0.02	0.60	<0.4	<0.005	<0.02	0.02	<0.008	2.14	78.50	4.83
Lab 27	1.30			0.50	2.20	2.00		5.70		29.80
Lab 28										
Lab 29	10.26	2.17	2.73	1.12	1.34	1.56	0.09	4.50	0.40	5.63
Lab 30								20.00		

	LiO_2	SO_3	MoO_3	HfO_2	Nb_2O_5	ZrO_2	As_2O_3	Bi_2O_3	Sb_2O_3	SnO_2
	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
x_{pt}	38.35	13.11	3.75	43.32		0.2143	2.20	0.10	0.32	0.83
σ_{pt}		8.19	5.69	1.79		0.0319	0.99	0.09	0.43	1.24
N	1	4	2	2		12	3	3	2	2

	LiO_2	SO_3	MoO_3	HfO_2	Nb_2O_5	ZrO_2	As_2O_3	Bi_2O_3	Sb_2O_3	SnO_2
	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
Lab 1										
Lab 2										
Lab 3										
Lab 4										
Lab 5		20.00								
Lab 6										
Lab 7										
Lab 8						0.5262	2.80	0.20		1.60
Lab 9		10.00				0.1719				
Lab 10										
Lab 11		18.00								
Lab 12										
Lab 13										
Lab 14										
Lab 15						0.1960				
Lab 16						0.2009				
Lab 17						0.2129				
Lab 18										
Lab 19										
Lab 20										
Lab 21										
Lab 22			0.20			0.2000	1.20	0.06	0.59	0.06
Lab 23										
Lab 24						0.1888				
Lab 25						0.2132				
Lab 26			<0.04	42.20		0.2440	<0.008	0.05	0.05	<0.03
Lab 27			7.30			0.3114	2.60			
Lab 28										
Lab 29	38.35	4.43	<0.18	44.43	<0.46	0.2219				
Lab 30						0.2000				

	SrO	Ga_2O_3	GeO_2	Rb_2O	La_2O_3	Y_2O_3	Cl	LOI	SiO_2
	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%
x_{pt}	3.78	0.22	1.29	1.54	0.82	183.30	0.0117	0.3000	99.4542
σ_{pt}	2.91						0.0057	0.0000	0.2869
N	5	1	1	1	1	1	2	3	12

	SrO	Ga_2O_3	GeO_2	Rb_2O	La_2O_3	Y_2O_3	Cl	LOI	SiO_2
	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%
Lab 1									
Lab 2									
Lab 3									
Lab 4									
Lab 5									99.6000
Lab 6									
Lab 7									99.7000
Lab 8	4.10								
Lab 9									99.5450
Lab 10									
Lab 11									99.5530
Lab 12									
Lab 13									99.8060
Lab 14									
Lab 15									99.2000
Lab 16									
Lab 17								0.3000	
Lab 18									
Lab 19								0.3000	99.3000
Lab 20							0.0153		99.4400
Lab 21	2.35								
Lab 22	1.92				0.82				
Lab 23									99.7400
Lab 24									
Lab 25	60.00							0.2167	
Lab 26	<0.08	0.22	1.29	1.54					
Lab 27	2.40					183.30	0.0081		99.1000
Lab 28									
Lab 29									99.4417
Lab 30									98.5000

ANNEX 5.4.1. Z-SCORE SAMPLE D

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO
Lab 1	-0.4	0.1	-0.4	-0.3	-1.4	-0.2	-0.3
Lab 2	-0.2	0.3	0.4	0.3	-0.1	-0.4	0.2
Lab 3	1.4	1.1	-2.1	-0.9	-1.4	2.2	
Lab 4	0.3	1.6	-0.5	1.1	0.0	0.1	-0.7
Lab 5	1.1	0.7	-2.1	-0.3	-0.7	0.1	-0.5
Lab 6	-0.5	0.1	0.4	0.2	1.0	0.4	0.1
Lab 7	-0.1	-0.1	-0.3	0.6	0.9	0.1	0.6
Lab 8	2.9	7.6	5.2	2.3	3.8	6.2	4.0
Lab 9	-0.3	-0.4	0.1	-0.4	0.2	-0.6	-0.4
Lab 10	-0.7	-4.2	-1.7	1.3	0.3	-1.4	-0.7
Lab 11	-0.2	0.4	2.4	-1.7	0.6	-0.6	-0.5
Lab 12	-0.7	-2.3	-2.0	-1.3			-2.0
Lab 13	-0.2		-0.3	0.5			2.1
Lab 14							
Lab 15	-1.0	-0.5	-0.5	-0.3	0.4	-1.0	-0.1
Lab 16	-1.4	0.1	0.1	0.0	0.3	-0.2	-0.1
Lab 17	-1.7	-0.5	-0.1	-0.6	-0.2	-0.8	-2.6
Lab 18	-1.4	-1.5	-0.3	-0.3	-0.3	-1.0	0.3
Lab 19	0.0	-0.8			-2.7	3.0	3.8
Lab 20	2.5	1.0	24.7	2.4		2.7	
Lab 21	0.7	0.8		-0.6	-3.8	0.2	-0.2
Lab 22	0.3	-0.6	3.3	-1.3	-0.4	-2.0	-0.4
Lab 23	-0.6	-0.2	1.5	-0.6	0.1	-0.4	
Lab 24	-0.7	1.2	0.4	0.8	1.0	0.2	2.0
Lab 25	0.2	-0.9	13.9	-0.9	-3.3	0.4	
Lab 26	-0.2	-1.2	-4.3			-2.2	-2.2
Lab 27	5.1	0.2	1.5	0.5	2.8	1.4	2.9
Lab 28							
Lab 29	0.5	0.1	-0.2	1.1	0.6	0.1	0.2
Lab 30	1.1	0.4				0.1	

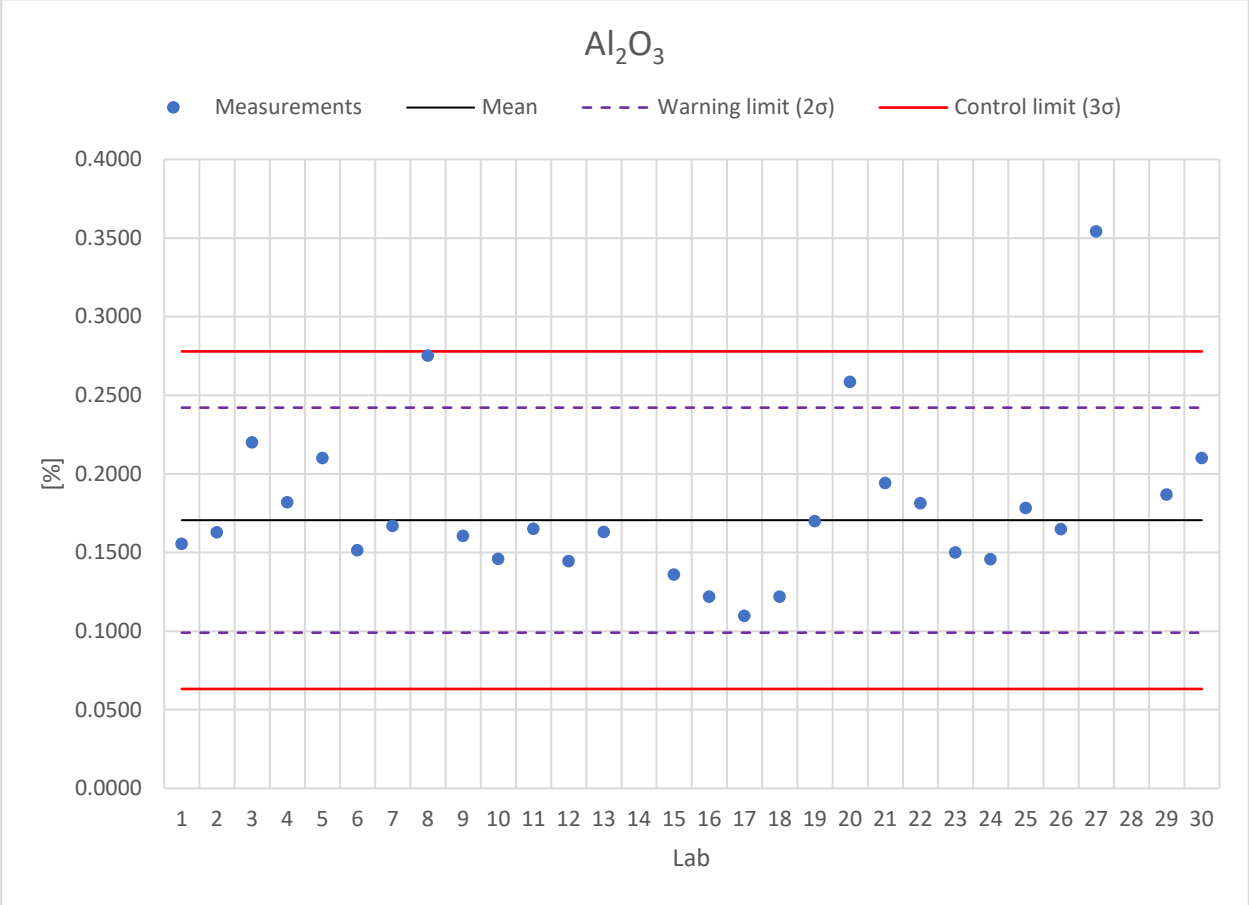
Satisfactory performance
Questionable performance
Unsatisfactory performance

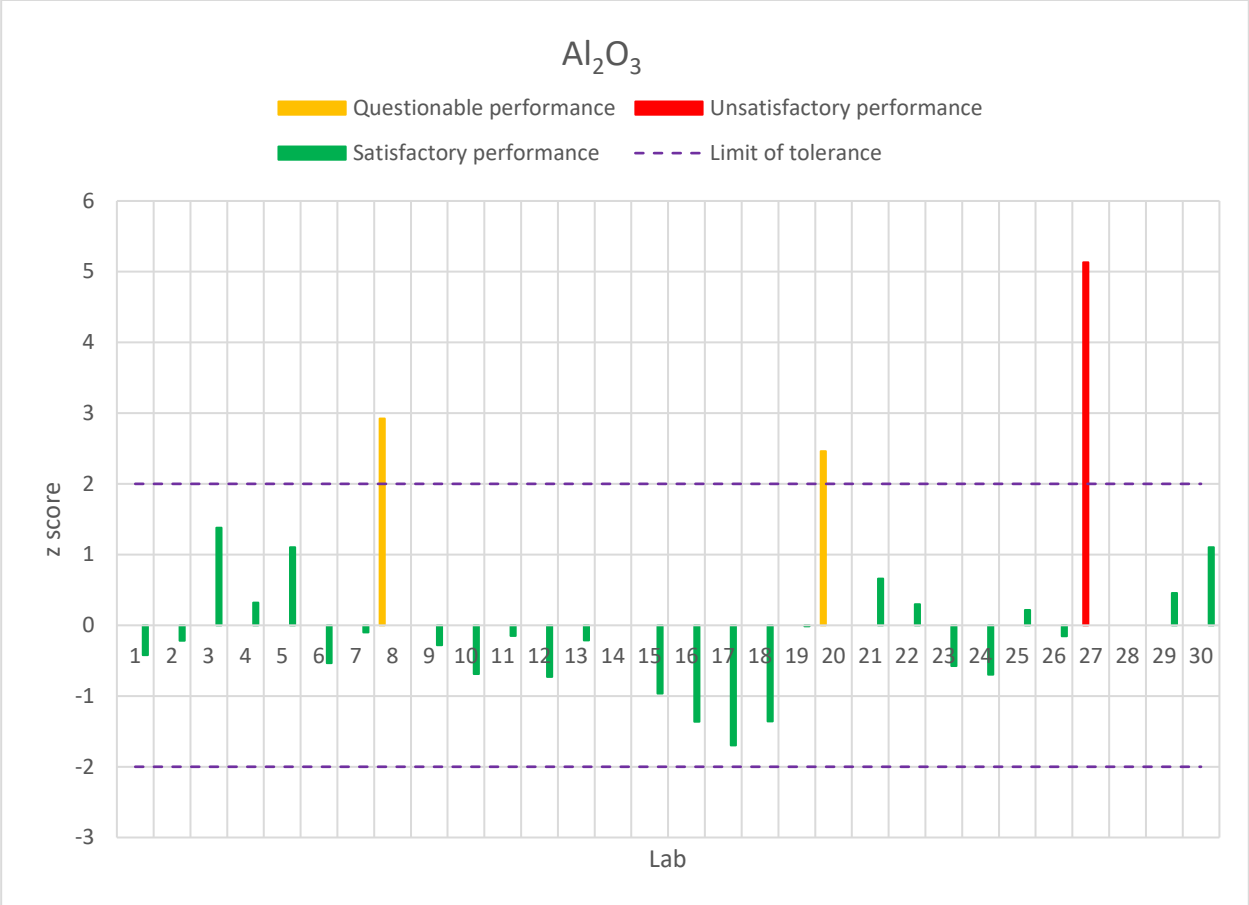
ANNEX 5.4.2. Z'-SCORE SAMPLE D

	MnO	P_2O_5	CuO	CoO	Cr_2O_3	BaO_2	SiO_2
Lab 1	-0.4	-0.2	0.1	-0.1	-0.5		
Lab 2	-0.3	-0.6	-1.0		-0.5		
Lab 3	0.8	-1.2				1.0	
Lab 4							
Lab 5	0.8	0.5					0.5
Lab 6	-0.6	-0.2			-0.2		
Lab 7	-0.6	-0.6			-0.2		0.8
Lab 8	2.3	1.4	0.6	0.7	1.6	-0.5	
Lab 9	-0.2	-0.5				2.9	0.3
Lab 10							
Lab 11	-0.2	-1.1				1.0	0.3
Lab 12							
Lab 13							1.2
Lab 14							
Lab 15					-0.2	-0.6	-0.8
Lab 16							
Lab 17	-0.3	-0.4	4.9	-0.7	-0.2		
Lab 18		-0.8					
Lab 19							-0.5
Lab 20	1.5	0.9	1.0		100.1	1.3	0.0
Lab 21	0.3			8.2	-0.4	-0.6	
Lab 22	-1.0		-1.0	-0.3	-0.5	-0.7	
Lab 23		0.8					0.9
Lab 24	-0.2	1.0	-0.3		-0.2	-0.6	
Lab 25	-0.8				-0.9	-0.7	
Lab 26	-1.5			-1.4	-1.5	-0.7	
Lab 27	2.2	37.3	-0.2	0.3	0.9	0.3	-1.2
Lab 28							
Lab 29	-0.3	-0.4	-0.7	-0.1	0.1	-0.6	0.0
Lab 30					10.2		-3.1

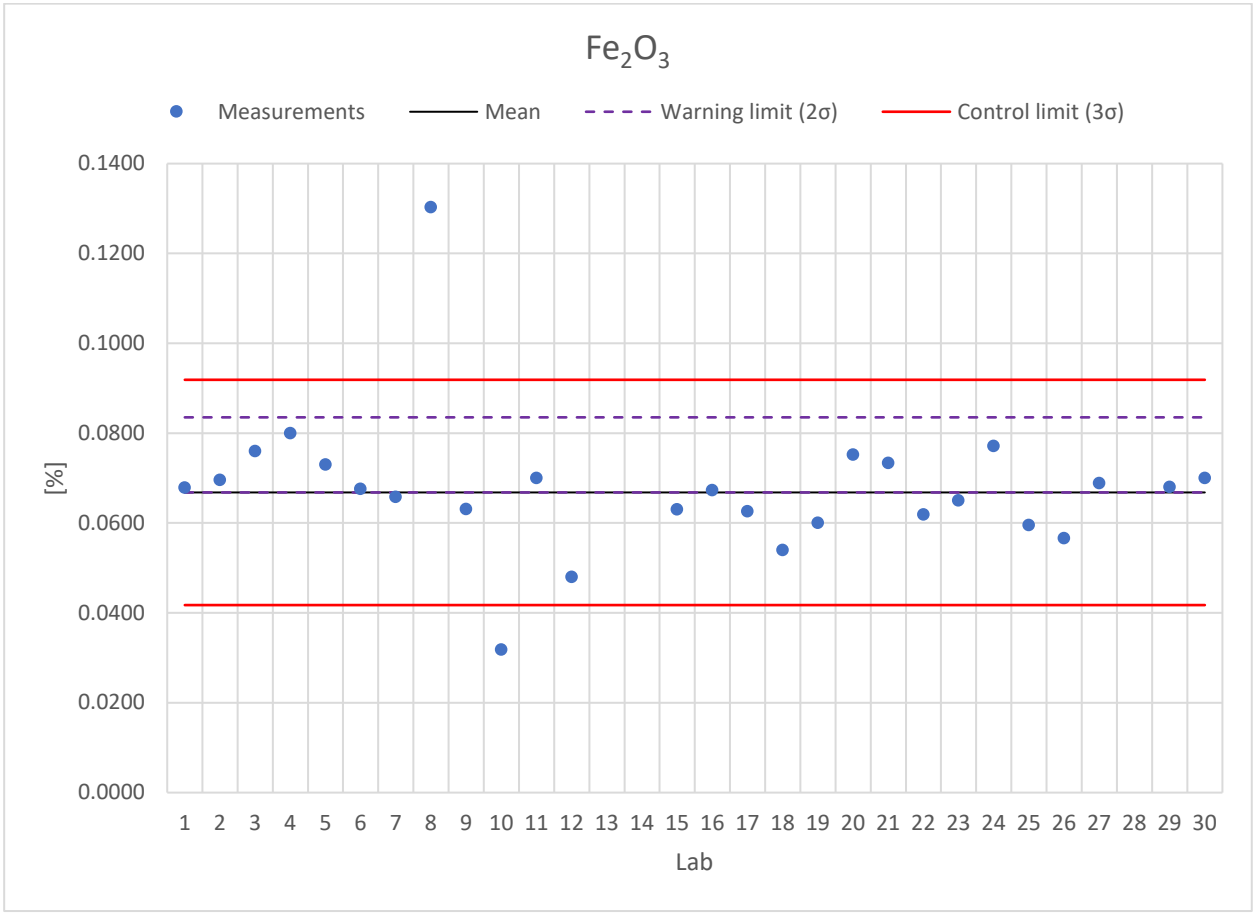
Satisfactory performance
Questionable performance
Unsatisfactory performance

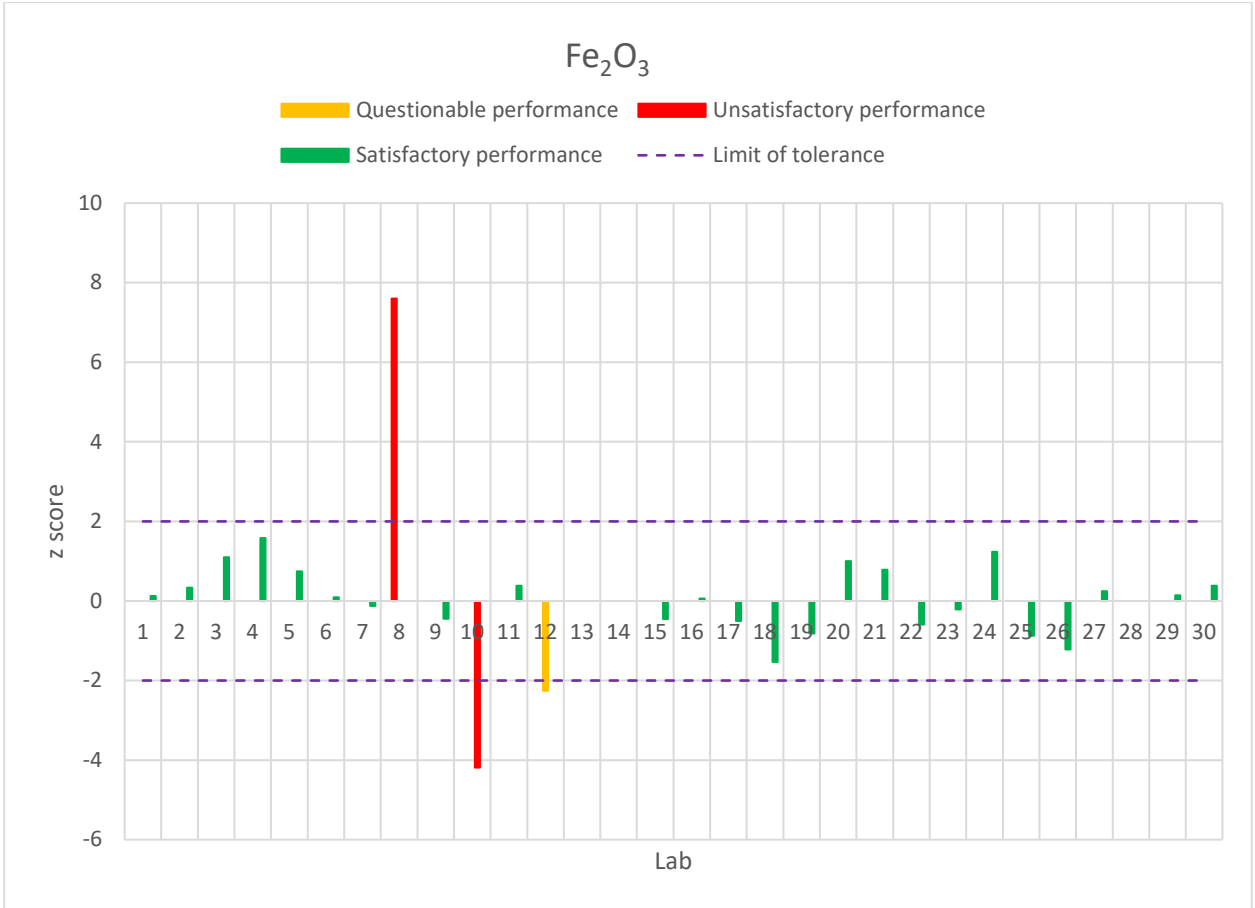
ANNEX 5.4.3. CHARTS SAMPLE D



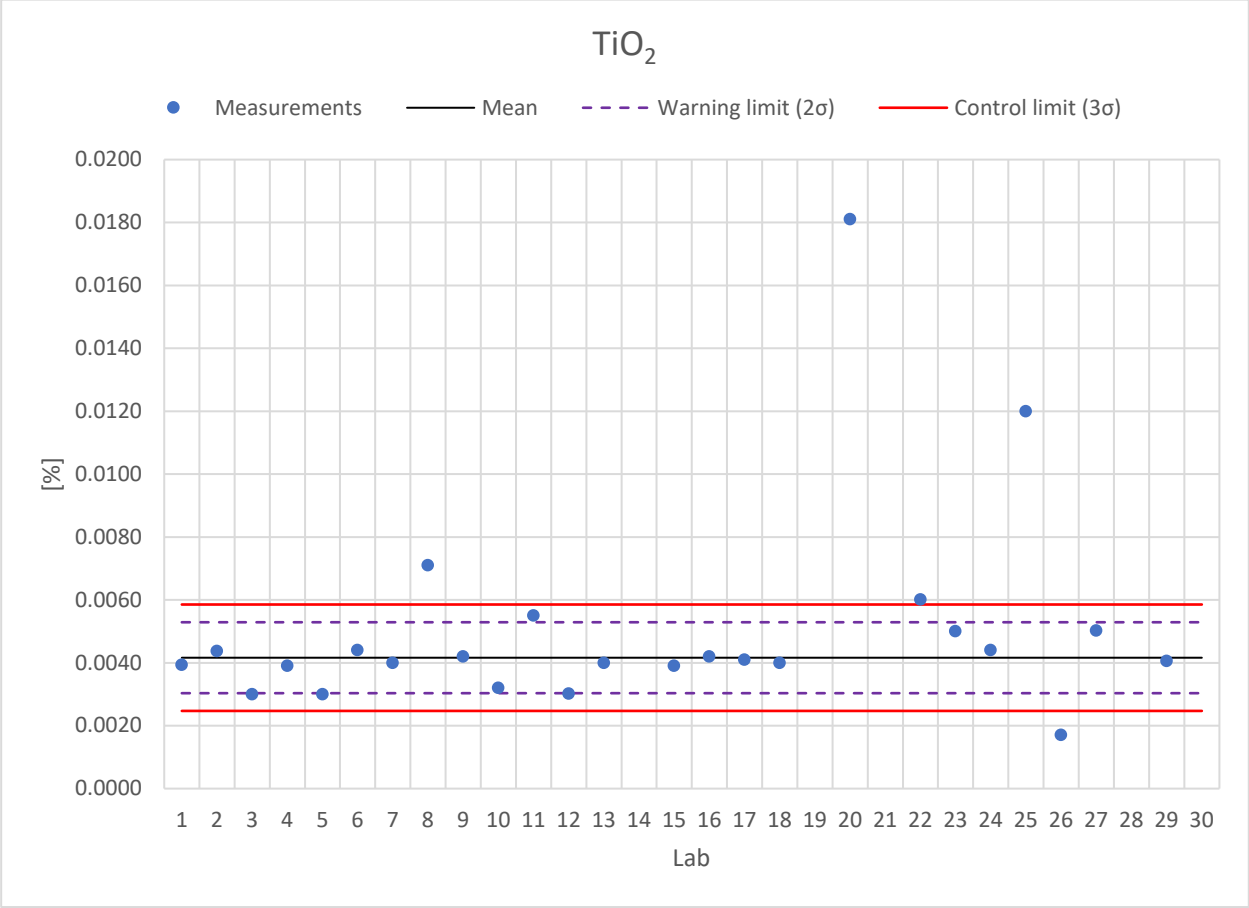


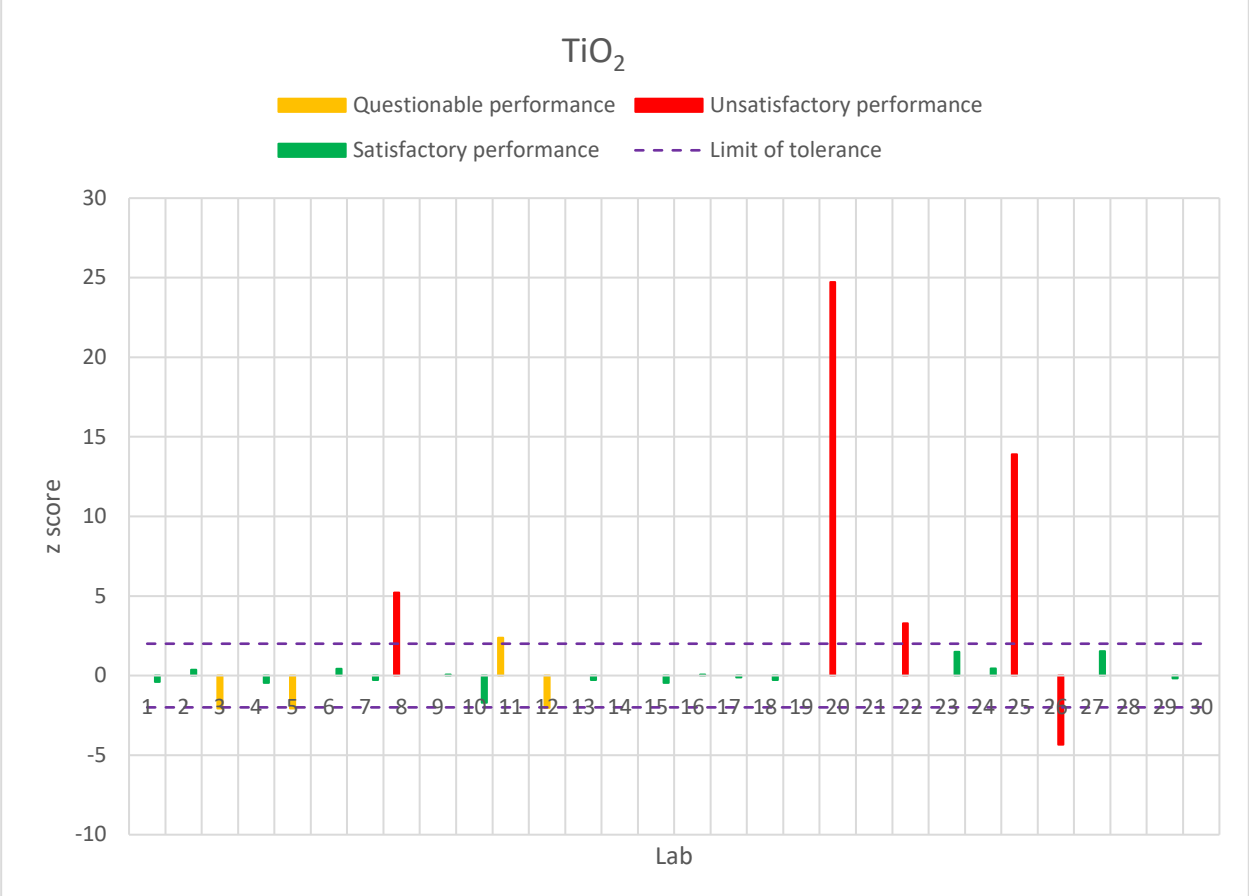
CHARTS SAMPLE D



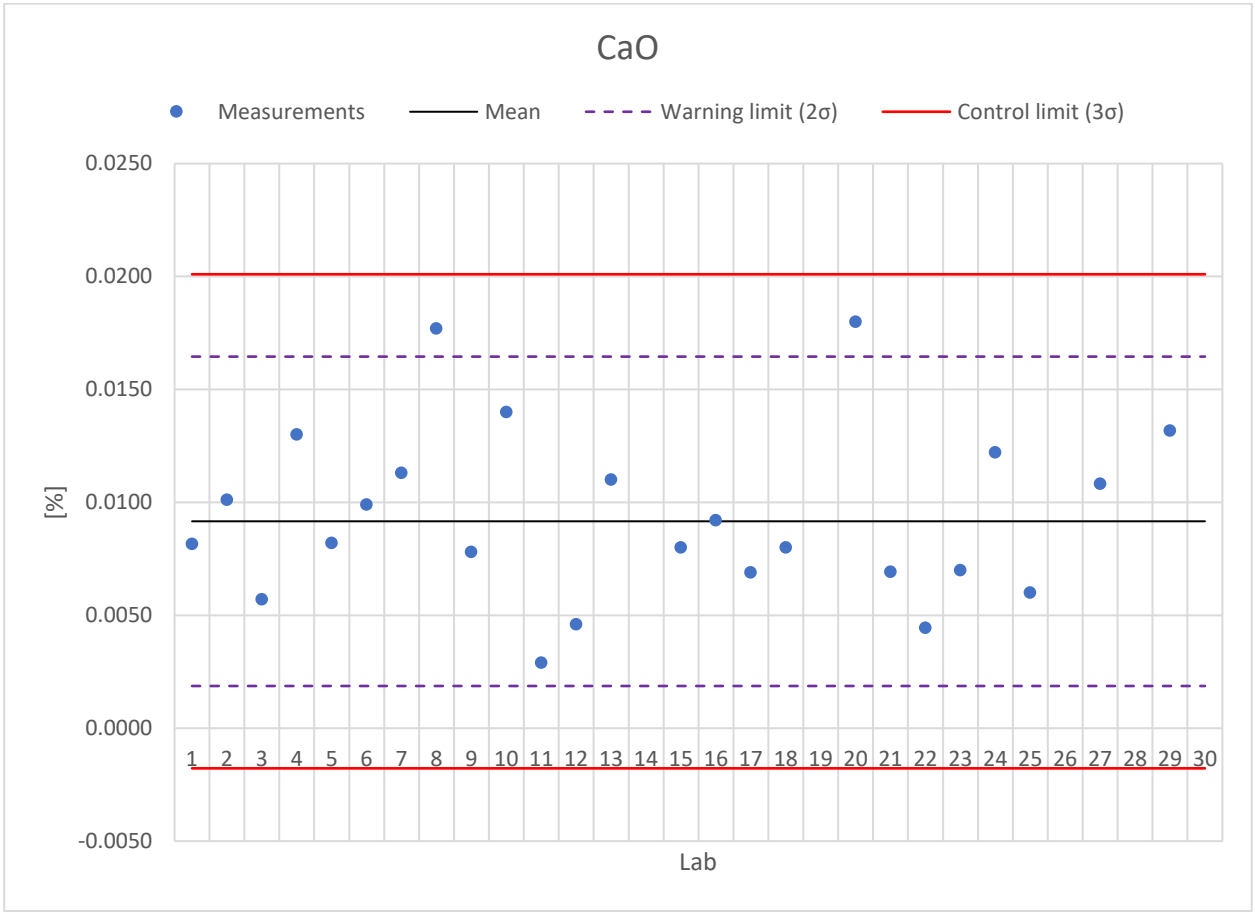


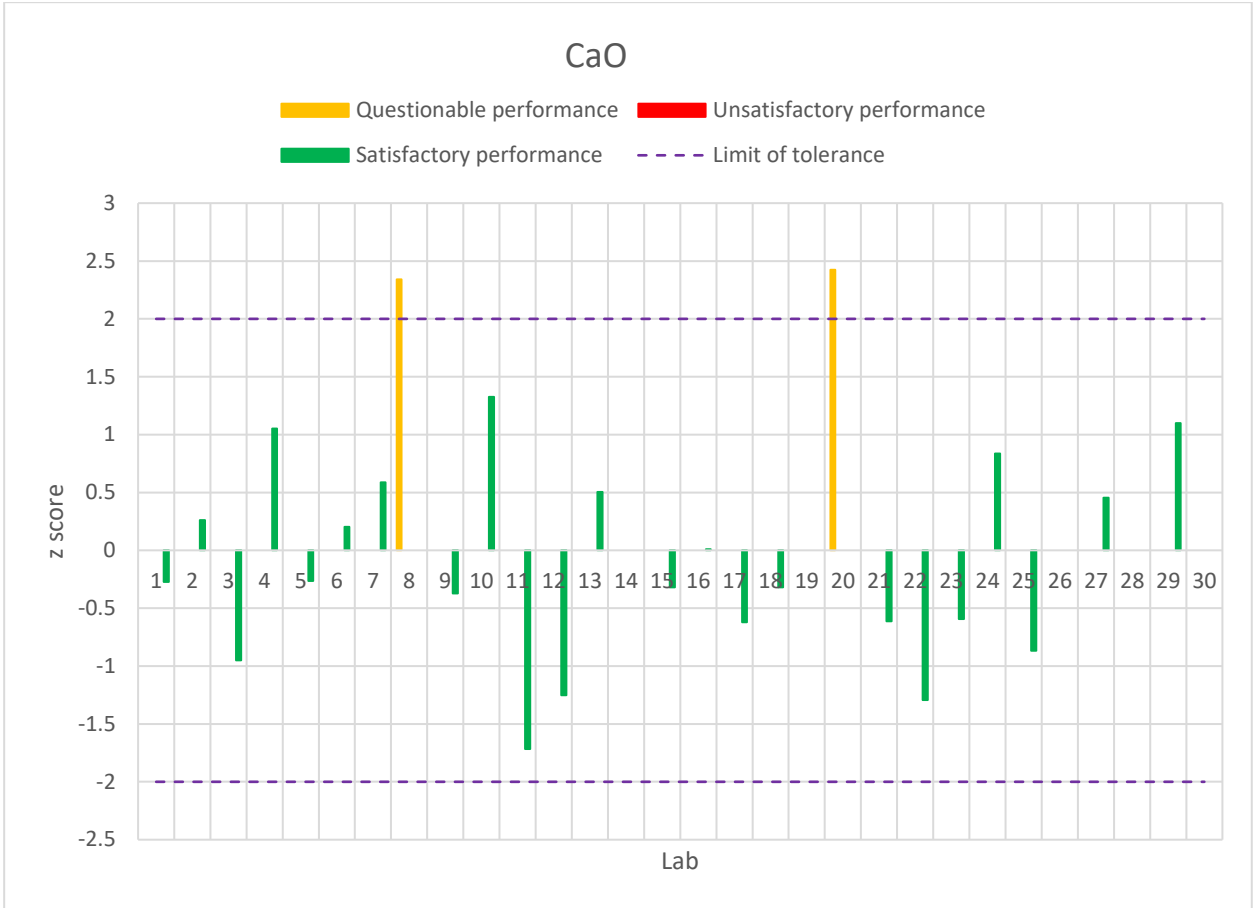
CHARTS SAMPLE D



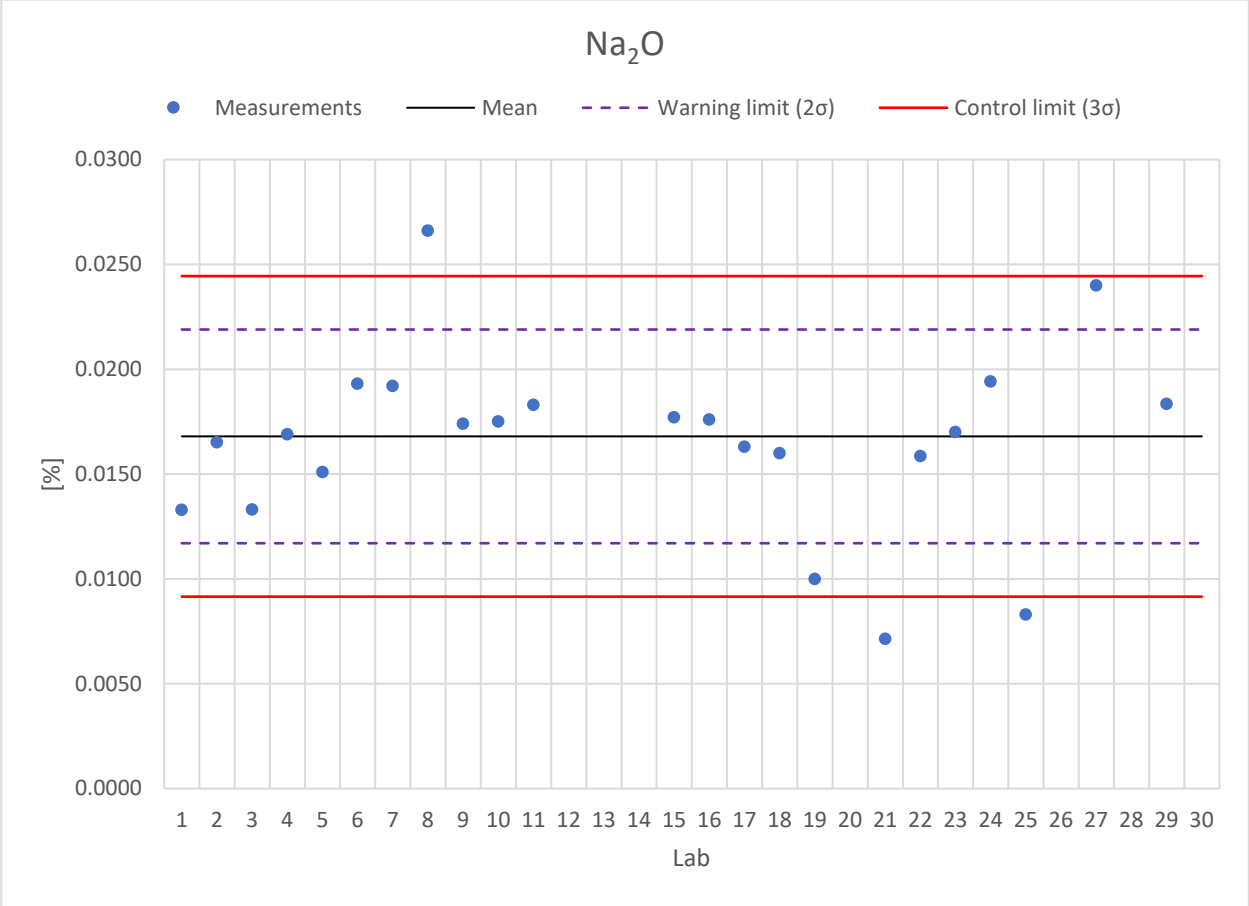


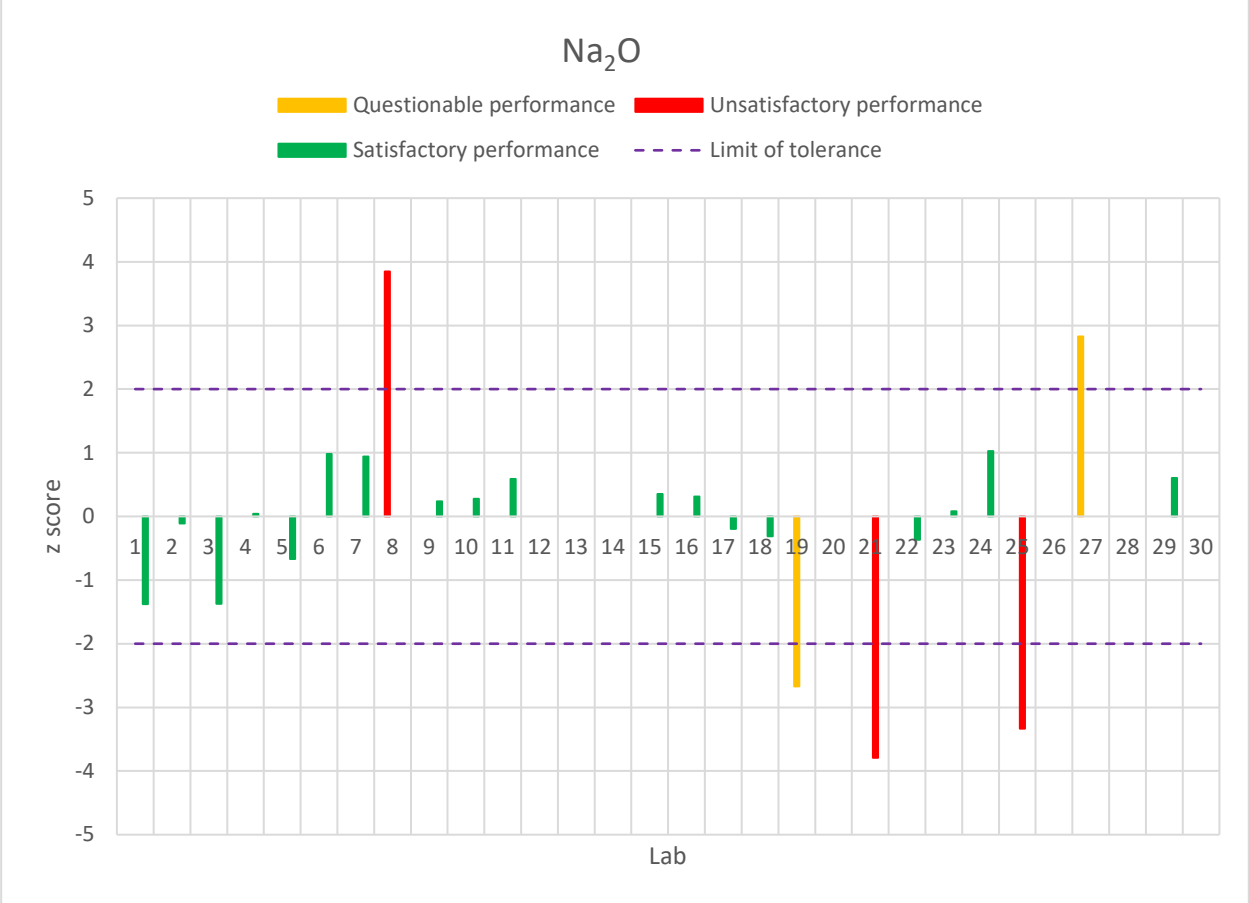
CHARTS SAMPLE D



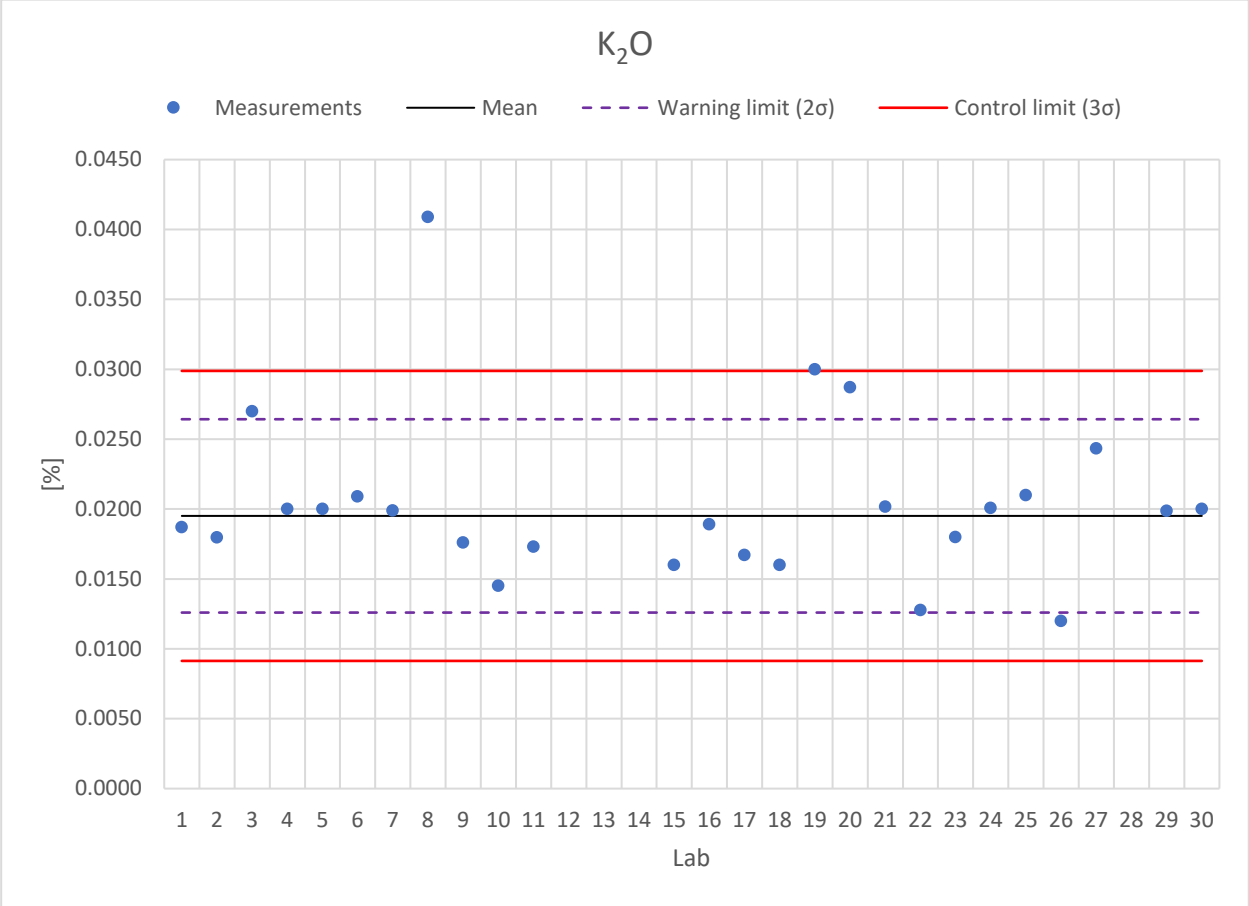


CHARTS SAMPLE D

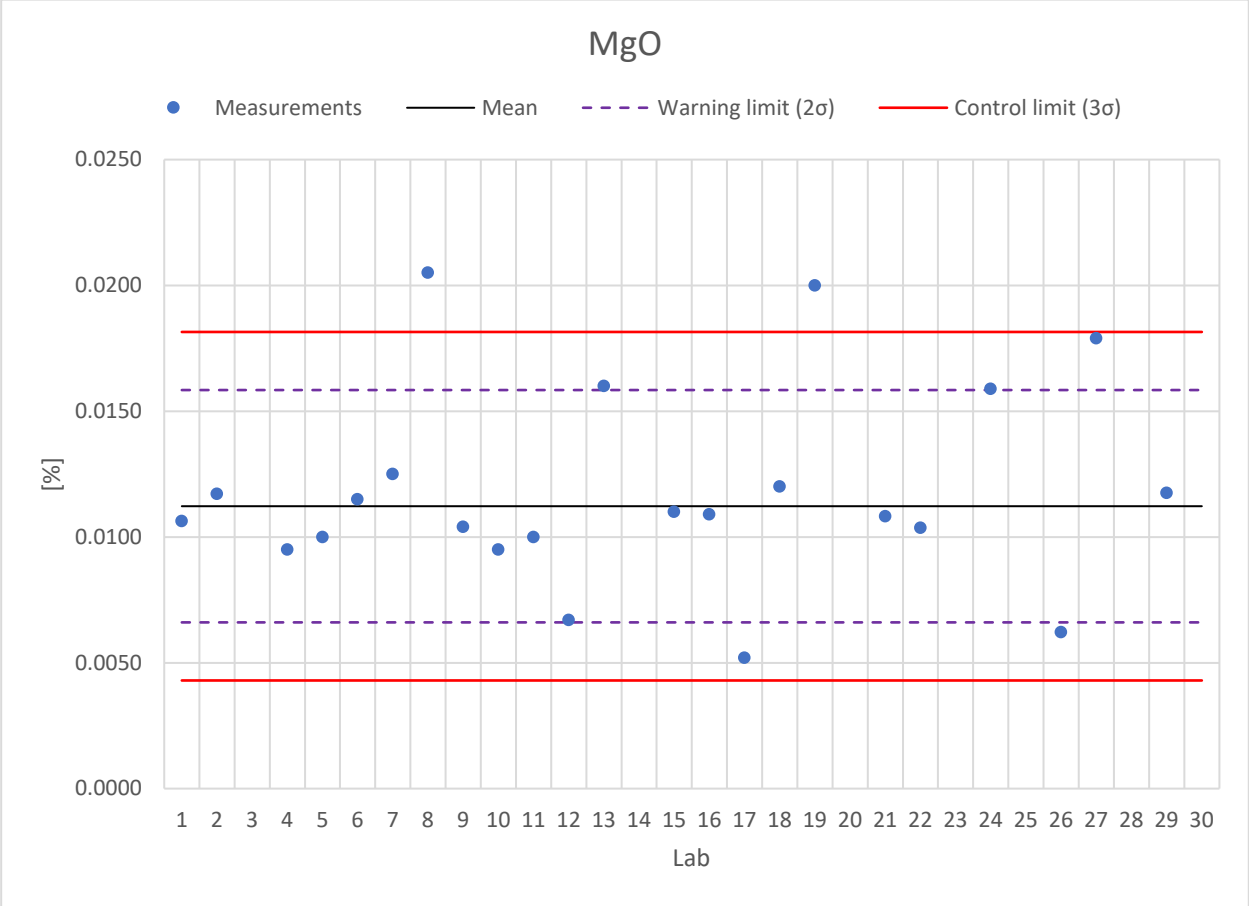


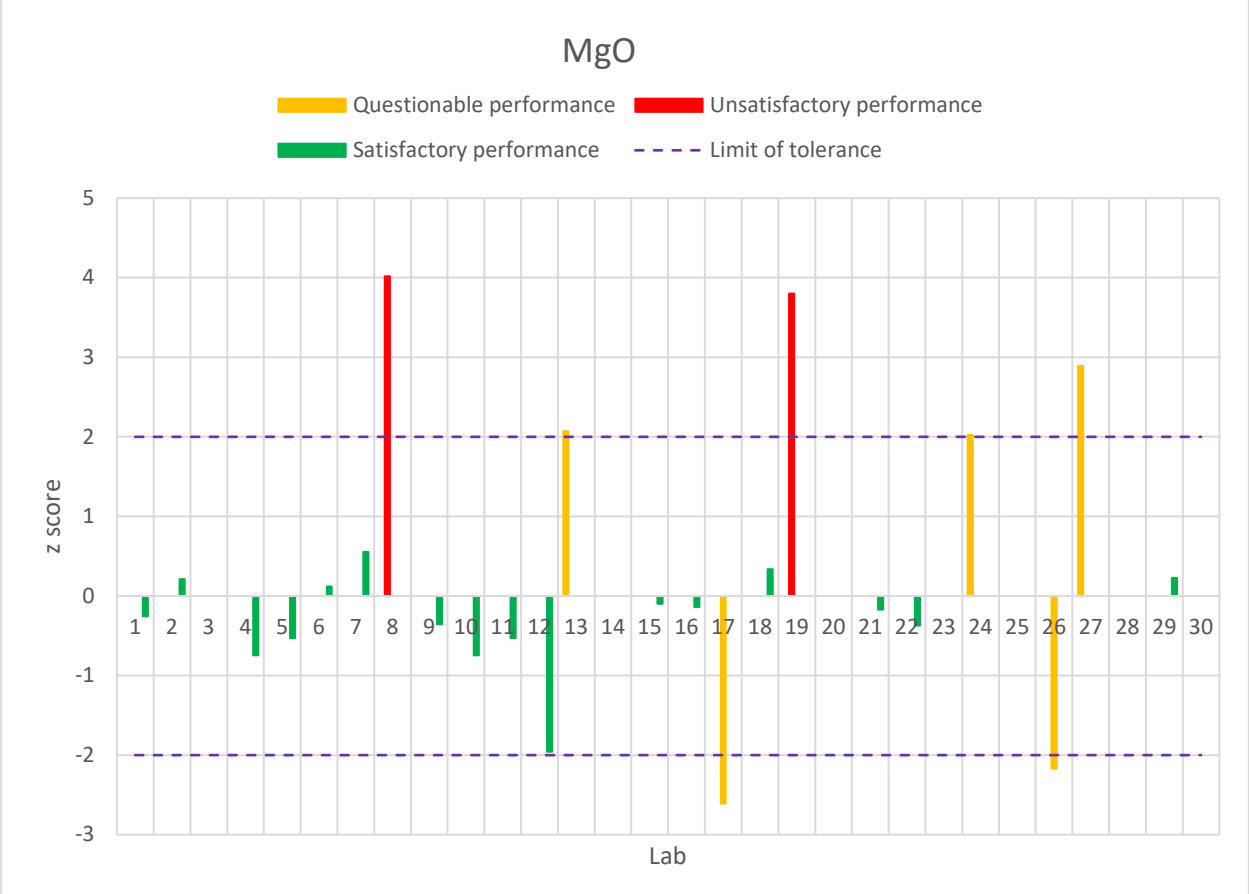


CHARTS SAMPLE D

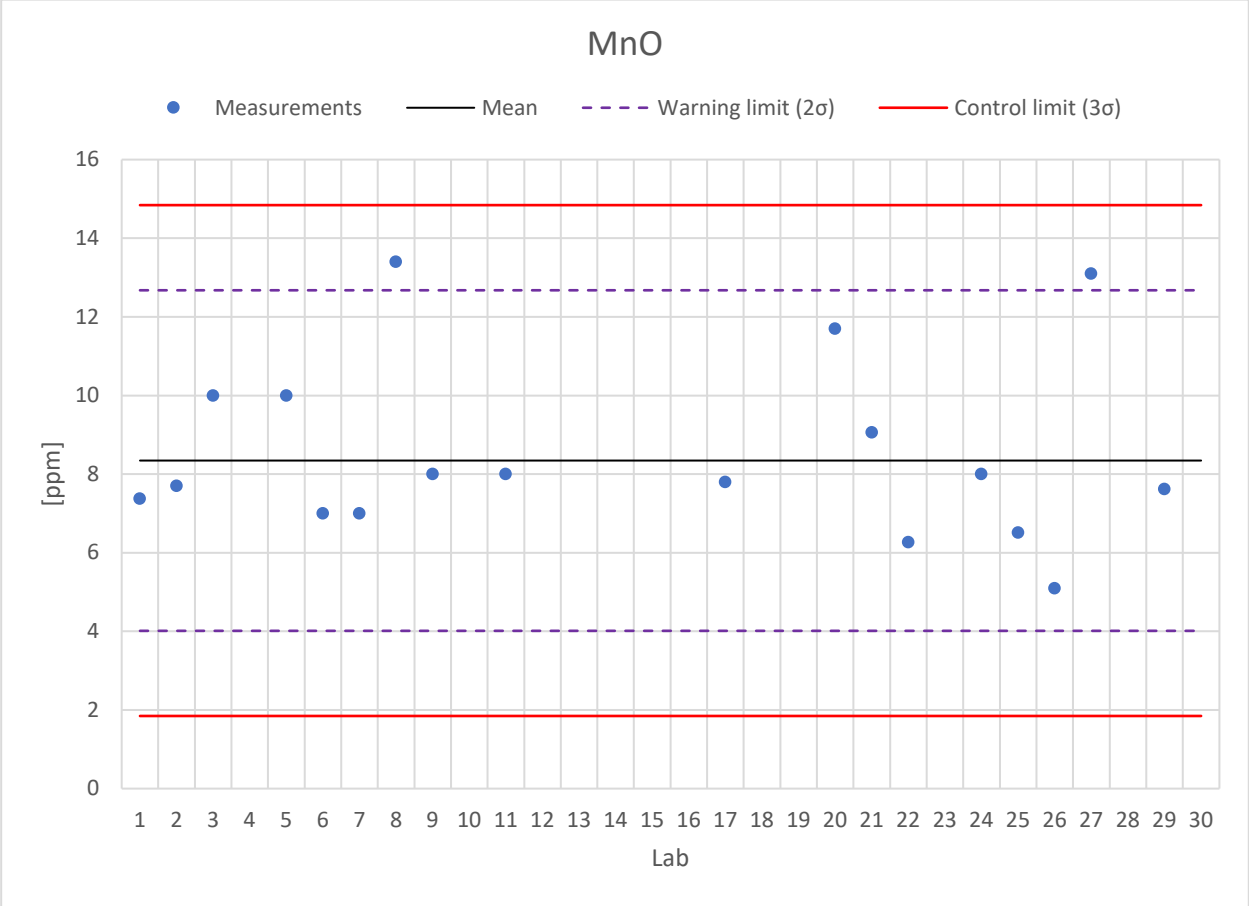


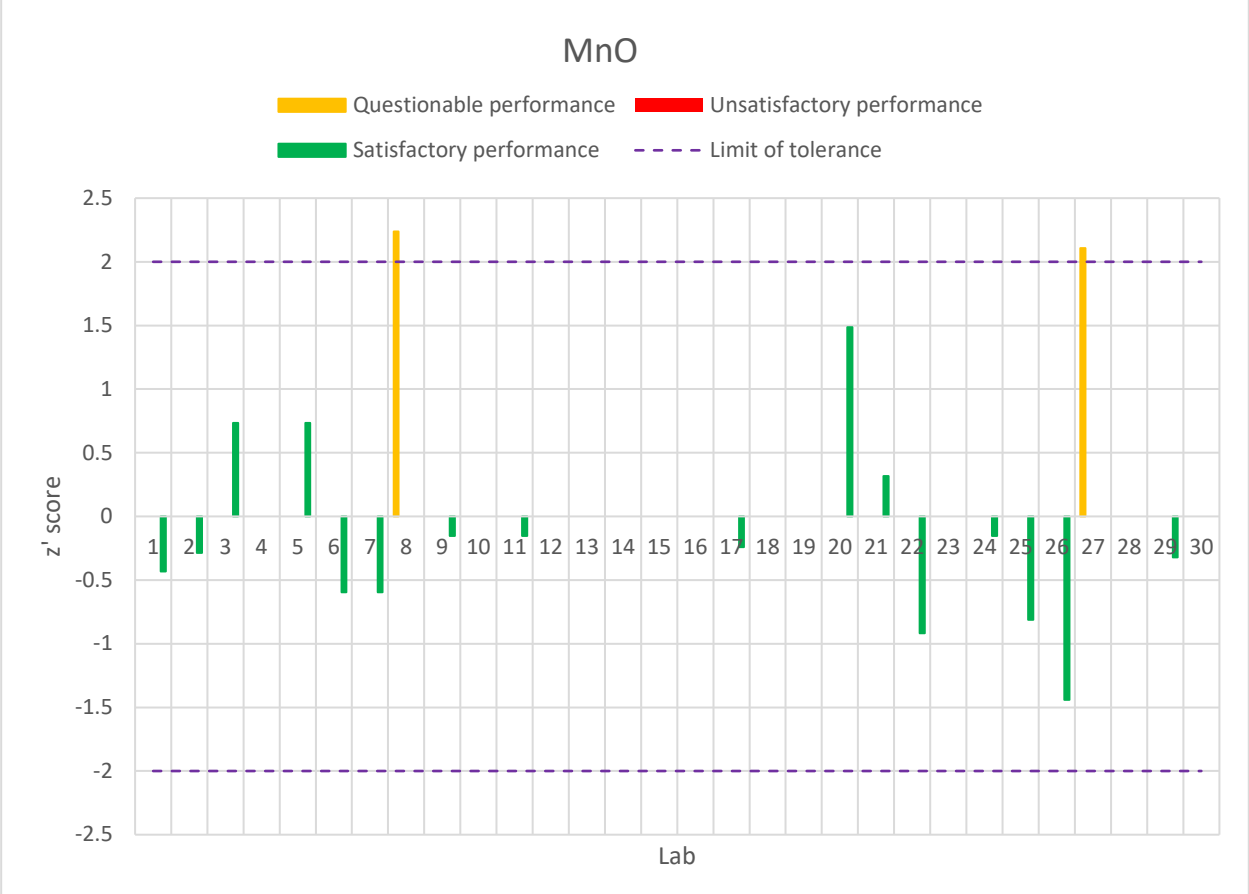
CHARTS SAMPLE D



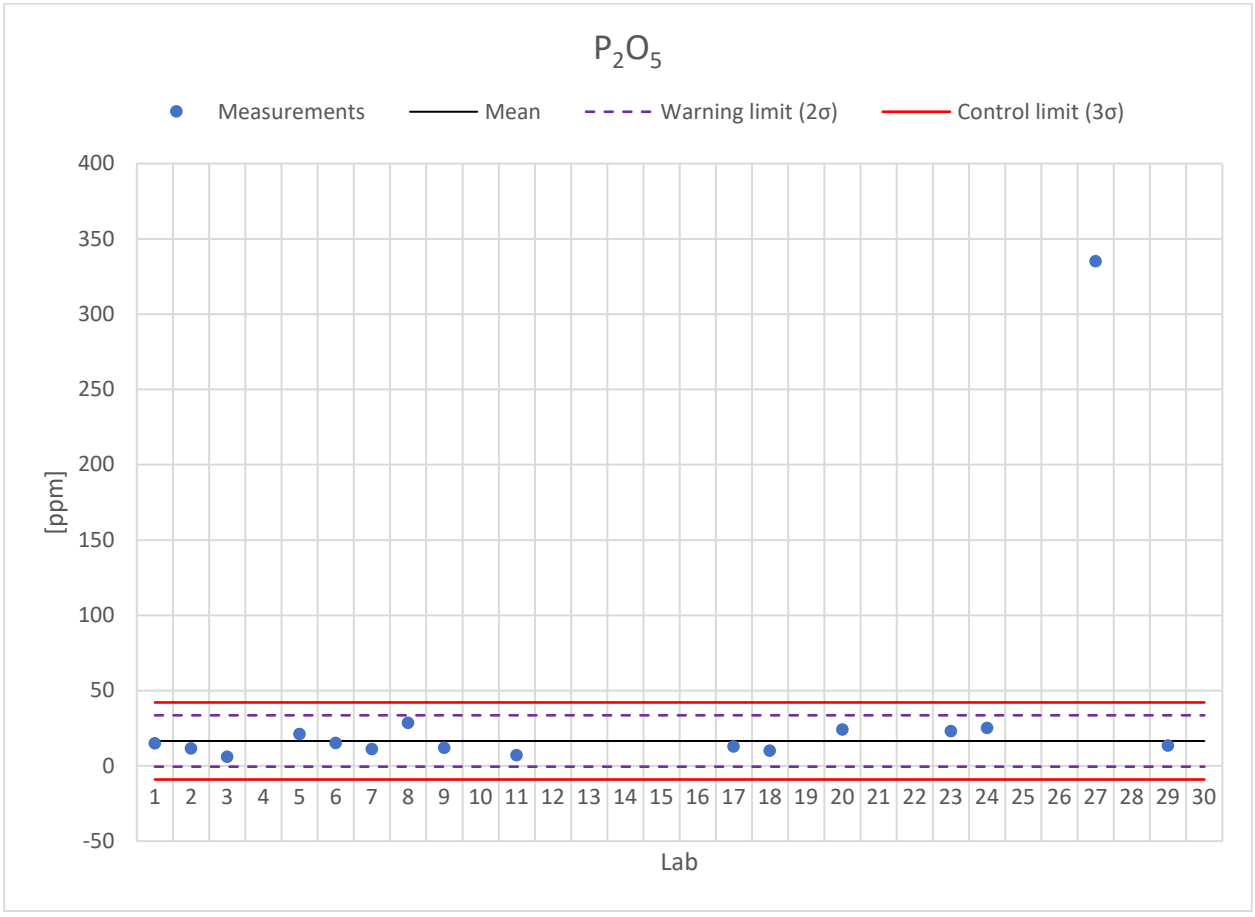


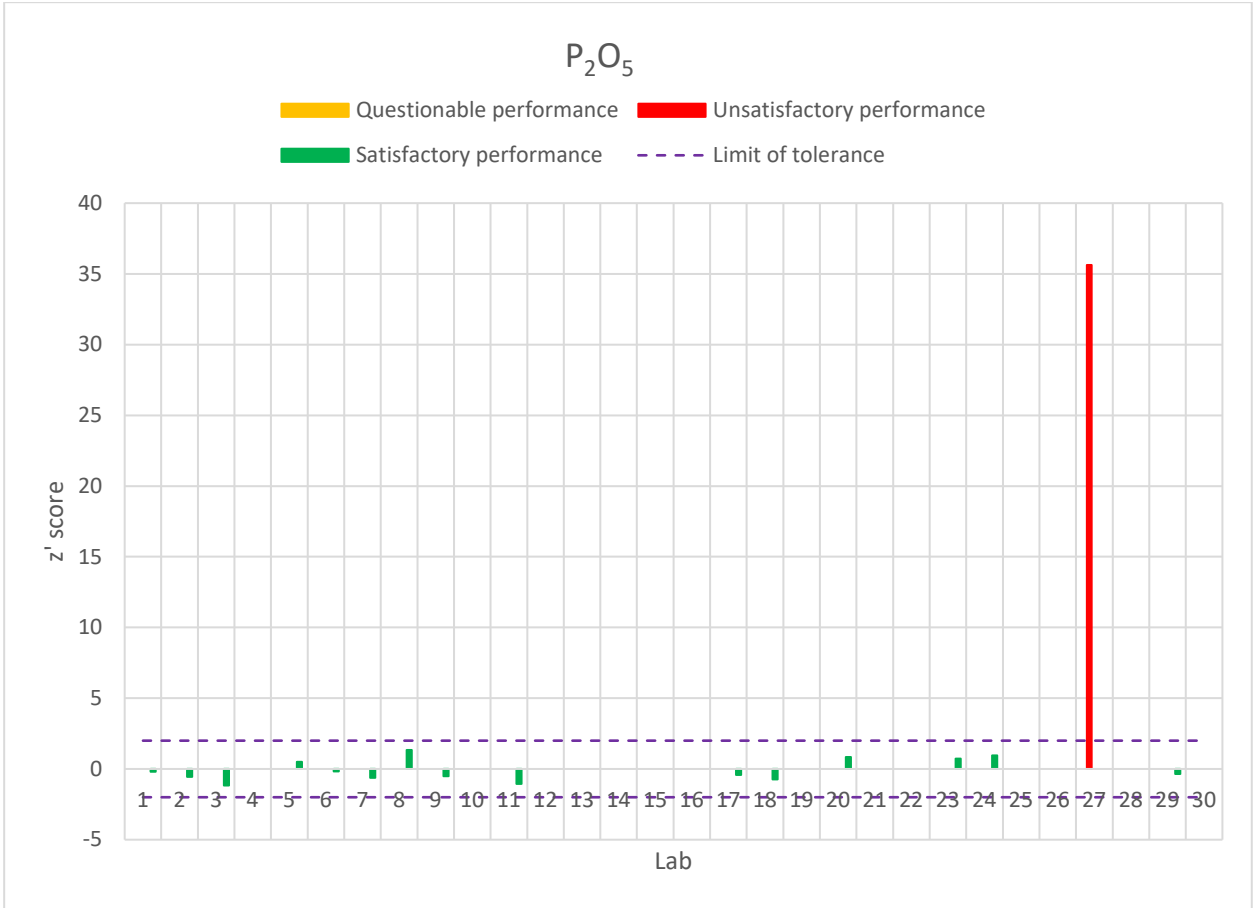
CHARTS SAMPLE D



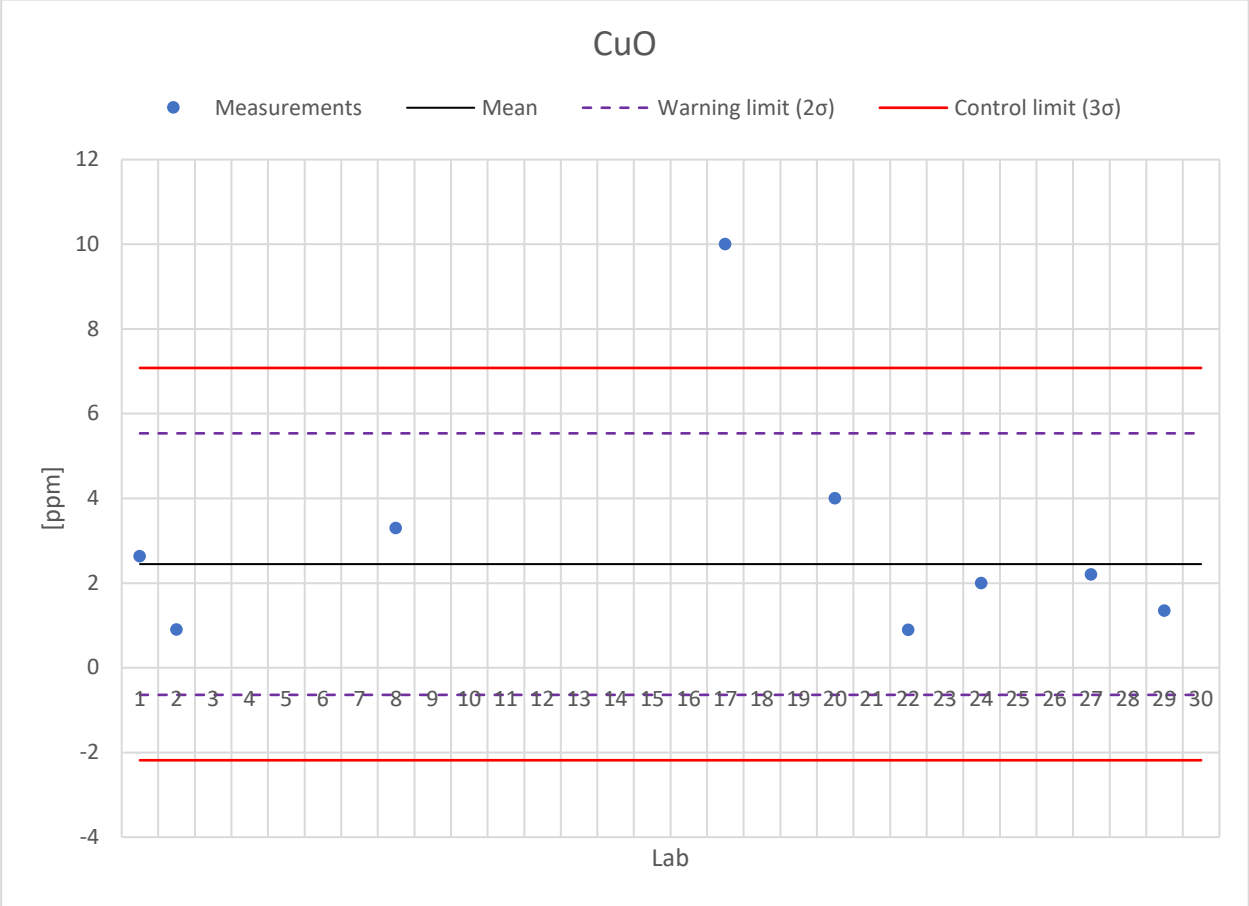


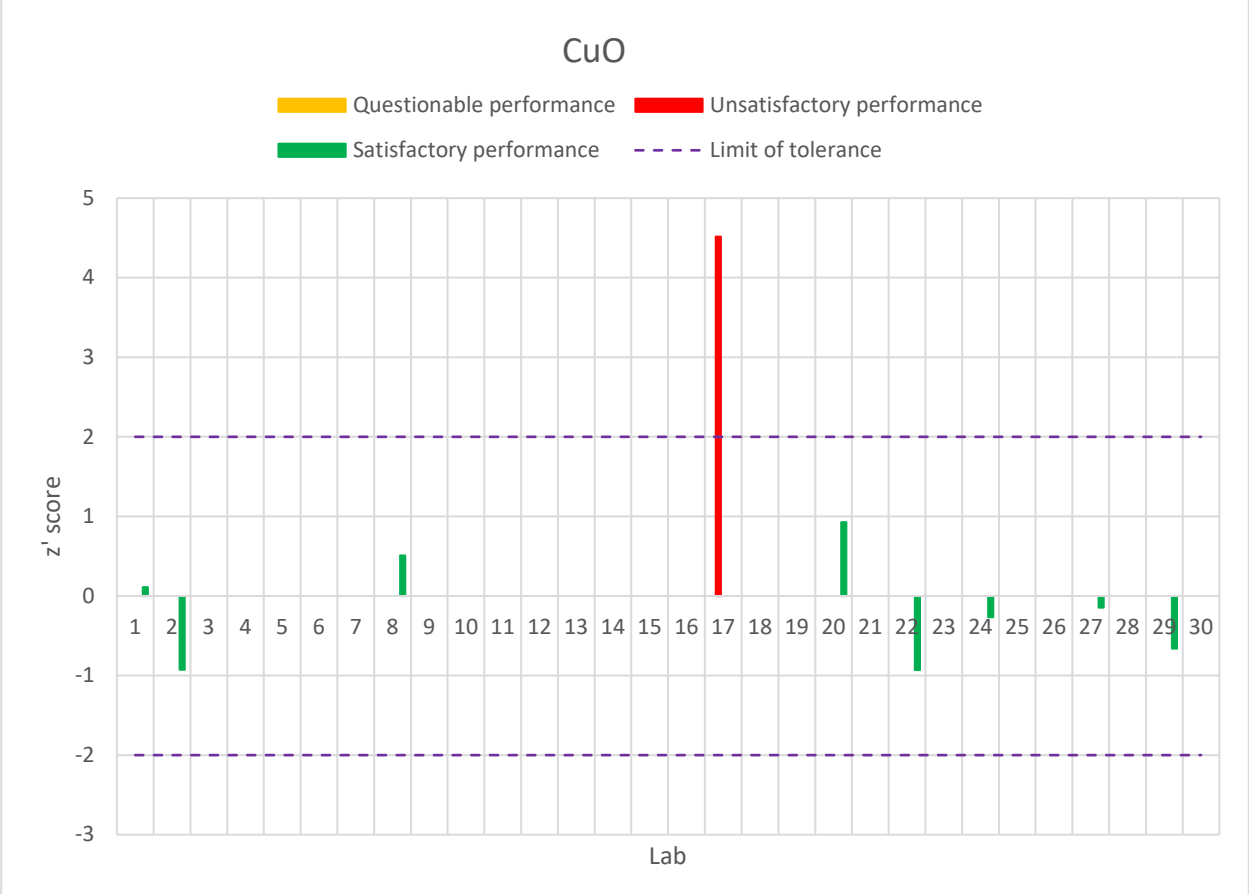
CHARTS SAMPLE D



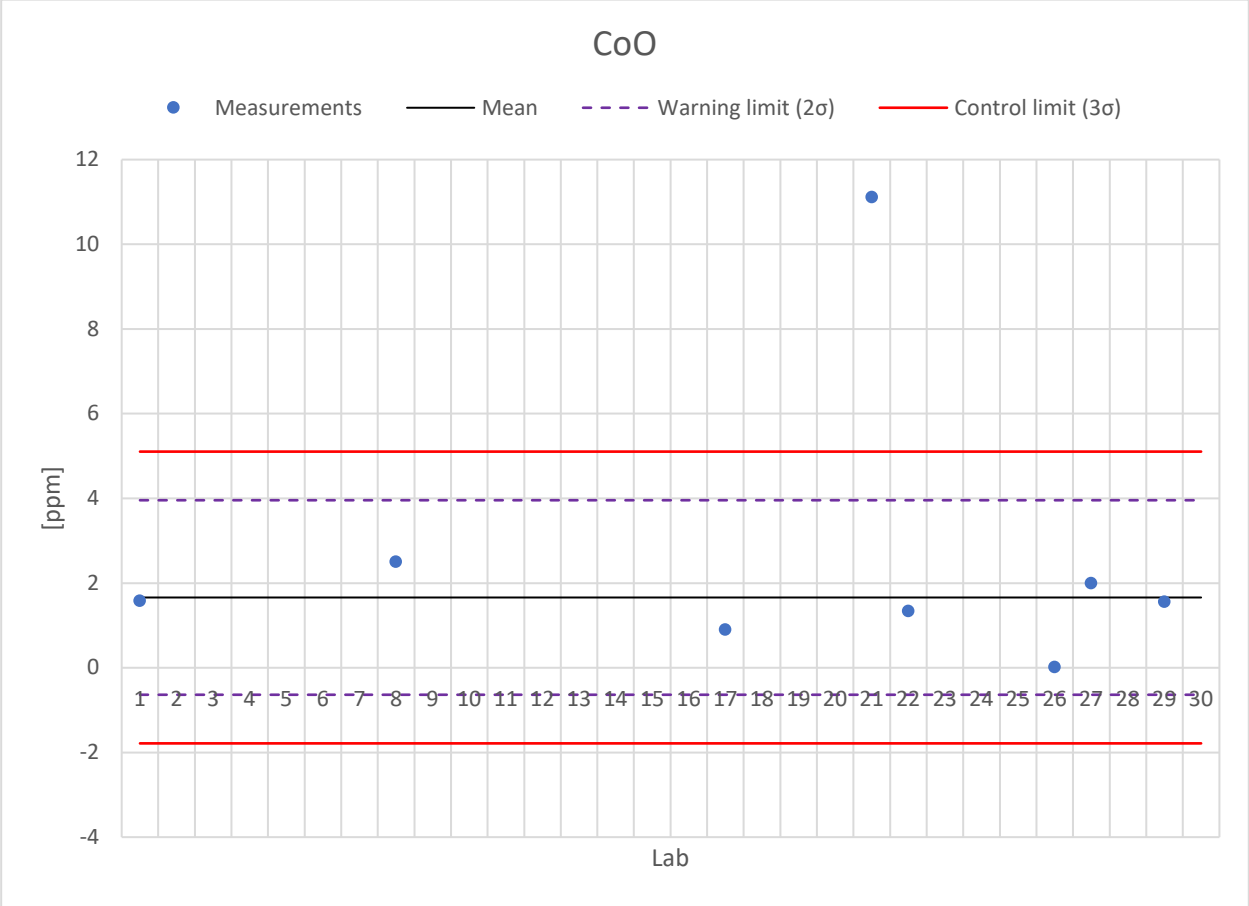


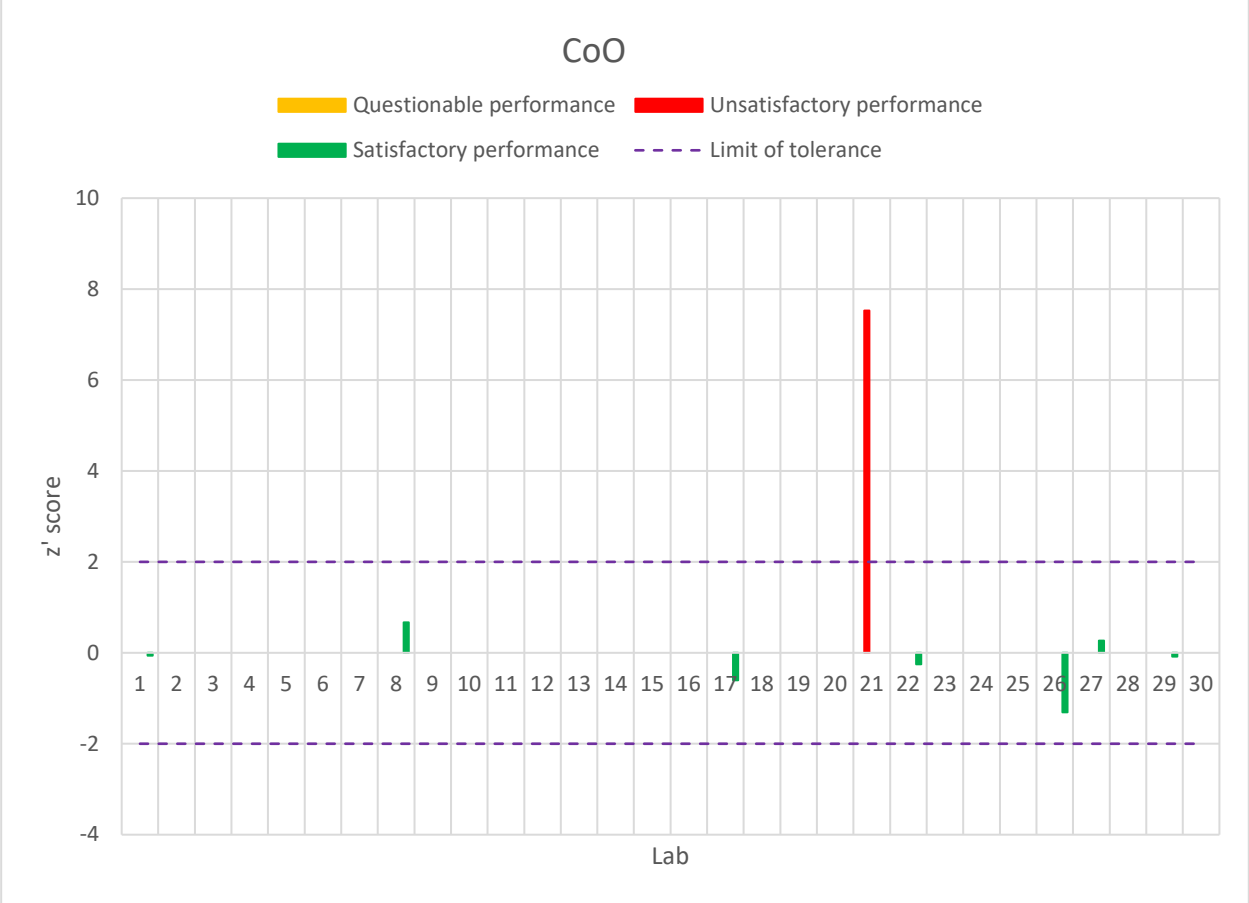
CHARTS SAMPLE D



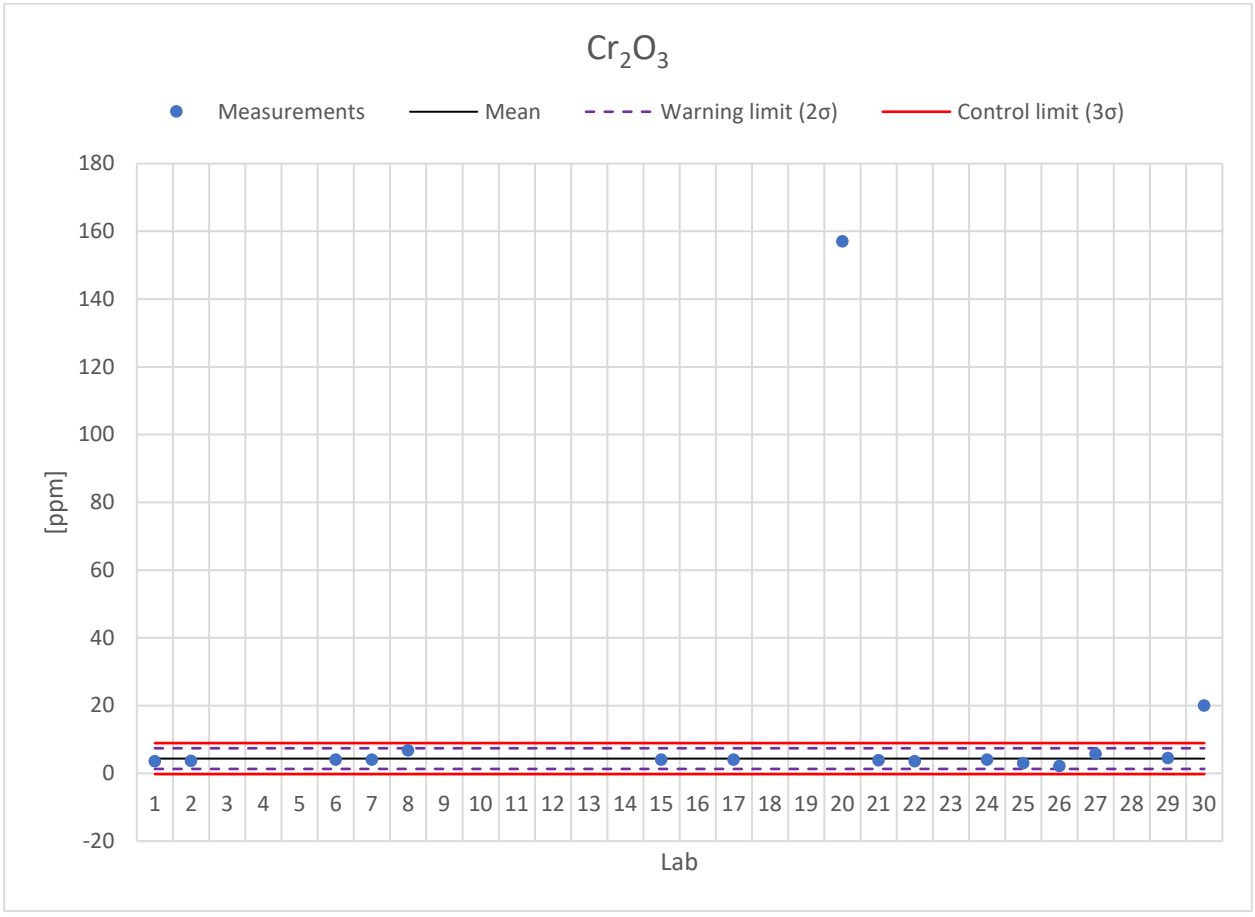


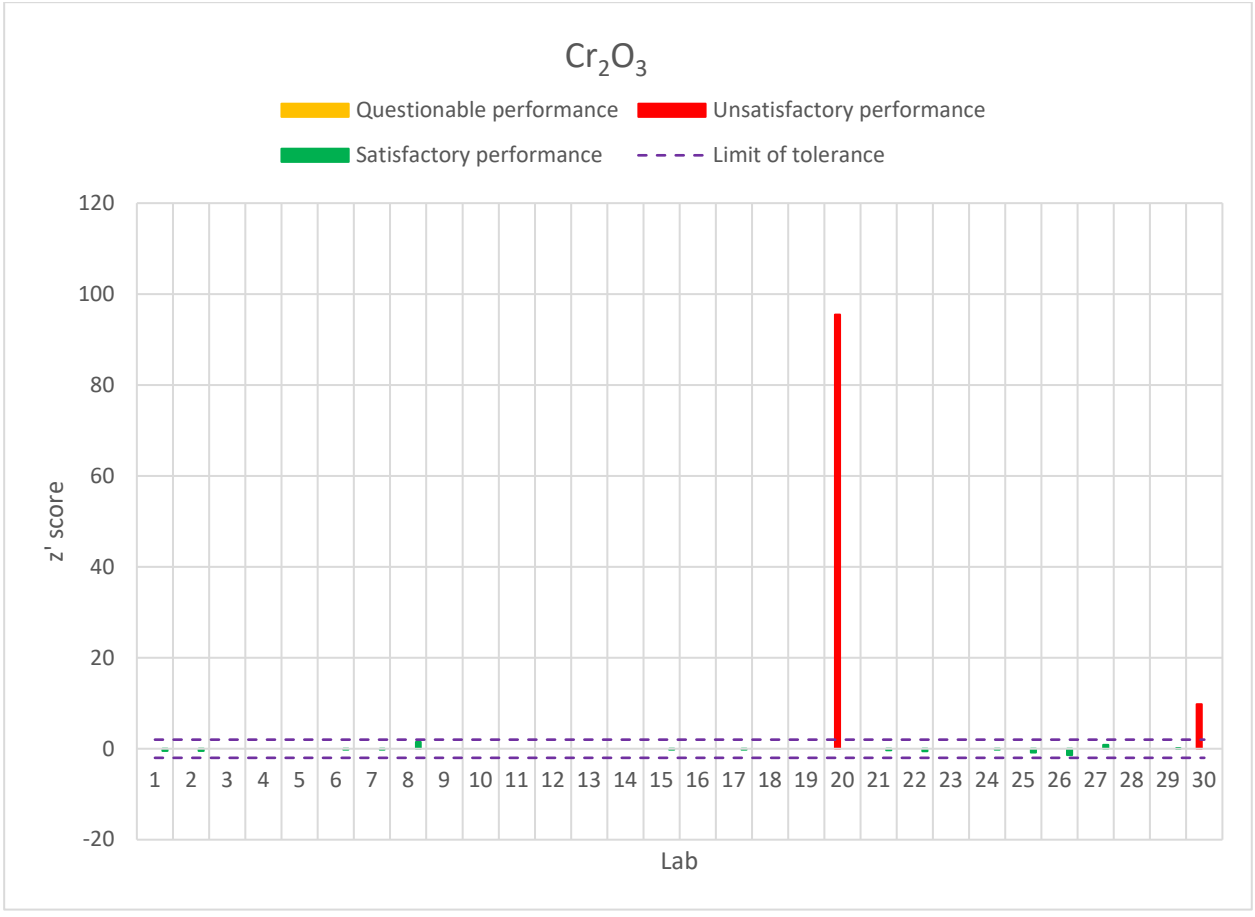
CHARTS SAMPLE D



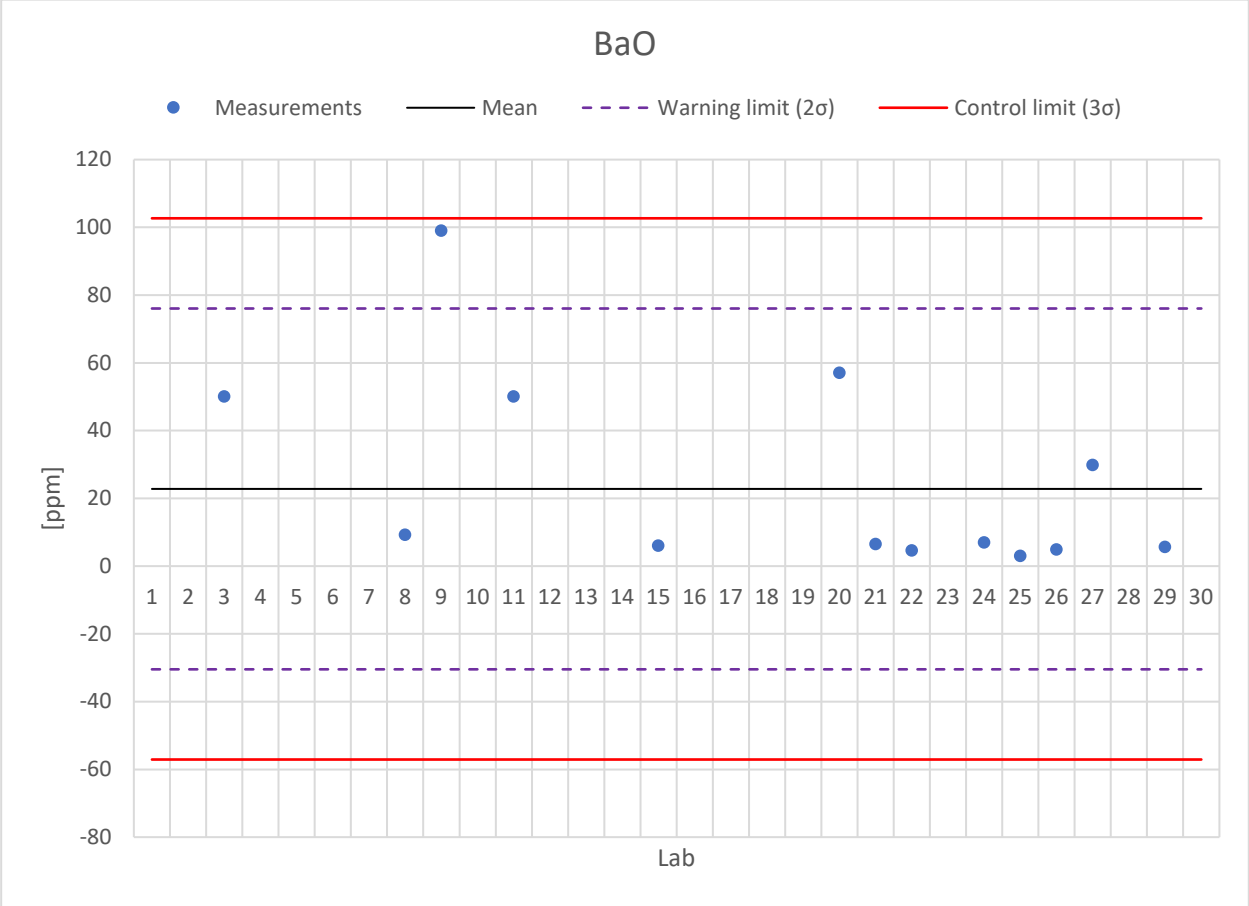


CHARTS SAMPLE D

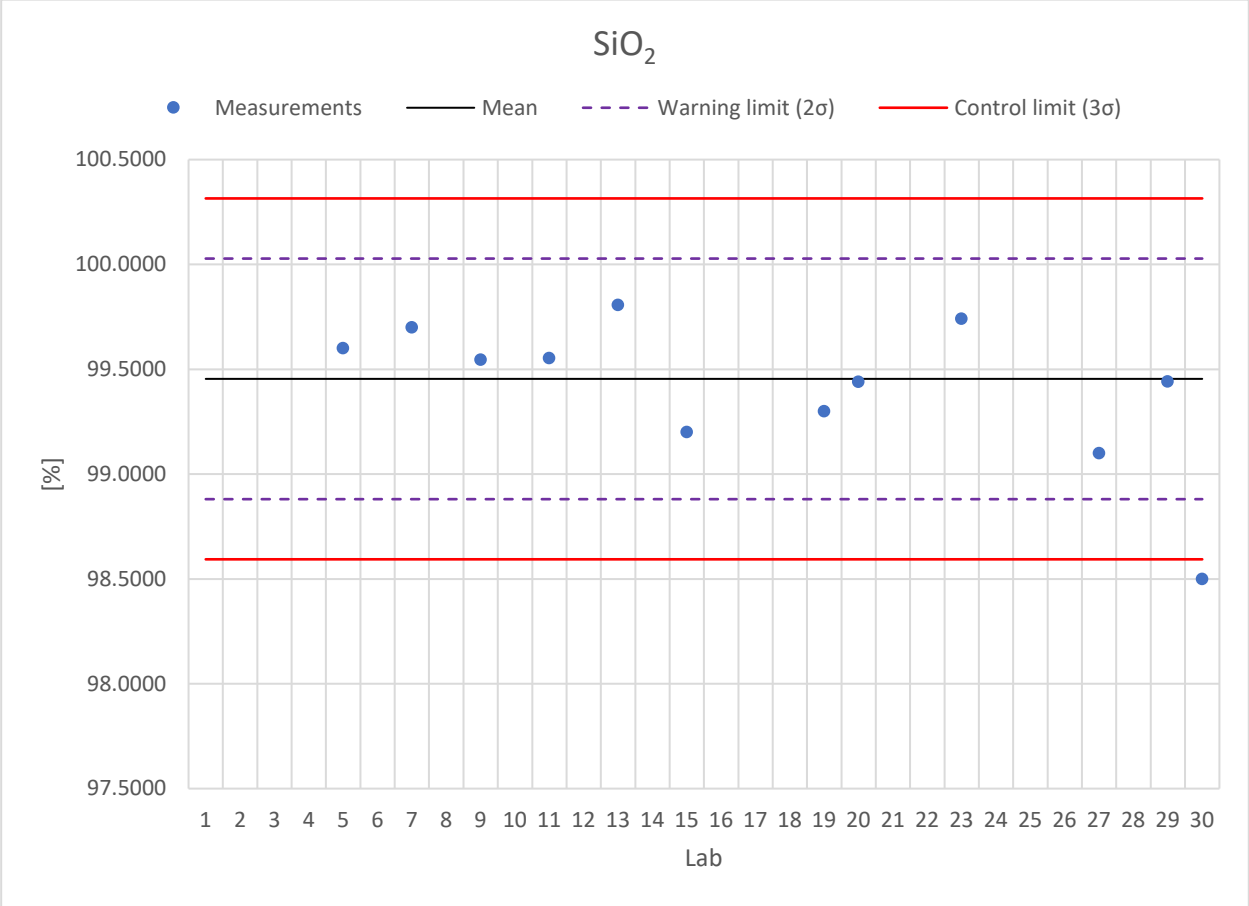


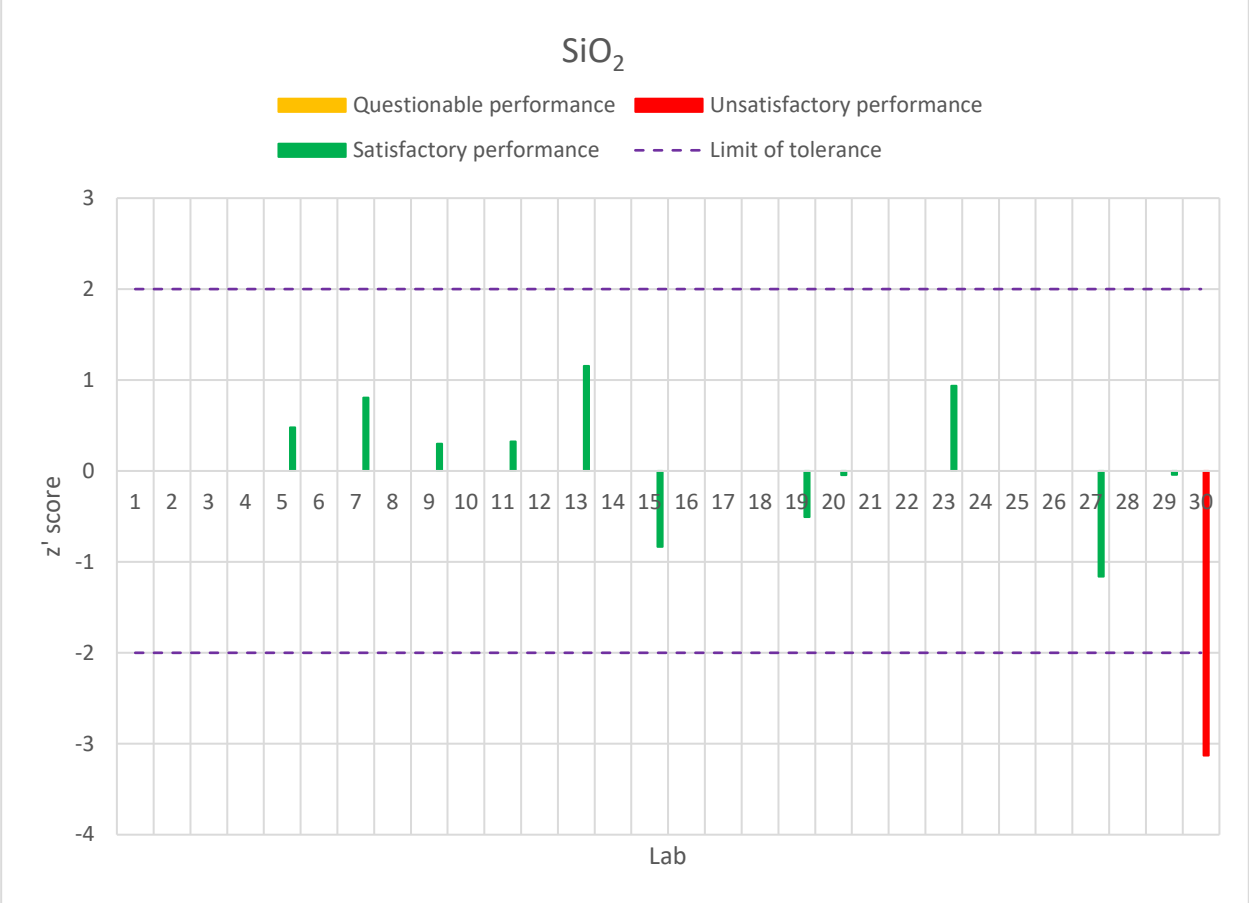


CHARTS SAMPLE D

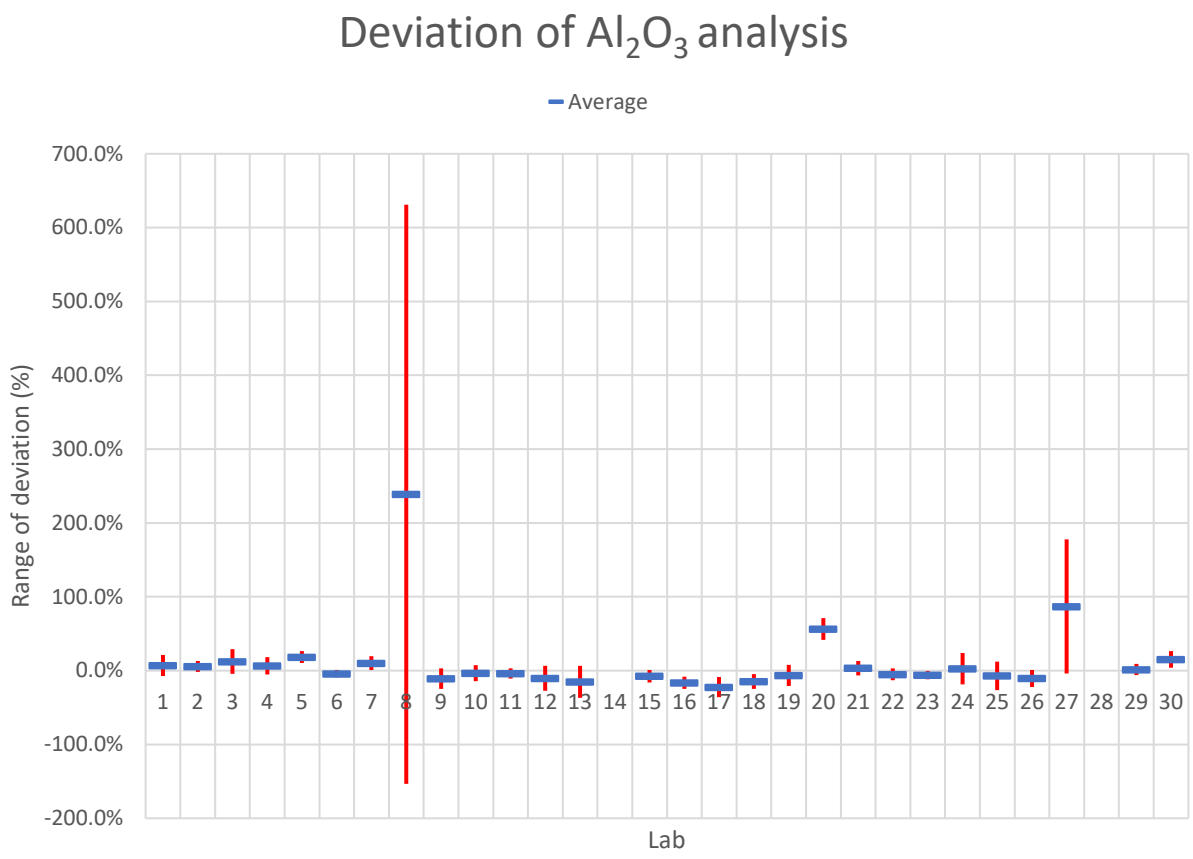


CHARTS SAMPLE D



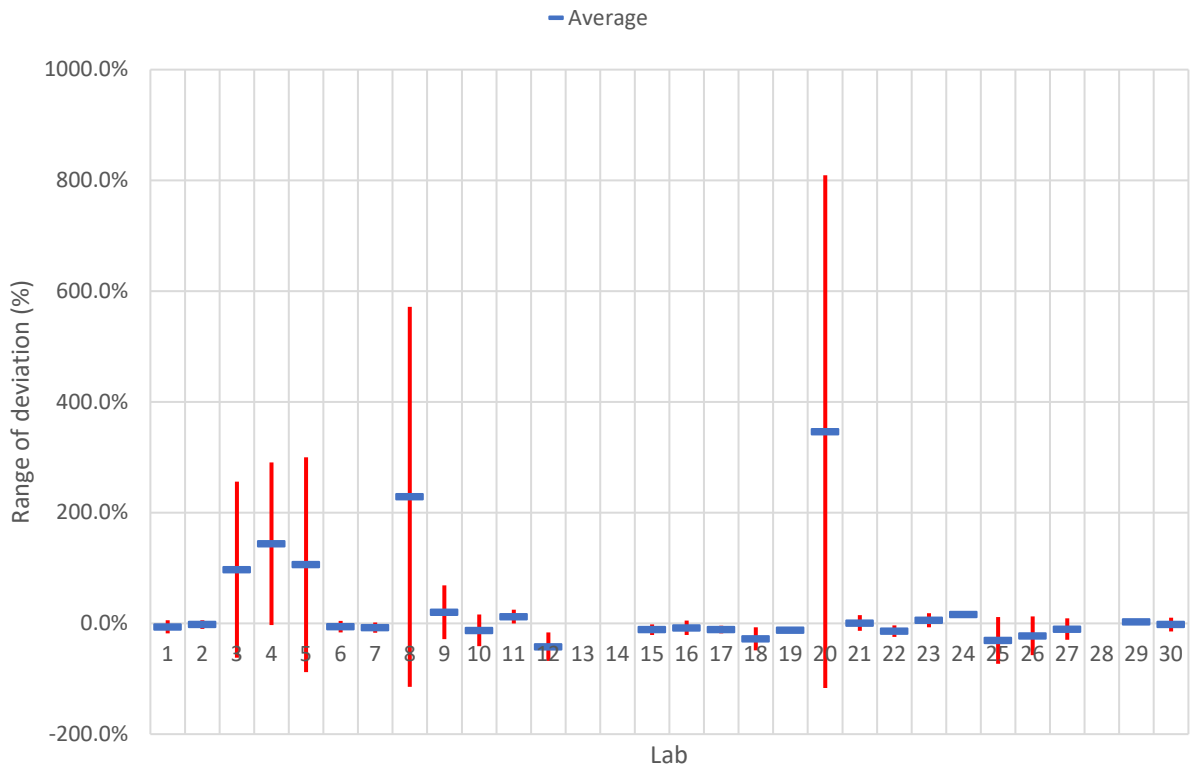


ANNEX 6. INTERSAMPLE AVERAGE



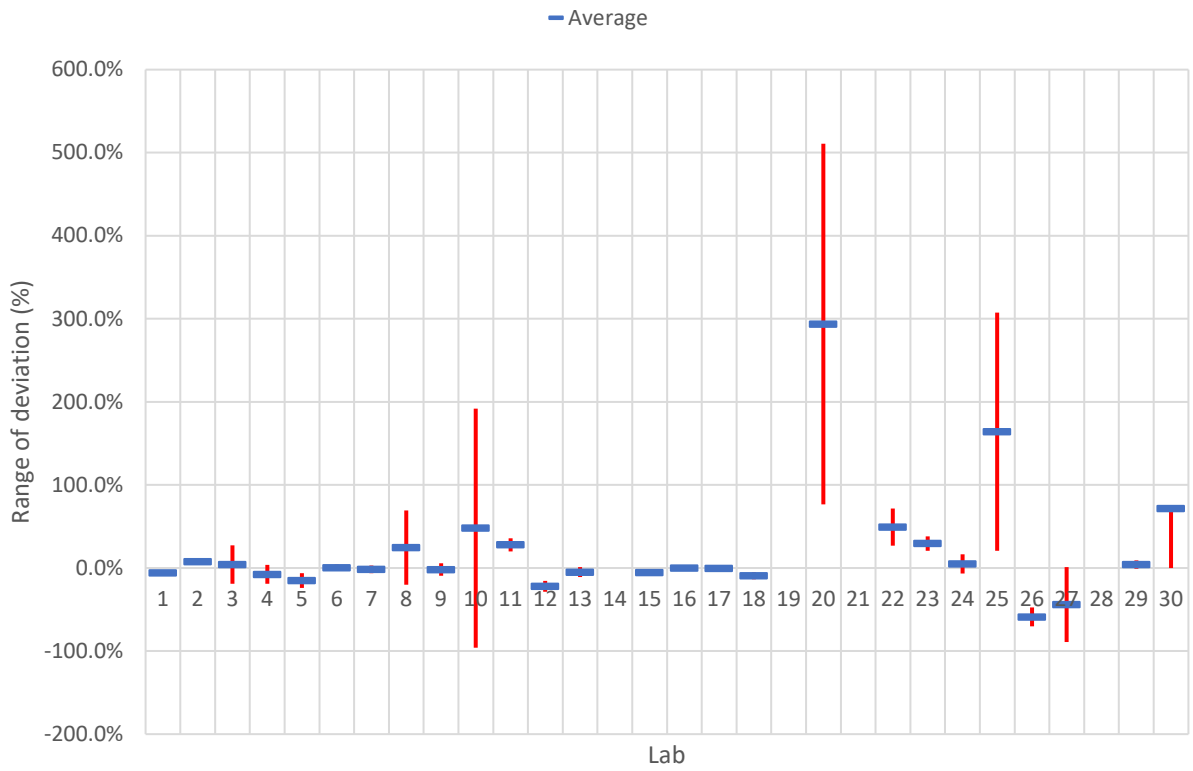
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	21%	13%	29%	18%	26%	1%	20%	631%	3%	7%	3%	7%	7%		1%
LL	-7%	-2%	-4%	-5%	10%	-9%	1%	-153%	-25%	-14%	-11%	-27%	-37%		-16%
Avg	7%	6%	12%	7%	18%	-4%	10%	239%	-11%	-4%	-4%	-10%	-15%		-8%
SD	14%	7%	17%	12%	8%	5%	9%	392%	14%	11%	7%	17%	22%		9%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL	-8%	-9%	-5%	8%	71%	13%	3%	0%	24%	12%	1%	178%		9%	26%
LL	-25%	-36%	-25%	-21%	42%	-6%	-13%	-12%	-19%	-26%	-22%	-4%		-6%	4%
Avg	-16%	-22%	-15%	-6%	56%	3%	-5%	-6%	3%	-7%	-10%	87%		1%	15%
SD	8%	14%	10%	14%	15%	10%	8%	6%	21%	19%	12%	91%		8%	11%



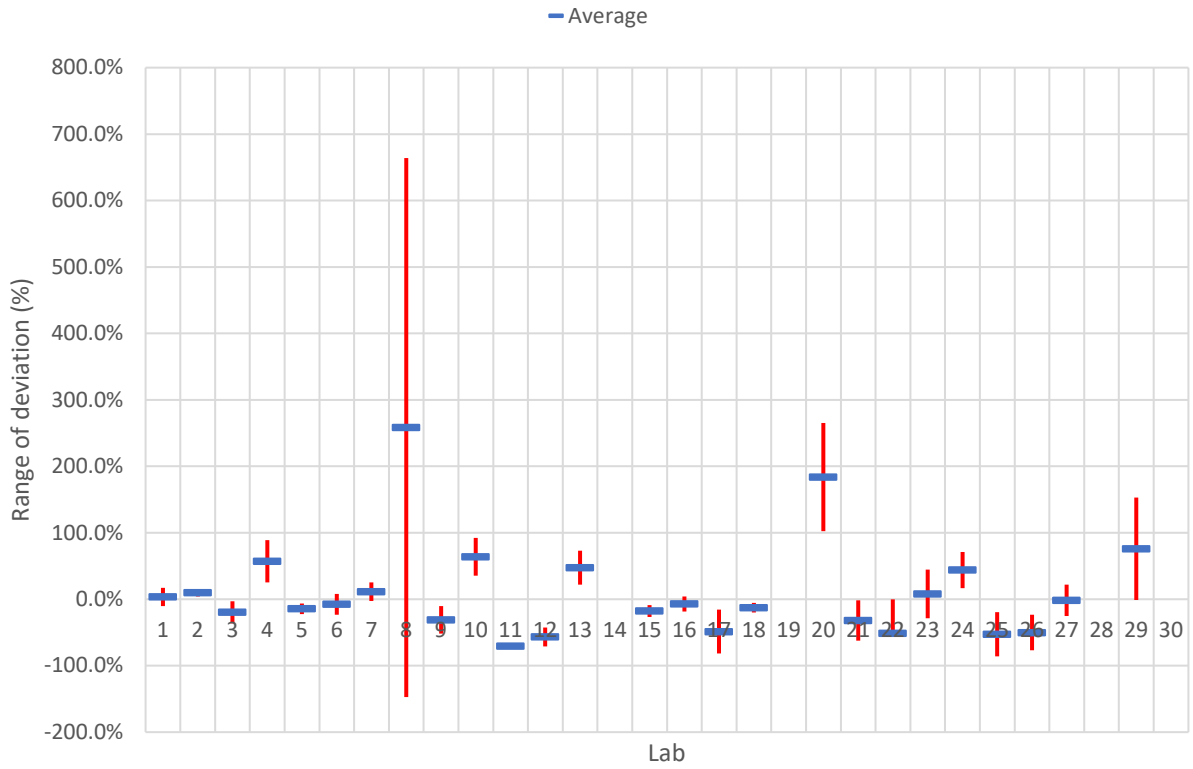
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	6%	6%	256%	291%	300%	5%	2%	572%	69%	16%	25%	-17%			-2%
LL	-18%	-10%	-62%	-3%	-88%	-16%	-17%	-115%	-28%	-41%	0%	-68%			-21%
Avg	-6%	-2%	97%	144%	106%	-6%	-8%	229%	20%	-13%	12%	-42%			-11%
SD	12%	8%	159%	147%	194%	10%	9%	343%	48%	29%	12%	25%			10%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL	5%	-4%	-7%	-8%	809%	15%	-3%	18%	19%	11%	12%	9%		4%	10%
LL	-21%	-18%	-48%	-16%	-117%	-14%	-24%	-7%	13%	-73%	-58%	-30%		1%	-14%
Avg	-8%	-11%	-28%	-12%	346%	1%	-14%	6%	16%	-31%	-23%	-10%		3%	-2%
SD	13%	7%	21%	4%	463%	14%	10%	13%	3%	42%	35%	19%		2%	12%



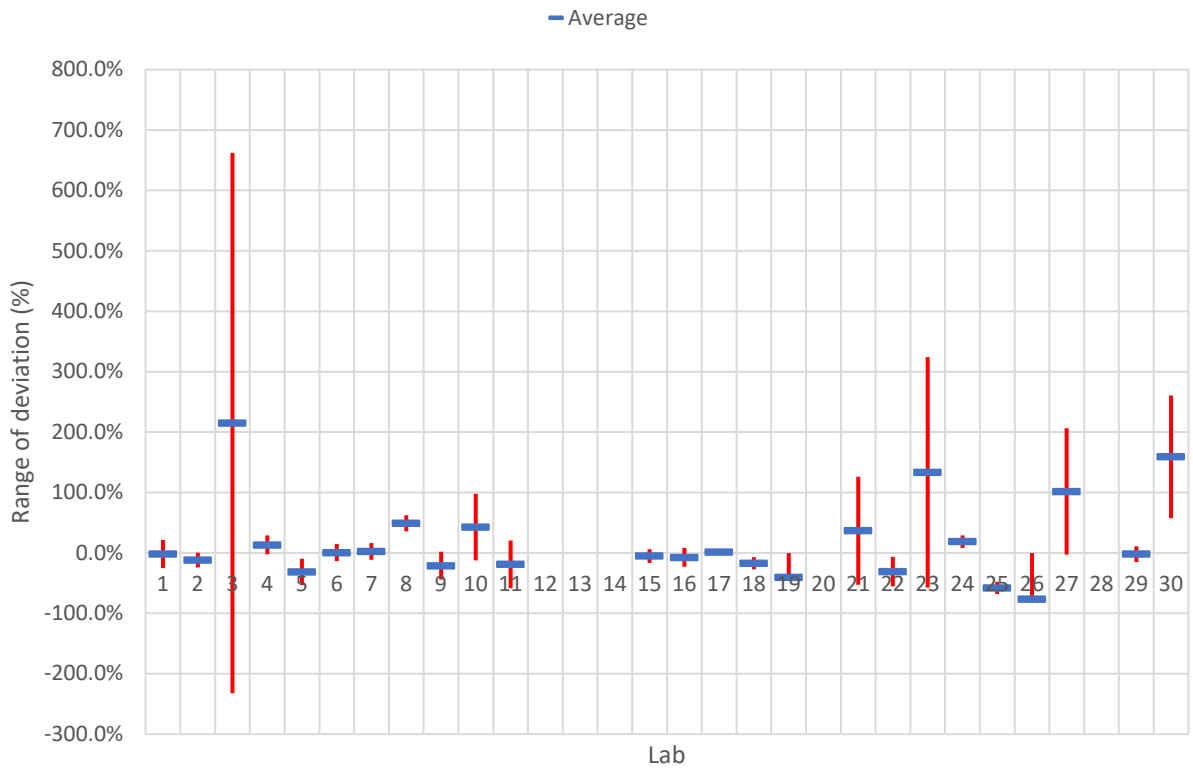
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	-5%	11%	27%	4%	-6%	4%	3%	69%	6%	192%	36%	-16%	1%		-2%
LL	-7%	4%	-19%	-19%	-24%	-3%	-6%	-20%	-9%	-96%	20%	-29%	-11%		-9%
Avg	-6%	8%	4%	-8%	-15%	0%	-2%	25%	-2%	48%	28%	-22%	-5%		-5%
SD	1%	4%	23%	11%	9%	4%	5%	45%	8%	144%	8%	7%	6%		3%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL	1%	2%	-5%		511%		71%	38%	17%	308%	-47%	1%		9%	
LL	-1%	-2%	-13%		76%		27%	21%	-6%	21%	-70%	-89%		-1%	
Avg	0%	0%	-9%		294%		49%	29%	5%	164%	-59%	-44%		4%	72%
SD	1%	2%	4%		217%		22%	9%	12%	143%	12%	45%		5%	



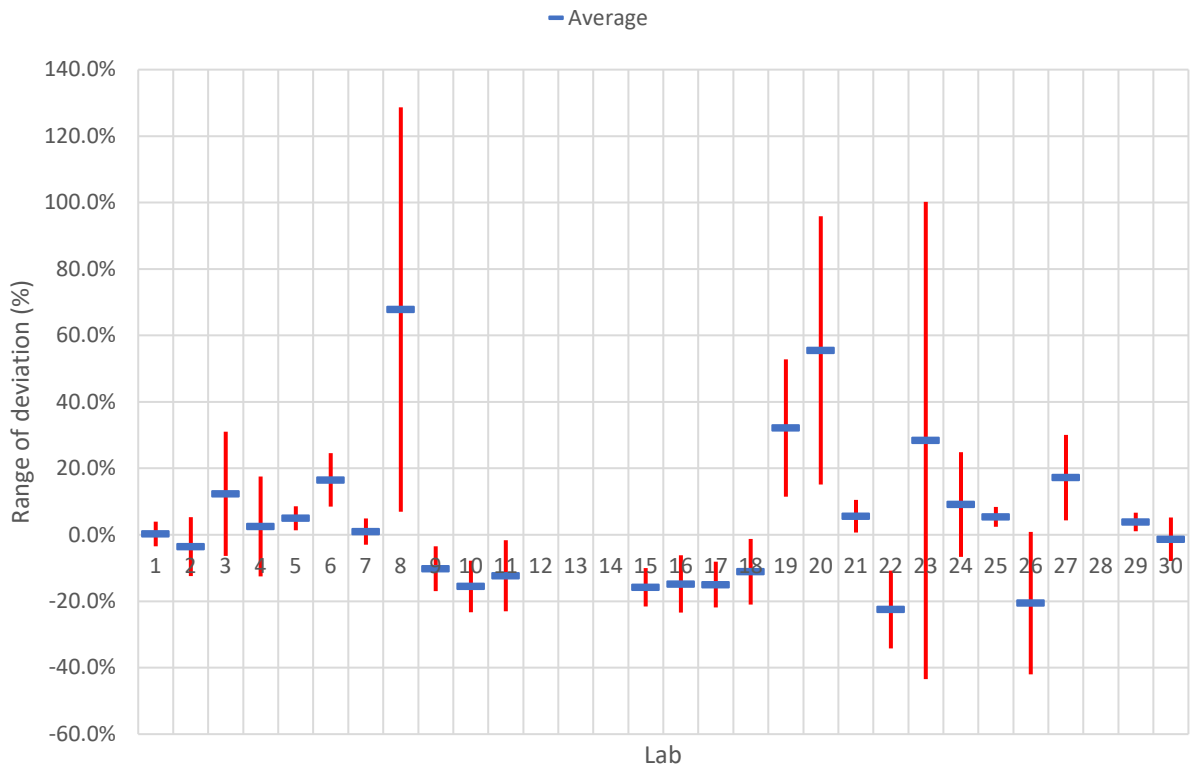
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	17%	15%	-3%	89%	-6%	8%	25%	664%	-10%	93%	-67%	-42%	73%		-9%
LL	-10%	4%	-36%	25%	-22%	-23%	-3%	-147%	-52%	35%	-74%	-71%	22%		-27%
Avg	3%	10%	-20%	57%	-14%	-8%	11%	258%	-31%	64%	-71%	-57%	47%		-18%
SD	14%	5%	17%	32%	8%	16%	14%	406%	21%	29%	3%	14%	26%		9%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL	4%	-16%	-5%		265%	-2%		45%	71%	-19%	-23%	22%		153%	
LL	-19%	-82%	-20%		102%	-63%		-29%	17%	-86%	-77%	-25%		-1%	
Avg	-7%	-49%	-13%		184%	-32%	-51%	8%	44%	-53%	-50%	-2%		76%	
SD	11%	33%	7%		81%	30%		37%	27%	33%	27%	24%		77%	



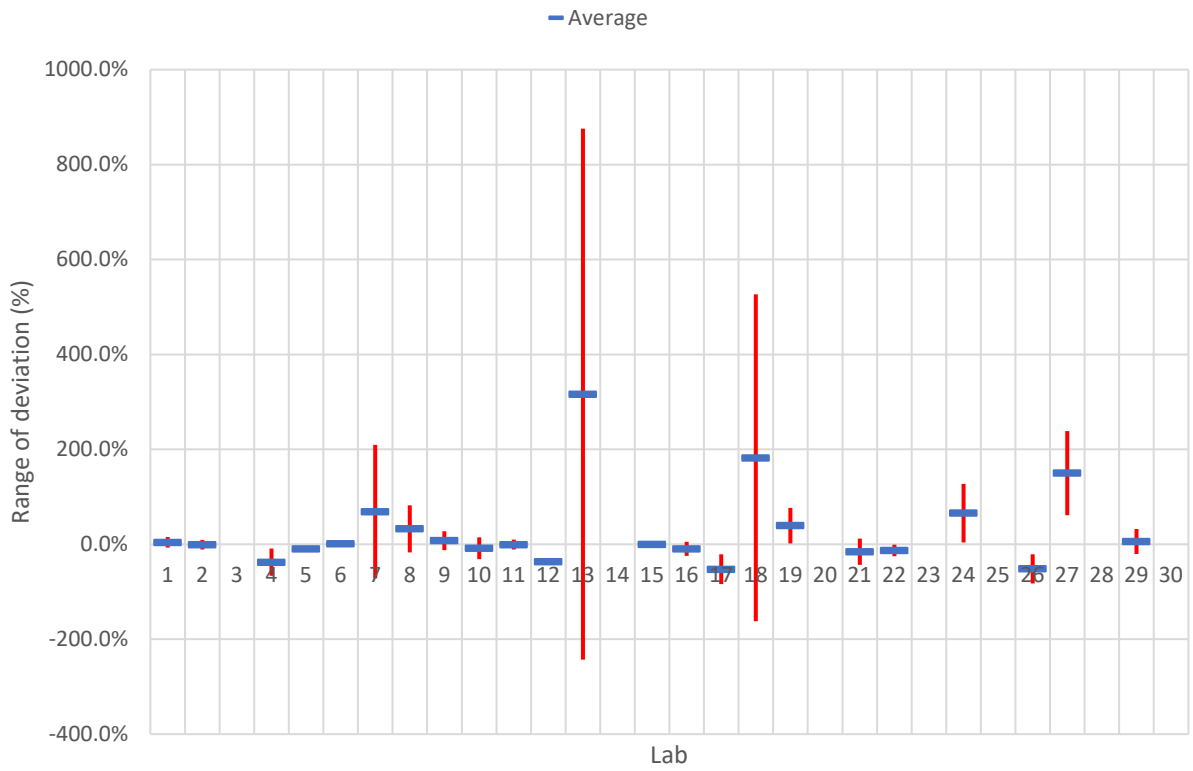
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	22%	0%	662%	29%	-10%	14%	16%	62%	2%	98%	21%				6%
LL	-25%	-24%	-232%	-2%	-53%	-14%	-11%	36%	-44%	-13%	-58%				-16%
Avg	-2%	-12%	215%	13%	-31%	0%	3%	49%	-21%	43%	-19%				-5%
SD	23%	12%	447%	16%	22%	14%	14%	13%	23%	55%	40%				11%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL	8%	6%	-7%			126%	-7%	324%	29%	-48%		206%		11%	261%
LL	-23%	-4%	-27%			-53%	-55%	-57%	8%	-68%		-3%		-15%	58%
Avg	-8%	1%	-17%	-40%		37%	-31%	133%	19%	-58%	-77%	102%		-2%	159%
SD	16%	5%	10%			89%	24%	191%	11%	10%		105%		13%	102%



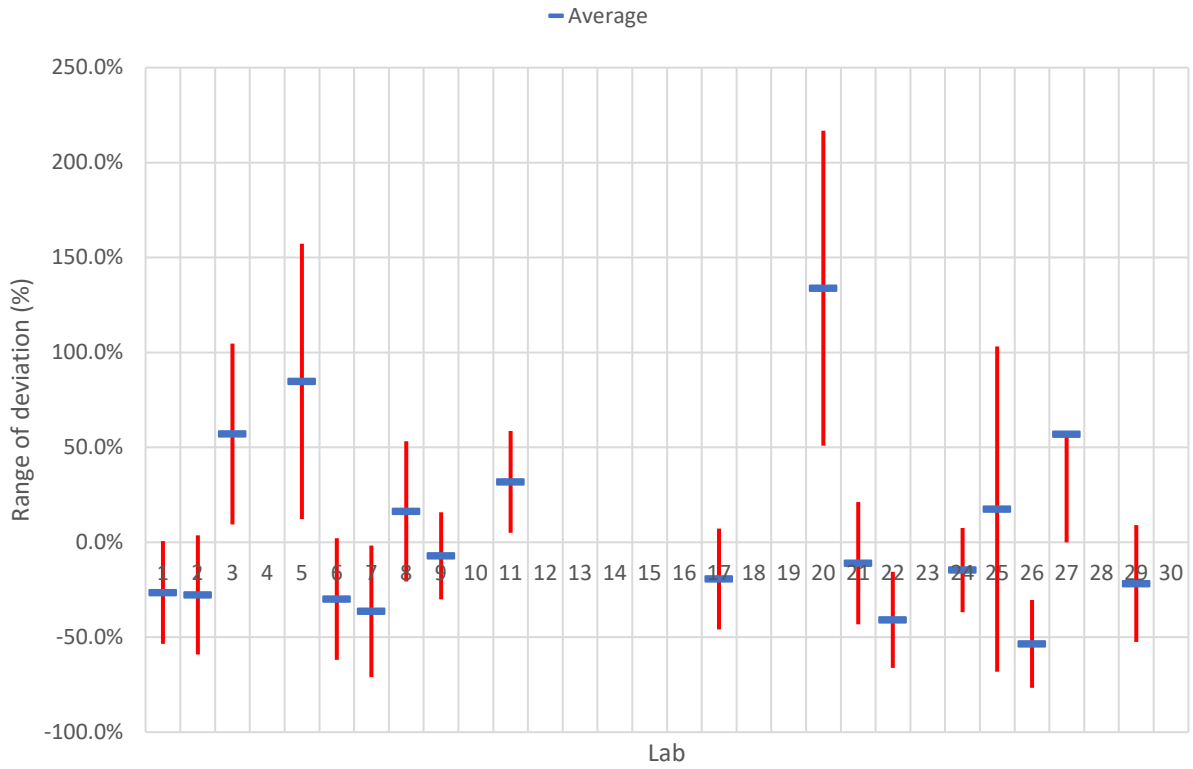
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	4%	5%	31%	18%	9%	25%	5%	129%	-3%	-8%	-2%				-10%
LL	-3%	-12%	-6%	-13%	1%	9%	-3%	7%	-17%	-23%	-23%				-22%
Avg	0%	-4%	12%	2%	5%	17%	1%	68%	-10%	-16%	-12%				-16%
SD	4%	9%	19%	15%	4%	8%	4%	61%	7%	8%	11%				6%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL	-6%	-8%	-1%	53%	96%	11%	-11%	100%	25%	8%	1%	30%		7%	5%
LL	-23%	-22%	-21%	11%	15%	1%	-34%	-43%	-7%	2%	-42%	4%		1%	-8%
Avg	-15%	-15%	-11%	32%	55%	6%	-22%	28%	9%	5%	-21%	17%		4%	-1%
SD	9%	7%	10%	21%	40%	5%	12%	72%	16%	3%	21%	13%		3%	7%



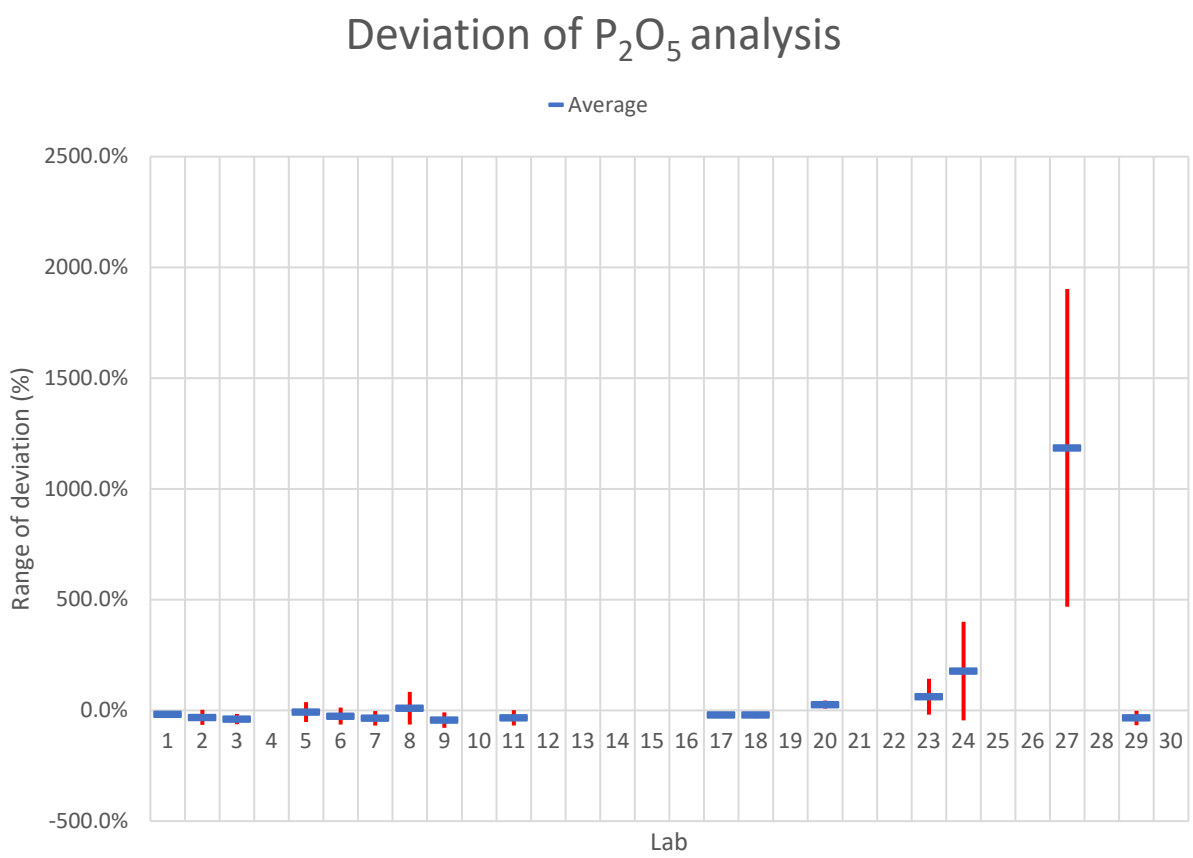
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	15%	9%		-9%	-9%	4%	210%	82%	28%	14%	10%	-32%	876%		2%
LL	-7%	-11%		-67%	-11%	-1%	-72%	-17%	-12%	-31%	-11%	-42%	-243%		-2%
Avg	4%	-1%		-38%	-10%	1%	69%	33%	8%	-8%	-1%	-37%	316%		0%
SD	11%	10%		29%	1%	2%	141%	49%	20%	23%	10%	5%	559%		2%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL	5%	-21%	527%	77%		12%	-1%		127%		-21%	239%		32%	
LL	-24%	-84%	-162%	2%		-43%	-25%		4%		-83%	61%		-21%	
Avg	-9%	-53%	182%	39%		-16%	-13%		66%		-52%	150%		6%	
SD	15%	31%	344%	38%		28%	12%		62%		31%	89%		26%	



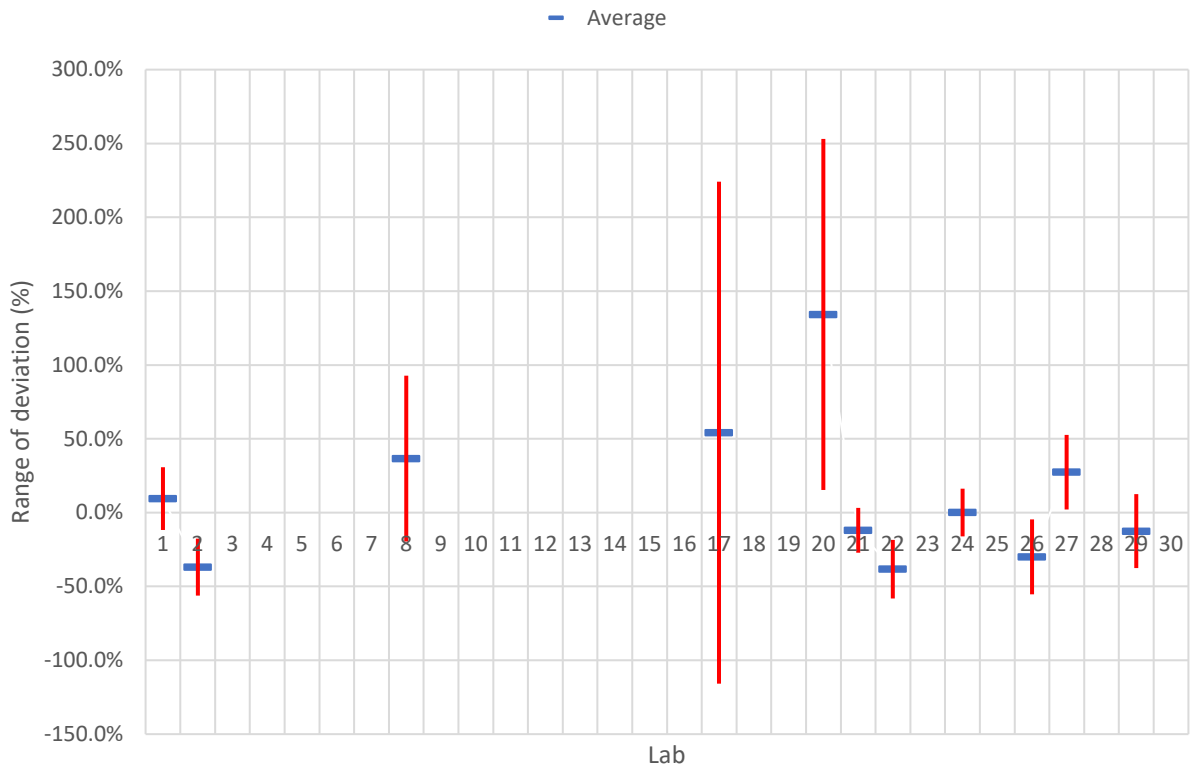
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	1%	4%	105%		157%	2%	-2%	53%	16%		59%				
LL	-54%	-59%	9%		12%	-62%	-71%	-21%	-30%		5%				
Avg	-26%	-28%	57%		85%	-30%	-36%	16%	-7%		32%				
SD	27%	31%	48%		72%	32%	35%	37%	23%		27%				

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL		7%			217%	21%	-16%		8%	103%	-30%			9%	
LL		-46%			51%	-43%	-66%		-37%	-68%	-77%			-53%	
Avg		-19%			134%	-11%	-41%		-15%	17%	-54%	57%		-22%	
SD		27%			83%	32%	25%		22%	86%	23%			31%	



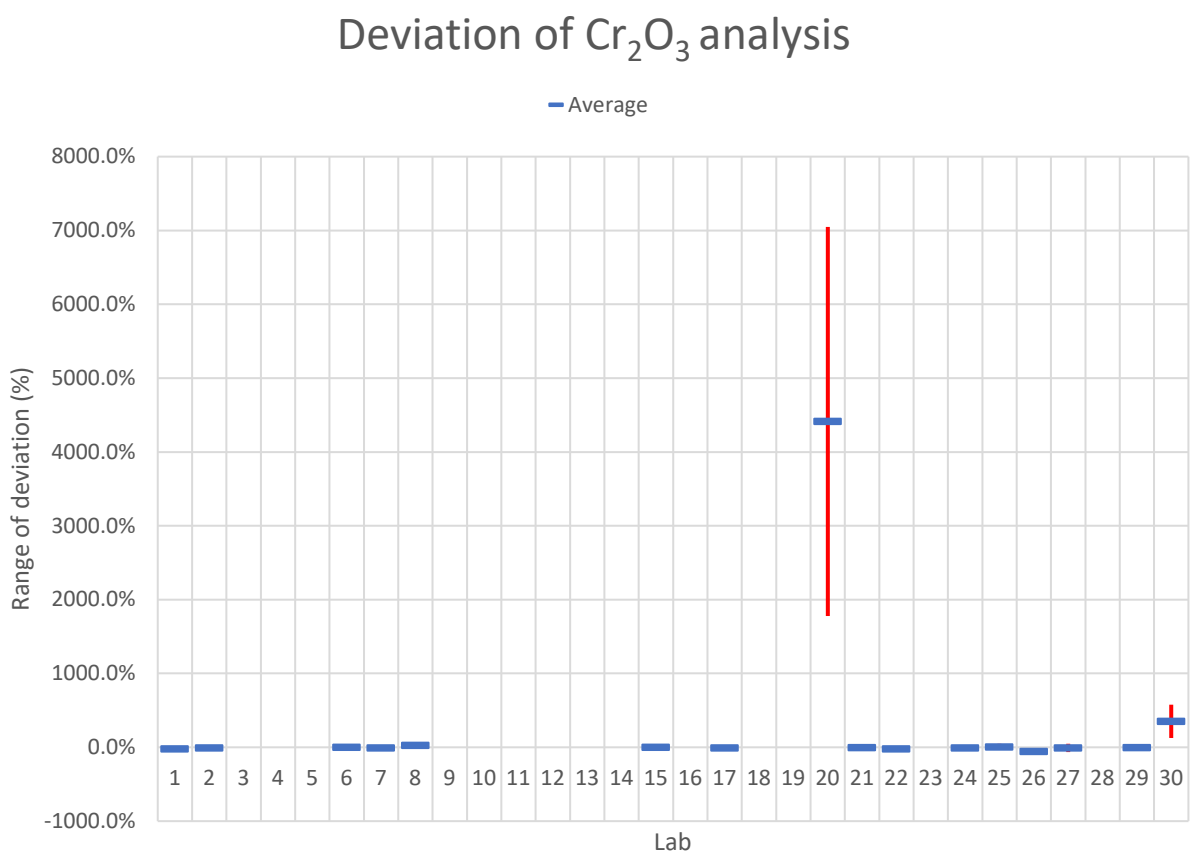
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	-4%	3%	-16%		37%	13%	-2%	83%	-9%		1%				
LL	-33%	-66%	-62%		-52%	-64%	-69%	-64%	-79%		-68%				
Avg	-18%	-31%	-39%		-7%	-26%	-36%	10%	-44%		-34%				
SD	15%	34%	23%		44%	38%	33%	74%	35%		34%				

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL		-9%	-7%		44%			143%	399%			1902%		-1%	
LL		-33%	-35%		8%			-19%	-45%			468%		-67%	
Avg		-21%	-21%		26%			62%	177%			1185%		-34%	
SD		12%	14%		18%			81%	222%			717%		33%	



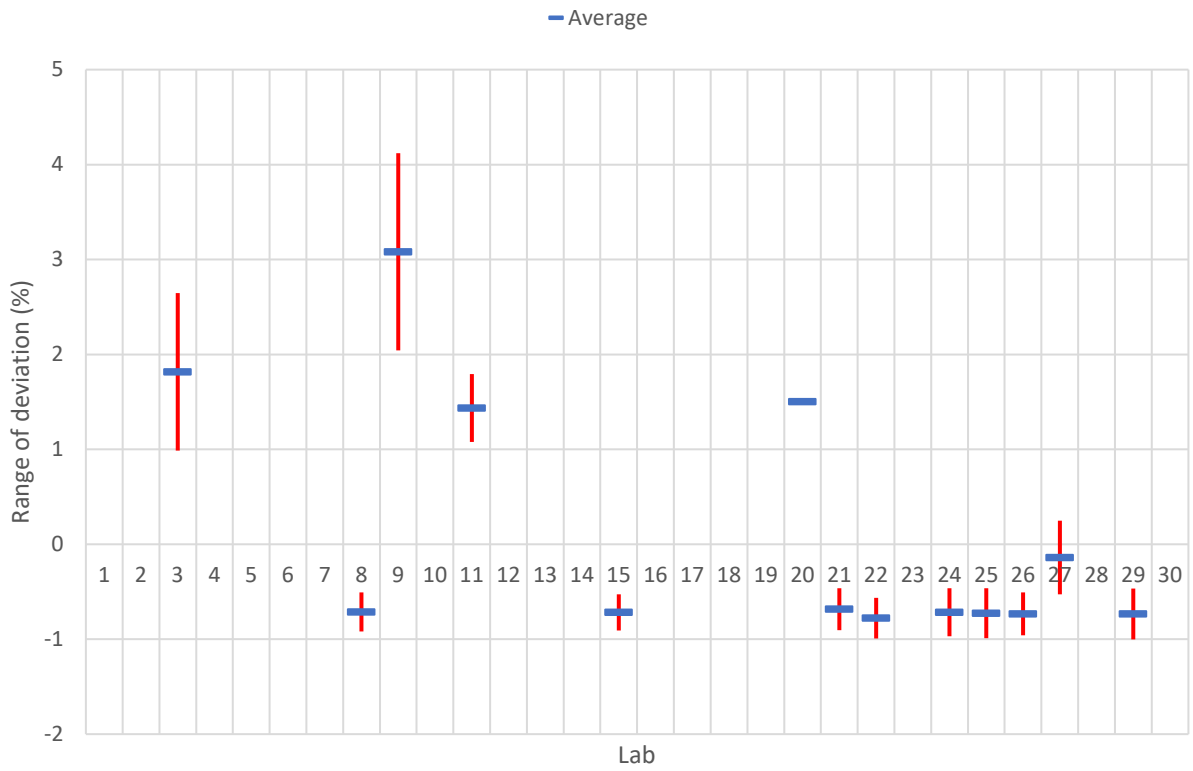
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	31%	-18%						93%							
LL	-12%	-56%						-20%							
Avg	9%	-37%						37%							
SD	21%	19%						56%							

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL		224%			253%	3%	-18%		16%		-4%	53%		13%	
LL		-116%			15%	-27%	-58%		-16%		-55%	2%		-38%	
Avg		54%			134%	-12%	-38%		0%		-30%	27%		-13%	
SD		170%			119%	15%	20%		16%		25%	25%		25%	



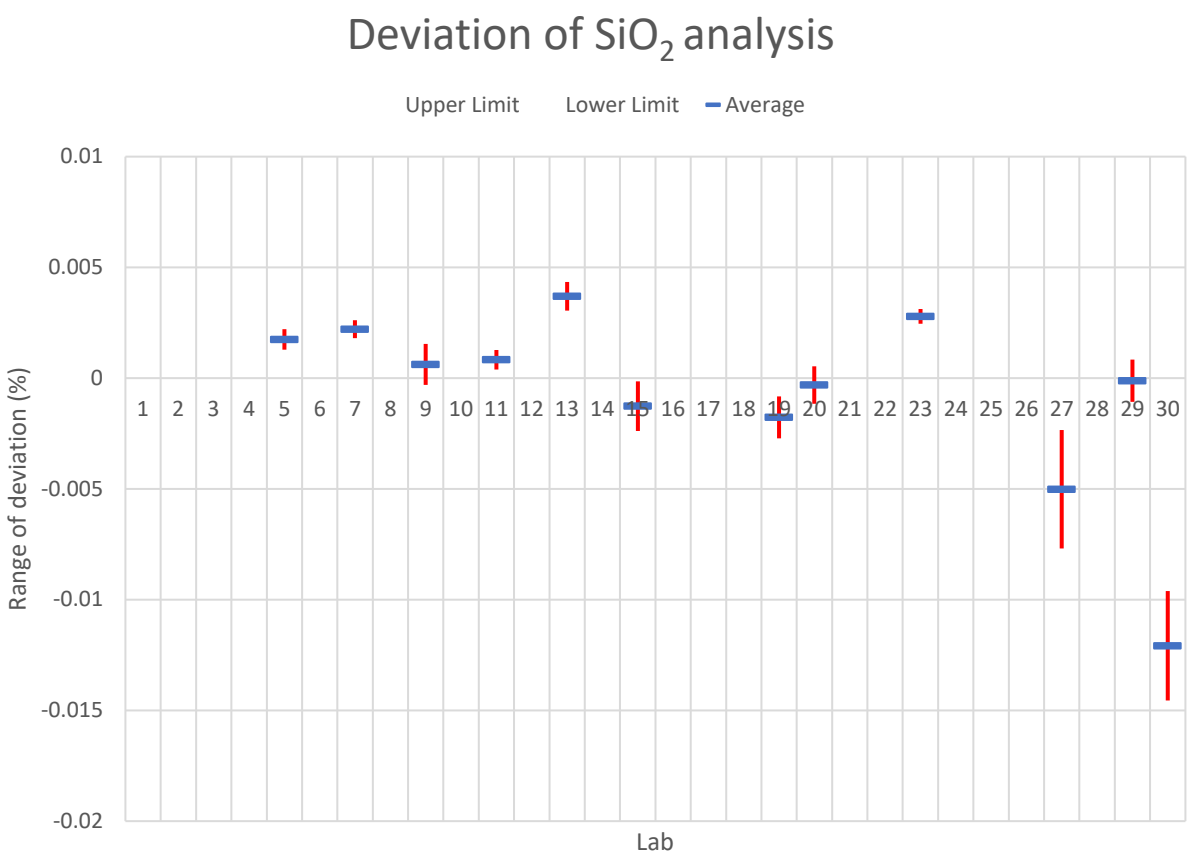
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL	-2%	2%				13%	-2%	55%							13%
LL	-40%	-16%				-13%	-12%	1%							-9%
Avg	-21%	-7%				0%	-7%	28%							2%
SD	19%	9%				13%	5%	27%							11%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL		-2%			7048%	6%	-11%		2%	48%	-26%	47%		24%	575%
LL		-12%			1778%	-10%	-27%		-18%	-34%	-85%	-65%		-32%	128%
Avg		-7%			4413%	-2%	-19%		-8%	7%	-56%	-9%		-4%	352%
SD		5%			2635%	8%	8%		10%	41%	30%	56%		28%	223%



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL			265%					-51%	412%		179%				-53%
LL			99%					-92%	204%		108%				-91%
Avg			182%					-71%	308%		143%				-72%
SD			83%					21%	104%		36%				19%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL					151%	-46%	-57%		-46%	-46%	-51%	25%		-47%	
LL					150%	-90%	-99%		-97%	-99%	-96%	-53%		-100%	
Avg					150%	-68%	-78%		-72%	-73%	-73%	-14%		-73%	
SD					1%	22%	21%		25%	26%	23%	39%		27%	



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UL					0%		0%		0%		0%		0%		0%
LL					0%		0%		0%		0%		0%		0%
Avg					0%		0%		0%		0%		0%		0%
SD					0%		0%		0%		0%		0%		0%

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
UL				0%	0%			0%				0%		0%	-1%
LL				0%	0%			0%				-1%		0%	-1%
Avg				0%	0%			0%				-1%		0%	-1%
SD				0%	0%			0%				0%		0%	0%

ANNEX 7. ANALYTICAL METHODS

	Al_2O_3	Fe_2O_3	TiO_2	CaO	Na_2O	K_2O	MgO	MnO	P_2O_5
	%	%	%	%	%	%	%	ppm	ppm
Lab 1	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 2	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 3	XRF	XRF	XRF	XRF	XRF	XRF		XRF	XRF
Lab 4	XRF	XRF	XRF	XRF	XRF	XRF	XRF		
Lab 5	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF
Lab 6	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 7	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 8	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 9	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF
Lab 10	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES		
Lab 11	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF
Lab 12	XRF	XRF	XRF	XRF			XRF		
Lab 13	XRF		XRF	XRF			XRF		
Lab 14									
Lab 15	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES		
Lab 16	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES		
Lab 17	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 18	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES		ICP-OES
Lab 19	XRF	XRF	XRF	XRF	XRF	XRF	XRF		
Lab 20	XRF	XRF	XRF	XRF		XRF		XRF	XRF
Lab 21	ICP-OES	ICP-OES		ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	
Lab 22	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	
Lab 23	XRF	XRF	XRF	XRF	XRF	XRF	XRF		XRF
Lab 24	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 25	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF
Lab 26	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	
Lab 27	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF
Lab 28									
Lab 29	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 30	XRF	XRF	XRF		XRF	XRF			

	B_2O_3	ZnO	V_2O_5	NiO	PbO	CuO	CoO	CdO	Cr_2O_3
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Lab 1	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 2			ICP-OES	ICP-OES		ICP-OES			ICP-OES
Lab 3	ICP-OES								
Lab 4									
Lab 5									
Lab 6	ICP-OES		ICP-OES	ICP-OES					ICP-OES
Lab 7									ICP-OES
Lab 8	ICP-OES	ICP-OES	ICP-OES	ICP-OES		ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 9									
Lab 10									
Lab 11									
Lab 12									
Lab 13									
Lab 14									
Lab 15									ICP-OES
Lab 16									
Lab 17		ICP-OES		ICP-OES		ICP-OES	ICP-OES		ICP-OES
Lab 18									
Lab 19									
Lab 20		XRF				XRF			XRF
Lab 21							ICP-OES	ICP-OES	ICP-OES
Lab 22		ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
Lab 23									
Lab 24		ICP-OES				ICP-OES			ICP-OES
Lab 25		XRF	XRF	XRF	XRF	XRF			XRF
Lab 26	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
Lab 27		XRF			XRF	XRF	XRF		XRF
Lab 28									
Lab 29	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
Lab 30									XRF

	Cr_2O_3	Sc_2O_3	BaO_2	LiO_2	SO_3	MoO_3	HfO_2	Nb_2O_5	ZrO_2
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
Lab 1	ICP-OES								
Lab 2									
Lab 3		XRF							
Lab 4									
Lab 5		XRF		XRF					
Lab 6									
Lab 7									
Lab 8		ICP-OES						ICP-OES	ICP-OES
Lab 9		XRF		XRF				XRF	
Lab 10									
Lab 11		XRF		XRF					
Lab 12									
Lab 13									
Lab 14									
Lab 15		ICP-OES						ICP-OES	
Lab 16								ICP-OES	
Lab 17								ICP-OES	
Lab 18									
Lab 19		XRF							
Lab 20		XRF							
Lab 21		ICP-OES							
Lab 22		ICP-MS			ICP-MS			ICP-MS	ICP-MS
Lab 23									
Lab 24		ICP-OES						ICP-OES	
Lab 25		XRF						XRF	
Lab 26	ICP-MS	ICP-MS			ICP-MS	ICP-MS		ICP-MS	ICP-MS
Lab 27		XRF			XRF			XRF	XRF
Lab 28									
Lab 29	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES	
Lab 30								XRF	

	Bi_2O_3	Sb_2O_3	SnO_2	SrO	Ga_2O_3	GeO_2	Rb_2O	La_2O_3	Y_2O_3
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
Lab 1									
Lab 2									
Lab 3									
Lab 4									
Lab 5									
Lab 6									
Lab 7									
Lab 8	ICP-OES		ICP-OES	ICP-OES					
Lab 9									
Lab 10									
Lab 11									
Lab 12									
Lab 13									
Lab 14									
Lab 15									
Lab 16									
Lab 17									
Lab 18									
Lab 19									
Lab 20									
Lab 21				ICP-OES					
Lab 22	ICP-MS	ICP-MS	ICP-MS	ICP-MS				ICP-MS	
Lab 23									
Lab 24									
Lab 25				XRF					
Lab 26	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS		
Lab 27				XRF			XRF		XRF
Lab 28									
Lab 29									
Lab 30									

	Cl	LOI	SiO_2
	%	%	%
Lab 1			
Lab 2			
Lab 3			
Lab 4			
Lab 5			XRF
Lab 6			
Lab 7			Difference
Lab 8			
Lab 9			XRF
Lab 10			
Lab 11			XRF
Lab 12			
Lab 13			XRF
Lab 14			
Lab 15			XRF
Lab 16			
Lab 17		XRF	
Lab 18			
Lab 19		Other	XRF
Lab 20	XRF		Difference
Lab 21			
Lab 22			
Lab 23			Difference
Lab 24			
Lab 25		XRF	
Lab 26			
Lab 27	XRF		XRF
Lab 28			
Lab 29			Difference
Lab 30			XRF

ANNEX 8. CERTIFIED VALUES

SAMPLE A

Elem.	Unit	Certified value	±	Uncertainty	Analytical method
Al2O3	%	0.040321612	±	0.004512209	ICP-OES, ICP-MS, XRF
Fe2O3	%	0.004828102	±	0.001199372	ICP-OES, ICP-MS, XRF
TiO2	%	0.003336307	±	0.000286280	ICP-OES, ICP-MS, XRF
CaO	%	0.003871671	±	0.000746390	ICP-OES, ICP-MS, XRF
Na2O	%	0.005582993	±	0.000992434	ICP-OES, ICP-MS, XRF
K2O	%	0.006351581	±	0.000562452	ICP-OES, ICP-MS, XRF
MgO	%	0.000876347	±	0.000206061	ICP-OES, ICP-MS, XRF
MnO	%	0.000378965	±	0.000229124	ICP-OES, ICP-MS, XRF
P2O5	%	0.001083580	±	0.000809362	ICP-OES, ICP-MS, XRF
CuO	%	0.000328223	±	0.000107901	ICP-OES, ICP-MS, XRF
CoO	%	0.000198484	±	0.000101698	ICP-OES, ICP-MS, XRF
Cr2O3	%	0.000254453	±	0.000038046	ICP-OES, ICP-MS, XRF
BaO2	%	0.001734243	±	0.001790413	ICP-OES, ICP-MS, XRF
SiO2	%	99.674214108	±	0.159277965	XRF, Difference

SAMPLE B

Elem.	Unit	Certified value	±	Uncertainty	Analytical method
Al_2O_3	%	0.302575017	±	0.013457483	ICP-OES, ICP-MS, XRF
Fe_2O_3	%	0.066326387	±	0.002811637	ICP-OES, ICP-MS, XRF
TiO_2	%	0.005827962	±	0.000439076	ICP-OES, ICP-MS, XRF
CaO	%	0.007386450	±	0.001039489	ICP-OES, ICP-MS, XRF
Na_2O	%	0.012881999	±	0.000940295	ICP-OES, ICP-MS, XRF
K_2O	%	0.097755729	±	0.005564701	ICP-OES, ICP-MS, XRF
MgO	%	0.009678363	±	0.000587845	ICP-OES, ICP-MS, XRF
MnO	%	0.000788438	±	0.000078799	ICP-OES, ICP-MS, XRF
P_2O_5	%	0.003423884	±	0.000346868	ICP-OES, ICP-MS, XRF
CuO	%	0.000441171	±	0.000021625	ICP-OES, ICP-MS, XRF
Cr_2O_3	%	0.000297623	±	0.000017826	ICP-OES, ICP-MS, XRF
BaO_2	%	0.002691800	±	0.001670104	ICP-OES, ICP-MS, XRF
SiO_2	%	99.273827615	±	0.178239474	XRF, Difference

SAMPLE C

Elem.	Unit	Certified value	±	Uncertainty	Analytical method
Al_2O_3	%	0.464656132	±	0.019358466	ICP-OES, ICP-MS, XRF
Fe_2O_3	%	0.047826943	±	0.002578352	ICP-OES, ICP-MS, XRF
TiO_2	%	0.003280473	±	0.000244087	ICP-OES, ICP-MS, XRF
CaO	%	0.003344690	±	0.000684175	ICP-OES, ICP-MS, XRF
Na_2O	%	0.003788390	±	0.000929386	ICP-OES, ICP-MS, XRF
K_2O	%	0.076848001	±	0.004009820	ICP-OES, ICP-MS, XRF
MgO	%	0.014644532	±	0.001612745	ICP-OES, ICP-MS, XRF
MnO	%	0.000437132	±	0.000128310	ICP-OES, ICP-MS, XRF
P_2O_5	%	0.001329164	±	0.000390220	ICP-OES, ICP-MS, XRF
V_2O_5	%	0.000510769	±	0.000176622	ICP-OES, ICP-MS, XRF
NiO	%	0.000232720	±	0.000070516	ICP-OES, ICP-MS, XRF
CuO	%	0.000526154	±	0.000151055	ICP-OES, ICP-MS, XRF
Cr_2O_3	%	0.001332424	±	0.000287692	ICP-OES, ICP-MS, XRF
BaO_2	%	0.002870641	±	0.002864062	ICP-OES, ICP-MS, XRF
SiO_2	%	99.100754538	±	0.228693504	XRF, Difference

SAMPLE D

Elem.	Unit	Certified value	±	Uncertainty	Analytical method
Al_2O_3	%	0.170582136	±	0.013872868	ICP-OES, ICP-MS, XRF
Fe_2O_3	%	0.066806952	±	0.003305973	ICP-OES, ICP-MS, XRF
TiO_2	%	0.004161505	±	0.000232762	ICP-OES, ICP-MS, XRF
CaO	%	0.009161685	±	0.001505054	ICP-OES, ICP-MS, XRF
Na_2O	%	0.016799126	±	0.001101867	ICP-OES, ICP-MS, XRF
K_2O	%	0.019509034	±	0.001396724	ICP-OES, ICP-MS, XRF
MgO	%	0.011223431	±	0.000998321	ICP-OES, ICP-MS, XRF
MnO	%	0.000834448	±	0.000107701	ICP-OES, ICP-MS, XRF
P_2O_5	%	0.001652232	±	0.000454613	ICP-OES, ICP-MS, XRF
CuO	%	0.000244765	±	0.000118682	ICP-OES, ICP-MS, XRF
CoO	%	0.000165926	±	0.000096002	ICP-OES, ICP-MS, XRF
Cr_2O_3	%	0.000436641	±	0.000081288	ICP-OES, ICP-MS, XRF
BaO_2	%	0.002279205	±	0.001609024	ICP-OES, ICP-MS, XRF
SiO_2	%	99.454186191	±	0.182268461	XRF, Difference