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Project HORIZONTAL Validation Report on specific electrical conductivity

Validation of a horizontal standard for the determination of specific electrical conductivity in soils, sludges and treated biowaste in a European Intercomparison Exercise

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Project HORIZONTAL Validation Report

Validation of a horizontal standard for the determination of specific electrical conductivity (EC) in soils, sludge and treated biowaste in a European Intercomparison Exercise

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Summary

Project HORIZONTAL is interdisciplinary aiming at a harmonisation and horizontal standardisation of test procedures, in particular for sludge, soils and biowastes. In the context of this standardization project, a series of draft technical specification were designed upon an extensive desk study, fine-tuned after expert consultations and finally validated in international intercomparisons exercise.

This report summarises the work performed within the validation study of the draft standard for the determination of specific electrical conductivity (EC) in soils, sludge and treated bio-waste using conductometric method. It further explains the underlying statistical concept for the calculation of reproducibility and repeatability from intercomparisons data. In addition all single values, results of the statistical evaluation as well as background information on the validation materials used are described and explained.

Abbreviations

Throughout this report the following abbreviations are used:

ANOVA	Analysis of variances
CAS	Chemical Abstracts System
CEN	Comitteé Européen de Normalisation
DG	Directorate General
EC	Electrical conductivity
ECN	Energy Research Centre for the Netherlands
EU	European Union
IES	Institute for Environment and Sustainability
IT	Information Technology
ISO	International Organization for Standardisation
JRC	Joint Research Centre
MILC	Measure Interlaboratory Comparison
p	Number of labs
r	Repeatability limit
R	Reproducibility limit
s_r	Repeatability standard deviation
s_R	Reproducibility standard deviation
TC	Technical Committee

Table of Contents

Introduction to the validation project

Project HORIZONTAL is interdisciplinary aiming at a harmonisation and horizontal standardisation of test procedures, in particular for sludge, soils and biowastes. It was created as in response to the European Commission Mandate M 330 given to CEN, asking for the development and validation of those standards in support of forthcoming EU Directives, such as:

- The revision of the Sewage Sludge Directive 86/278/EEC.
- The Directive on the biological treatment of biodegradable waste.
- The initiative on a legal framework for soil monitoring in Europe.

This mandate explicitly considers standards for the entire analytical procedure (i.e., sampling, pre-treatment and analytical measurement methods for inorganic, organic, hygiene and biological parameters). These are grouped into classes according to their physical/chemical properties, which in turn determine the methods needed to quantify the potential impact on human and animal health, plant uptake, soil function and groundwater quality. As the materials generally feature a mixture of different types of contaminants, it is important to provide an integrated answer covering evaluation of all relevant pollutants.

In order to fulfil the requirements of the aforementioned mandate, the European Commissions Joint Research Centre (JRC) and its Directorate-General for Environment (DG ENV) together with the Technical Committees of the European Standardisation Committee (CEN TCs) concerned designed a pre-normative research initiative called Project HORIZONTAL and presented it to the Commission and the Environmental Authorities in the Member States.

After an extensive literature research and careful evaluation of the feasibility of a given horizontal standard, the standards were drafted and finally validated in a European laboratory intercomparison[1].

The underlying statistical concept, information about the materials used, details about the participants, measurement results obtained as well as the derived performance characteristics obtained for the determination of electrical conductivity (EC) are described hereafter.

[1] The desk study regarding evaluation of measurements of specific electrical conductivity included only literature research. Thus no experimental evaluation was undertaken before the standard was drafted.

1.1 Statistical concept underlying the validation

According to the requirements of the work package concerning data handling & interpretation of the project HORIZONTAL-ORG the respective validation intercomparisons have to be evaluated according to the principles laid down in ISO standard 5725-2:1994. In particular repeatability and reproducibility of the draft standard methods have to be determined. The determination of trueness would require the availability of independent reference values for the materials investigated. This, however, is not possible and was not requested in the frame of this work. In the following, the approach chosen is explained.

1.1.1 Introduction to the statistical model

The statistical model used in ISO 5725 for estimation of accuracy of a measurement method assumes that every test result is the sum of three components:

$$y = m + B + e$$

y: test result

m: general mean

B: laboratory component of bias under repeatability conditions

e: random error occurring in every measurement under repeatability conditions

In the workprogram the quantification of term *e* is explicitly asked for (i.e. repeatability and reproducibility). The repeatability variance is measured directly as the variance of the error term *e*, but the reproducibility depends on the sum of the repeatability variance and the between-laboratory variance:

$$\sigma_r = \sqrt{\mathrm{var}(e)}$$

$$\sigma_R = \sqrt{\sigma_L^2 + \sigma_r^2} \qquad \text{with} \qquad \sigma_L = \sqrt{\mathrm{var}(B)}$$

However, soil, biowaste and sludge are multi-phase materials, i.e. they contain two or more distinct types of particles which are fundamentally different in their properties and composition. As a consequence, this introduces an important source of variation for the intercomparison exercise which needs to be considered, i.e. the inherent heterogeneity of the materials.

Thus, a contribution of variation between samples *H* is introduced to the general statistical model:

$$y = m + B + e + H$$

Using ANOVA techniques the different variances are calculated and separated for the evaluation.

1.1.2 Requirements for precision experiment

Layout of the experiment

A suite of 10 to 12 different materials (soil, sludge and biowaste) has been made available for the intercomparison exercise. For each parameter investigated, at least 10 to laboratories should be nominated to participate. The same laboratories should be used for different parameters as far as possible. Due to the complexity of analysis and the respective workload to the laboratories, it was decided to propose three materials for the validation of the EC draft standard.

Each laboratory received two bottles of each material and was be requested to perform 6 independent analyses per material[2] (3 per bottle) using the respective draft standard methods. The 6 analyses per material should be carried out under repeatability conditions (i.e. same operator[3], same equipment, within a short period of time). As far as possible, also the different materials should be measured under repeatability conditions; however, changes of e.g. operator or equipment are permitted, but must be reported. Likewise, different materials can be analysed on different days if necessary.

Equipment used in the experiment needed to be checked prior to the experiment according to the requirements of the draft standard. The results of these checks have to be documented. Similarly, date and time of each measurement had to be recorded for verification of repeatability conditions.

An appropriate timeframe for the entire exercise has been set and was to be respected.

Recruitment of the laboratories

Each sub-workpackage leader of HORIZONTAL was asked to select the laboratories using the information from section 5.2 of ISO 5725-2:1994 and provide the signed questionnaires (see also Annex 1). The workpackage leaders were responsible for providing the laboratories with the draft standard method and explaining the context of this exercise.

Preparation and use of the materials

Materials used for the exercise were prepared according to the general requirements for reference materials as laid down in ISO Guide 34. Materials were accompanied by instructions for use.

Reporting of results

Online submissions of results using an internet-based IT platform as well as XLS-Spreadsheets were used. In case of online data submission, the participating laboratories received a unique and confidential login and password in due time, enabling them to

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[2] Independent analysis means analysis of independent test portions, applying the entire analytical scheme to this test portion, from e.g. extraction to quantification. For instance it does not mean replicate injections of aliquots into a GC-MS instrument.

[3] Operator in this context may also consist of a fixed team of persons, e.g. one person performing extraction, one clean-up, one quantification.

enter their data in a structured form. For authentication purposes a signed printout had to be submitted by mail.

The online data submission included a detailed questionnaire for additional information on the measurements.

1.1.3 Statistical analysis

Statistical analysis of data followed the requirements of ISO 5725-2:1994 and ISO 5725-5:1998. Appropriate tests for the homogeneity of variance, detection of outliers and normal distribution were applied. Statistical evaluation was done using an Excel Macro, developed, tested and successfully applied in other occasion by ECN. Evaluation was executed jointly by JRC and ECN.

1.2 Validation exercise for electrical conductivity

1.2.1 Samples dispatched for the validation of electrical conductivity

After a preliminary rough screening, the following materials were used for the validation round of EC.

- Compost 1 — A pollutant loaded compost material from Vienna
- Compost 2 — A pollutant loaded compost materia from Germany
- Sewage Sludge 1 — A mixed sewage sludge from Essen, Germany
- Sewage Sludge 2 — A mixed municipal WWTP sludge from North Rhine Westphalia, Germany
- Soil 4 — A sludge amended soil from Hohenheim, Germany
- Soil 5 — An agricultural soil from Reading, UK

A more detailed description of background concentrations can be found in Annex 2 to this report. The samples were dispatched simultaneously to all participants using a private courier service.

1.2.2 Draft standards to be followed

The draft standards to be followed could be downloaded following this link, which is situated on the website of the Project HORIZONTAL:

http://www.ecn.nl/docs/society/horizontal/EC_standard_for_validation.pdf

1.2.3 Analytical program

Of each of the six materials 2 bottles had to be analyzed and each bottle had to analyze independently three times. As mentioned above analyses were to be done under repeatability conditions. Results were to be reported referring to DRY MATTER content. The choice, how to apply d.m. correction was free for each participant.

1.2.4 Timing and Submission of data

Dispatch of samples was done on the 18th of October 2006. For users of the Online data submission system (MILC), User Registration was possible from 14th of November 2006 with opening of the MILC Data Submission on 1st of December 2006. The deadline for submission of results has been set for EC to the 31st of January 2007. After that no further submission was possible.

Alternatively the participants were allowed to submit data electronically as Excel sheet using simply Email.

All data were treated in a confidential way. Any presentation hereafter will refer only to numerical data and it will not be possible to identify the originating laboratory. Lab Codes displayed are NOT related to the order of laboratories hereafter.

In addition to the information provide a Helpdesk was implemented in order to give quick and individual response to the participants during and immediately after the validation study. In case of doubt and suspected transcription errors, further enquires were conducted by JRC.

1.2.5 Participants

The following table lists the participating organizations and entities in the validation exercise for the horizontal EC standard;

- Austria
  - barbara - Engineering, Consulting, Research & Service GmbH
  - Amt der Steirmärkischen Landesregierung
  - Magistrat der Stadt Wien
  - NUA Umweltanalytik GmbH
  - Universität für Bodenkultur Wien
  - University of Natural resources and Applied Life Science
- Belgium
  - VITO
- Finland
  - Finnish Food safety Authority Evira
  - VTT
- France
  - SAS Laboratoire
- Germany
  - Umweltbundesamt
  - Fachhochschule Weihenstephan, Forschungsanstalt für Gartenbau
  - Biolab Umweltanalysen GmbH
- Italy
  - C.R.A. - Istituto Sperimentale per la Nutrizione delle Piante
- Sweden
  - ALCONTROL AB
- The Netherlands
  - ALCONTROL BV
  - Analytico Milieu B. V.

1.3 Summary results and derived performance characteristics

The result of the various statistical evaluation including outlier tests, calculation of repeatability and reproducibility standard deviation for the congeners of interest can be found in Annex 3 of this report. In addition, all data submitted by the participants as well as those considered for the calculation of the performance characteristics are listed in Annex 3 to this report.

Based on these calculations the following results were obtained in the validation round upon statistical evaluation according to ISO 5725-2. The average values, the repeatability standard deviation (s_r) and the reproducibility standard deviation (s_R) were obtained (Table1).

The repeatability is determined as an interval around a measurement result (i.e. "repeatability limit"). This interval corresponds to the maximum difference that can be expected (with a 95% statistical confidence) between one test result and another, both test results being obtained under the following conditions: The tests are performed in accordance with all the requirements of the present standard by the same laboratory using its own facilities and testing laboratory samples obtained from the same primary field sample and prepared under identical procedures. The repeatability limit was calculated using the relationship: $r_{test} = f \cdot \sqrt{2} \cdot s_{r,test}$ with the critical range factor f = 2.

The reproducibility, like repeatability is also determined as an interval around a measurement result (i.e. "reproducibility limit"). This interval corresponds to the maximum difference that can be expected (with a 95% statistical confidence) between one test result and another test result obtained by another laboratory, both test results being obtained under the following conditions : The tests are performed in accordance with all the requirements of the present standard by two different laboratories using their own facilities and testing laboratory samples obtained from the same primary field sample and prepared under identical procedures. The reproducibility limit was calculated using the relationship: $R = f \cdot \sqrt{2} \cdot s_R$ with the critical range factor f = 2.

Table 1 - Results of the interlaboratory comparison studies of the determination of specific electrical conductivity (EC) in treated biowaste, sludge and soil. All concentrations are expressed in mS/m at 20 deg.

Matrix	*Parameter*	*Mean*	*sr*	*sR*	*r*	*R*	*p*	*Outliers*	*Total number of data*	Number of data reported below detection
Sludge 1	EC	377	1.43%	28.50%	15.1	301	14	2	66	0
Sludge 2	EC	436	1.84%	32.97%	22.4	402	15	1	67	0
Compost 1	EC	277	1.79%	25.66%	13.9	199	14	2	68	0
Compost 2	EC	235	2.71%	36.24%	17.8	238	16	0	78	0
Soil 4	EC	10.3	4.30%	17.81%	1.24	5.12	14	2	62	0
Soil 5	EC	10.3	6.00%	16.15%	1.72	4.64	13	2	58	0

Abbreviations: sr Repeatability standard deviation; SR Reproducibility standard deviation; r Repeatability limit (comparing two measurements); R Reproducibility limit (comparing two measurements); p Number of labs.

1.4 Annexes

Annex 1: Model questionnaire to be filled by the participating laboratories

Annex 2: Report on the validation materials used

Annex 3: Statistical calculations

Annex 4: Data submitted

Annex 1:

Model questionnaire to be filled by the participating laboratories

Model questionnaire to be filled by the participating laboratories

Name of laboratory:
Contact person:
Contact details: email:
Phone:
Fax:
Mail address of lab:

Dispatch address of lab for shipment of samples (no PO boxes!):

Title of measurement method (copy attached):

Our laboratory is willing to participate in the precision experiment for this draft standard method.

Yes ☐ No ☐

As participant we understand that:

- All essential apparatus, chemicals and other requirements specified in the method must be available in our laboratory when the programme begins
- Specified timing requirements such as starting and finishing date of the programme must be rigidly met
- The method must be strictly adhered to
- Samples must be handled in accordance with instructions
- A qualified operator must perform the measurements

Having studied the method and having made a fair appraisal of our capabilities and facilities, we feel that we will be adequately prepared for cooperative testing of this method.

Comments:

……………………………………………………………………………….
Signature Date

Annex 2:

Report on the validation materials used

Abstract

This report gives an overview on the available analytical information on the following raw materials to be used for the production of validation materials of the so-called Project HORIZONTAL:

- Four sludge materials from Düsseldorf, Germany,
- An agricultural soil material from Reading, United Kingdom;
- A compost material from Vienna, Austria;
- A compost material from Korschenbroich, Germany;
- A sludge-amended, agricultural soil from Pavia Province, Italy;
- A sludge-amended soil from Barcelona, Spain
- A sludge-amended soil from Essen, Germany
- A long-term sludge exposed soil from Hohenheim, Germany

List of Abbreviations

Throughout this report the following abbreviations are used.

AOX	absorbable organic halogens
C_{org}	organic carbon content
C_{total}	total carbon content
CAT	cation exchangeable
CDD	chlorinated dibenzodioxin
CDF	chlorinated dibenzofuran
DEHP	di(2-ethylhexyl)phthalate
DM	dry matter
EPA	Environment Protection Agency
EU	European Union
FM	fresh matter
Hp	hepta
Hx	hexa
IES	Institute for Environment and Sustainability
IRMM	Institute for Reference Materials and Measurements
JRC	Joint Research Centre
LAS	linear alkylsulfonates
LoD	limit of detection
LUA	Landesumweltamt
N_{total}	total nitrogen content
NH_4-N	Ammonium nitrogen
NO_3-N	Nitrate nitrogen
NP	nonylphenol
NRW	North Rhine Westphalia
O	octa
P	poly
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
Pe	penta
T	tetra
TEQ	toxicity equivalent
UBA	Umweltbundesamt
WHO	World Health Organization
WWTP	waste water treatment plant

1 Introduction

This report gives an overview on the available analytical information on the following raw materials to be used for the production of validation materials of the so-called Project HORIZONTAL:

- Four sludge materials from Düsseldorf, Germany,
- An agricultural soil material from Reading, United Kingdom;
- A compost material from Vienna, Austria;
- A compost material from Korschenbroich, Germany;
- A sludge-amended, agricultural soil from Pavia Province, Italy;
- A sludge-amended soil from Barcelona, Spain
- A sludge-amended soil from Essen, Germany
- A long-term sludge exposed soil from Hohenheim, Germany

The following analytical information was gathered partly before and during the sampling of the raw materials, to be used for the production of the HORIZONTAL validation materials. The material were sampled by IES and shipped to IRMM in the course of the year 2005. The information gathered was then completed by various analytical screenings for PAHs and PCBs done by the Institute for Reference Materials and Measurements, Geel, Belgium, for phthalates done by UBA, Berlin, Germany, for PBDE done by IIQAB-CSIC, Barcelona, Spain, for trace elements and some selected major and minor elements by the Institute for Environment and Sustainability, Ispra, Italy.

The work compiled hereafter is based on the numerous additional efforts of the scientists working at various members of the consortium Project HORIZONTAL-Org and contributing organisations.

This work is gratefully acknowledged.

2 Overview on property values

2.1 Sludge materials from Düsseldorf, Germany

The various sewage sludge materials originate from various installations in the North Rhine Westphalia and were produced and sampled by staff from the Landesumweltamt (LUA) NRW under the responsibility from Dr. K. Furtmann.

In total, four sludge materials (Sludge A and D from a major municipal WWTP, Sludge B from a municipal WWTP with industrial input, and Sludge C from a municipal WWTP with high PCB-Content,) were obtained and will be blended to two final materials. Before sampling the following analytical data for a typical sample were received.

Table 1 – Analytical data obtained on an average sludge sample in LUA NRW (with courtesy of K. Furtmann, LUA, Düsseldorf)

Parameter	*Concentration*
PCB	120 ug/kg
DEHP	110 mg/kg
PAH	5 mg/kg (EPA)
PCDD/F	15 ng TE/kg
PBDE	400 ug/kg
NP	40 mg/kg
LAS	3 g/kg
AOX	300 mg/kg

Subsequent screening led to the information displayed hereafter. It should be stressed that the data were obtained as SCREENING information on the UNTREATED or partially treated raw materials. Therefore, the final target values, which are relevant for the validation intercomparison can be different.

Table 2 – Analytical data obtained on a first screening on the sludge samples from LUA NRW

	Sewage sludge A Dusseldorf	*sewage sludge D Dusseldorf*
PCB (ng/g)		
28	62	35
52	101	65
101	31	38
118	49	40
153	30	33
105	24	11
138	46	38
156	<1	<1
180	34	23
170	23	19
PAH (ng/g)		
Naphtalene	34	381
Acenaphtylene	15	43
Acenaphthene	81	108
Fluorene	94	1167
Phenantrene		3440
Anthracene	22	344
Flouranthene	316	4817
Pyrene	235	3011
Benz(a)anthracene	473	791
Chrysene	691	1078
Benz(b)fluoranthene	538	1688
Benz(k)fluoranthene	228	635
Benz(a)pyrene	383	1114
Indeno(1,2,3-c,d)pyrene	92	229
Dibenzo(a,h)anthracene	71	70
Benzo(g,h,i)perylene	80	185

Table 3 – Data on phthalate contents (with courtesy of S. Heise, UBA, Germany)

	DiBP	*DBP*	*DCHP*	*DEHP*	*Water*
	µg/g dm	µg/g dm	µg/g dm	µg/g dm	Wgt. %
Sludge D (1)		0.135		41.474	3.85
Sludge B (2)	0.538	0.034		30.634	5.47
Sludge A (3)	0.184	0.037		31.399	1.46
Sludge C (4)		0.354	1.528	6.678	2.29

Table 4 – Data on PDBE contents (with courtesy of D. Barceló and co-workers, IIQAB-CSIC, Barcelona, Spain)

	Sludge 2 (B)
Tetra-BDE-47	55.4
Penta-BDE-100	9.59
Penta-BDE-99	69.4
Hexa-BDE-154	5.91
Hexa-BDE-153	7.72
Hepta-BDE-183	5.09
Octa-BDE-196	nq
Octa-BDE-197	nq
Octa-BDE-203	9.70
Deca-BDE-209	2216
TOTAL	2379

Table 5 – Screening data on some selected trace elements by ICP-AES after micro-wave assisted digestion using aqua regia (with courtesy of F. Sena, IES, Ispra, Spain). Note that these data are based on single measurements!

	Cd	***Co***	***Cr***	***Cu***	***Mn***	***Ni***	***Pb***	***Sb***	***Tl***	***V***	***Zn***
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Sludge 1 (D)	2.65	29.0	53.3	359	1231	33.8	78.4	4.38	< 0.05	23.2	786
Sludge 2 (B)	1.19	31.1	62.6	202	278	29.9	72.2	2.51	< 0.05	11.8	625
Sludge 3 (A)	1.68	36.0	62.1	332	847	41.6	119	4.51	< 0.05	11.6	1237
Sludge 4 (C)	5.63	19.8	116	273	726	51.1	473	6.18	< 0.05	44.4	2015

Table 6 – Screening data on some selected matrix constituents and elements by WDXRF (with courtesy of S. Vaccaro).

Sample	***SiO2 (%)***	***Al2O3 (%)***	***CaO (%)***	***K2O (%)***	***Fe2O3 (%)***	***MgO (%)***	***TiO2 (PPM)***	***S (PPM)***	***P2O5 (PPM)***
Sludge 1 (D)	21.54	5.8	8.44	0.99	10.3	1.01	4367	<15	50448
Sludge 2 (B)	10.67	3.66	6.92	0.46	14.91	0.77	5217	<15	57633
Sludge 3 (A)	7.31	6.63	6.84	0.35	12.87	0.68	3733	<15	60369
Sludge 4 (C)	43.79	9.65	5.27	1.63	5.22	1.07	5628	<15	23945

Sample	***Na2O (%)***	***Cl (PPM)***	***Pb (PPM)***	***Zn (PPM)***	***Cu (PPM)***	***Ni (PPM)***	***Mn (PPM)***	***Cr (PPM)***
Sludge 1 (D)	0.3	2403	101	1002	350	15	1944	132
Sludge 2 (B)	0.31	315	97	879	172	12	514	180
Sludge 3 (A)	0.31	1281	153	1567	265	16	1440	168
Sludge 4 (C)	0.55	231	628	2625	371	81	1101	244

2.2 Agricultural soil material from Reading, United Kingdom

The material was proposed by the University of Reading (S. Nortcliff) and was sampled from a site called "*Frogmore Farm*" which was featured in the "*Metals*" Report for HORIZONTAL. This site is close to Reading with soils developed on flintyloamy periglacial materials over Chalk, has a long and well documented history of sludge application. The focus of the work of Nortcliff *et al.* undertook at this site and the monitoring and control at the site (by Thames Water and the subsequent subsidiary bodies dealing with sludge application to soil) was on metals (and metal loads), with no analysis or indeed any form of investigation in to organics in the broadest sense.

The analytical information produced in the context of the screening of the raw material is displayed below.

Table 7 – Data on phthalate contents (with courtesy of S. Heise, UBA, Germany)

	DiBP	*DBP*	*DCHP*	*DEHP*	*Water*
	µg/g dm	µg/g dm	µg/g dm	µg/g dm	Wgt. %
Soil 3 (Reading)		0.032		0.119	6.69

Table 8 – Screening data on some selected trace elements by ICP-AES after micro-wave assisted digestion using aqua regia (with courtesy of F. Sena). Note that these data are based on single measurements!

	Cd	***Co***	***Cr***	***Cu***	***Mn***	***Ni***	***Pb***	***Sb***	***Tl***	***V***	***Zn***
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Soil 3 (Reading)	0.15	7.06	27.9	13.8	152	9.01	26.7	3.00	< 0.05	25.8	93.1

Table 9 – Analytical data obtained on a first screening on the sludge-amended soil from Reading (courtesy of IRMM)

Parameter	*Concentration*
PCB	**ng/g**
28	<1
52	<1
101	<1
118	<1
153	<1
105	<1
138	<1
156	<1
180	<1
170	<1
PAH	**ng/g**
Naphtalene	<10
Acenaphtylene	21
Acenaphthene	<10
Fluorene	<10
Phenantrene	<10
Anthracene	<10
Flouranthene	818
Pyrene	776
Benz(a)anthracene	565

Parameter	*Concentration*
Chrysene	608
Benz(b)fluoranthene	824
Benz(k)fluoranthene	329
Benz(a)pyrene	799
Indeno(1,2,3-c,d)pyrene	779
Dibenzo(a,h)anthracene	118
Benzo(g,h,i)perylene	394

Table 10 – Data on PDBE contents (with courtesy of D. Barceló and co-workers, IIQAB-CSIC, Barcelona, Spain)

	Soil 3 (Reading)
Tetra-BDE-47	nq
Penta-BDE-100	nq
Penta-BDE-99	1.03
Hexa-BDE-154	0.03
Hexa-BDE-153	nq
Hepta-BDE-183	nq
Octa-BDE-196	nq
Octa-BDE-197	nd
Octa-BDE-203	nd
Deca-BDE-209	272
TOTAL	273

Table 11 – Screening data on some selected trace elements by ICP-AES after micro-wave assisted digestion using aqua regia (with courtesy of F. Sena). Note that these data are based on single measurements!

	Cd	***Co***	***Cr***	***Cu***	***Mn***	***Ni***	***Pb***	***Sb***	***Tl***	***V***	***Zn***
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Soil 3 (Reading)	0.15	7.06	27.9	13.8	152	9.01	26.7	3.00	< 0.05	25.8	93.1

Table 12 – Screening data on some selected matrix constituents and elements by WDXRF (with courtesy of S. Vaccaro).

Sample	***SiO2 (%)***	***Al2O3 (%)***	***CaO (%)***	***K2O (%)***	***Fe2O3 (%)***	***MgO (%)***	***TiO2 (PPM)***	***S (PPM)***	***P2O5 (PPM)***
Soil 3 (Reading)	79.36	4.77	1.12	0.96	1.94	0.17	4107	443	2102

Sample	***Na2O (%)***	***Cl (PPM)***	***Pb (PPM)***	***Zn (PPM)***	***Cu (PPM)***	***Ni (PPM)***	***Mn (PPM)***	***Cr (PPM)***
Soil 3 (Reading)	0.42	13	45	69	69	69	216	92

Table 13 – Screening data on mercury by solid-sampling cold-vapour AAS using amalgamation enrichment (with courtesy of G. Locoro).

Sample	***Hg** µg/g*
Soil 3 (Reading)	0.12

2.3 Compost from Vienna, Austria

The fresh compost material was obtained from the Austrian Federal Environment Agency (UBA, Vienna), which had used a sub-batch of the raw material for national intercomparson. The remainder of the material was stored at 4°C until shipment to IRMM for further processing. The following analytical information was provided by UBA Austria and completed with various screenings.

Table 14 – Analytical data on compost material received from UBA Austria Inorganic and sum parameters

Parameter	*Unit*	*Sample fraction used*	*Observed mean*
B CAT	mg/l F.M.	Fresh sample, <10mm	6.1
K CAT	mg/l F.M.	Fresh sample, <10mm	2624
Mg CAT	mg/l F.M.	Fresh sample, <10mm	242
P CAT	mg/l F.M.	Fresh sample, <10mm	49
B CAT	% D.M.	Fresh sample, <10mm	0.0017
K CAT	% D.M.	Fresh sample, <10mm	0.72
Mg CAT	% D.M.	Fresh sample, <10mm	0.07
P CAT	% D.M.	Fresh sample, <10mm	0.01
NO3-N	mg/kg F.M.	Fresh sample, <10mm	3.5
NH4-N	mg/kg F.M.	Fresh sample, <10mm	230
Ctotal	% D.M.	<45°dry, milled	29
Corg	% D.M.	<45°dry, milled	27
Ntotal	% D.M.	<45°dry, milled	1.7
P	mg/kg D.M.	<45°dry, milled	2596
K	mg/kg D.M.	<45°dry, milled	11019
K	% D.M.	<45°dry, milled	1.10
B	mg/kg D.M.	<45°dry, milled	60
Cd	mg/kg D.M.	<45°dry, milled	0.46
Cr	mg/kg D.M.	<45°dry, milled	25
Cu	mg/kg D.M.	<45°dry, milled	46
Hg	mg/kg D.M.	<45°dry, milled	0.20
Ni	mg/kg D.M.	<45°dry, milled	18
Pb	mg/kg D.M.	<45°dry, milled	45
Zn	mg/kg D.M.	<45°dry, milled	198
Ca	mg/kg D.M.	<45°dry, milled	68776
Ca	% D.M.	<45°dry, milled	6.9
Mo	mg/kg D.M.	<45°dry, milled	0.8
S	mg/kg D.M.	<45°dry, milled	2137
Fe	mg/kg D.M.	<45°dry, milled	9959
Mn	mg/kg D.M.	<45°dry, milled	418
Na	mg/kg D.M.	<45°dry, milled	742
Co	mg/kg D.M.	<45°dry, milled	4.1
AOX	mg/kg D.M.	<30° dry, milled	62

Table 15 – Analytical data on compost material received from UBA Austria Polycyclic aromatic hydrocarbons

PAH	*Unit*	*Result*
Naphthaline	µg/kg DM	9.3
Acenaphthylene	µg/kg DM	8.6
Acenaphthene	µg/kg DM	5
Fluorene	µg/kg DM	8.0
Phenanthrene	µg/kg DM	89
Anthracene	µg/kg DM	27
Fluoranthene	µg/kg DM	487
Pyrene	µg/kg DM	380

PAH	*Unit*	*Result*
Benzo(a)anthracene	µg/kg DM	278
Chrysene	µg/kg DM	317
Benzo(b)fluoranthene	µg/kg DM	365
Benzo(k)fluoranthene	µg/kg DM	193
Benz(a)pyrene	µg/kg DM	320
Indeno(1,2,3-c,d)pyrene	µg/kg DM	233
Dibenz(a,h)anthracene	µg/kg DM	67
Benzo(g,h,i)perylene	µg/kg DM	225
Sum EPA	µg/kg DM	3013
Sum EPA	mg/kg DM	3.0

Table 16 – Analytical data on compost material received from UBA Austria Sum PCDDs and PCBs

Parameter			
Dioxine	TEQ (ITEF)	ng/kg DM	7.3
PCB	TEQ (WHO)	ng/kg DM	3.5
	Σ Ballschmiter	mg/kg DM	0.05

Table 17 – Analytical data on compost material obtained by screening in IRMM

Parameter	*Result in ng/g*
PCB	
28	2
52	2
101	4
118	3
153	10
105	1
138	8
156	1
180	5
170	<1
PAH	
Naphtalene	<10
Acenaphtylene	<10
Acenaphthene	<10
Fluorene	<10
Phenantrene	<10
Anthracene	26
Fluoranthene	611
Pyrene	510
Benz(a)anthracene	888
Chrysene	957
Benz(b)fluoranthene	1531
Benz(k)fluoranthene	547
Benz(a)pyrene	1101
Indeno(1,2,3-c,d)pyrene	416
Dibenzo(a,h)anthracene	81
Benzo(g,h,i)perylene	295

Table 18 – Data on PDBE contents (with courtesy of D. Barceló and co-workers, IIQAB-CSIC, Barcelona, Spain)

	Compost 1 (Vienna)
Tetra-BDE-47	4.02
Penta-BDE-100	0.19
Penta-BDE-99	2.59
Hexa-BDE-154	nq
Hexa-BDE-153	0.23
Hepta-BDE-183	0.04
Octa-BDE-196	nq
Octa-BDE-197	nq
Octa-BDE-203	1.44
Deca-BDE-209	17.4
TOTAL	25.9

Table 19 – Data on phthalate contents (with courtesy of S. Heise, UBA, Germany)

	DiBP	*DBP*	*DCHP*	*DEHP*	*Water*
	µg/g dm	µg/g dm	µg/g dm	µg/g dm	Wgt. %
Compost 1 (Vienna)		0.058		1.426	5.57

Table 20 – Screening data on some selected trace elements by ICP-AES after micro-wave assisted digestion using aqua regia (with courtesy of F. Sena). Note that these data are based on single measurements!

	Cd	***Co***	***Cr***	***Cu***	***Mn***	***Ni***	***Pb***	***Sb***	***Tl***	***V***	***Zn***
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Compost 1 (Vienna)	0.39	7.36	31.9	41.0	365	12.7	49.5	0.04	0.79	0.13	208

Table 21 – Screening data on some selected matrix constituents and elements by WDXRF (with courtesy of S. Vaccaro).

Sample	***SiO2 (%)***	***Al2O3 (%)***	***CaO (%)***	***K2O (%)***	***Fe2O3 (%)***	***MgO (%)***	***TiO2 (PPM)***	***S (PPM)***	***P2O5 (PPM)***
Compost 1 (Vienna)	20.63	4.31	6.17	4.26	1.99	2.49	1602	<15	10521

Sample	***Na2O (%)***	***Cl (PPM)***	***Pb (PPM)***	***Zn (PPM)***	***Cu (PPM)***	***Ni (PPM)***	***Mn (PPM)***	***Cr (PPM)***
Compost 1 (Vienna)	0.35	3496	81	375	79	55	653	60

Table 22 – Screening data on mercury by solid-sampling cold-vapour AAS using amalgamation enrichment (with courtesy of G. Locoro).

Sample	***Hg*** *µg/g*
Compost 1 (Vienna)	0.17

2.4 Agricultural soil, sludge amended soil from Pavia, Italy

This sludge-amended soil material was obtained during a monitoring campaign, which aimed at a generic description of the over-all soil quality in Pavia Province, Italy. The material, which was collected from the upper horizon, originates from a small farm called "*Cascina Novello*". During the characterisation of the site, the following analytical information was obtained on a pooled sample of a sub-area of the farm of 20 X 20 m^2.

Table 23 – Analytical data on Pavia soil

Parameter	*Result*
Al	7.13 Wgt%
As	22.4 mg/kg
Cd	0.79 mg/kg
Cr	59 mg/kg
Cu	30.8 mg/kg
Hg	0.08 mg/kg
Ni	34.4 mg/kg
Pb	24.6 mg/kg
Zn	95 mg/kg
C	0.91 Wgt %
2,3,7,8-TCDD	0.047 pg/g
1,2,3,7,8-PeCDD	0.15 pg/g
1,2,3,4,7,8-HxCDD	0.19 pg/g
1,2,3,6,7,8-HxCDD	1.5 pg/g
1,2,3,7,8,9-HxCDD	0.74 pg/g
1,2,3,4,6,7,8-HpCDD	26 pg/g
OCDD	382 pg/g
2,3,7,8-TCDF	0.68 pg/g
1,2,3,7,8-PeCDF	0.53 pg/g
2,3,4,7,8-PeCDF	0.71 pg/g
1,2,3,4,7,8-HxDF	1.00 pg/g
1,2,3,6,7,8-HxDF	0.66 pg/g
2,3,4,6,7,8-HxDF	1.6 pg/g
1,2,3,7,8,9-HxDF	0.27 pg/g
1,2,3,4,6,7,8-HpDF	12 pg/g
1,2,3,4,7,8,9-HpDF	0.68 pg/g
OCDF	33 pg/g
I-TEQ	2.0 pg/g
WHO-TEQ	1.7 pg/g

In addition, the screening performed at IRMM did not reveal significant quantities of PCBs and PAHs, which were all below the LoDs (1 ng/g for PCBs and 10 ng/g for PAHs, respectively).

Table 24 – Data on phthalate contents (with courtesy of S. Heise, UBA, Germany)

	DiBP	*DBP*	*DCHP*	*DEHP*	*Water*
	µg/g TM	µg/g TM	µg/g TM	µg/g TM	Wgt. %
Soil 5 (Pavia)		0.005		0.011	1.54

Table 25 – Data on PDBE contents (with courtesy of D. Barceló and co-workers, IIQAB-CSIC, Barcelona, Spain)

	Soil 5 (Pavia)
Tetra-BDE-47	nq
Penta-BDE-100	nq
Penta-BDE-99	0.39
Hexa-BDE-154	nq
Hexa-BDE-153	nq
Hepta-BDE-183	0.08
Octa-BDE-196	nq
Octa-BDE-197	nd
Octa-BDE-203	nd
Deca-BDE-209	670
TOTAL	671

Table 26 – Screening data on some selected trace elements by ICP-AES after micro-wave assisted digestion using aqua regia (with courtesy of F. Sena). Note that these data are based on single measurements!

	Cd	***Co***	***Cr***	***Cu***	***Mn***	***Ni***	***Pb***	***Sb***	***Tl***	***V***	***Zn***
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Soil 5 (Pavia)	0.33	18.4	57.3	22.5	426	30.5	20.6	2.00	< 0.05	38.1	87.8

Table 27 – Screening data on some selected matrix constituents and elements by WDXRF (with courtesy of S. Vaccaro).

Sample	***SiO2 (%)***	***Al2O3 (%)***	***CaO (%)***	***K2O (%)***	***Fe2O3 (%)***	***MgO (%)***	***TiO2 (PPM)***	***S (PPM)***	***P2O5 (PPM)***
Soil 5 (Pavia)	69.39	12.9	1.45	2.24	4.25	1.16	6118	255	1789

Sample	***Na2O (%)***	***Cl (PPM)***	***Pb (PPM)***	***Zn (PPM)***	***Cu (PPM)***	***Ni (PPM)***	***Mn (PPM)***	***Cr (PPM)***
Soil 5 (Pavia)	1.84	62	38	108	55	66	597	110

Table 28 – Screening data on mercury by solid-sampling cold-vapour AAS using amalgamation enrichment (with courtesy of G. Locoro).

Sample	***Hg*** *µg/g*
Soil 5 (Pavia)	0.06

2.5 Sludge-amended-soil from Barcelona, Spain

The sludge-amended soil material from Barcelona sampled upon indication from the Barcelo'- Group in Barcelona.

Table 29 – Data on phthalate contents (with courtesy of S. Heise, UBA, Germany)

	DiBP	*DBP*	*DCHP*	*DEHP*	*Water*
	µg/g dm	µg/g dm	µg/g dm	µg/g dm	Wgt. %
Soil 2 (Lleida T.)		0.015		0.183	11.38

Table 30 – Data on PDBE contents (with courtesy of D. Barceló and co-workers, IIQAB-CSIC, Barcelona, Spain)

	Soil 2 (Lleida T.)
Tetra-BDE-47	nq
Penta-BDE-100	nq
Penta-BDE-99	1.59
Hexa-BDE-154	0.45
Hexa-BDE-153	nq
Hepta-BDE-183	0.48
Octa-BDE-196	1.60
Octa-BDE-197	nq
Octa-BDE-203	nq
Deca-BDE-209	1000
TOTAL	1004

Table 31 – Screening data on some selected trace elements by ICP-AES after micro-wave assisted digestion using aqua regia (with courtesy of F. Sena). Note that these data are based on single measurements!

	Cd	***Co***	***Cr***	***Cu***	***Mn***	***Ni***	***Pb***	***Sb***	***Tl***	***V***	***Zn***
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Soil 2 (Lleida T.)	0.59	14.1	32.7	53.6	405	18.6	18.4	2.24	< 0.05	31.8	111

Table 32 – Screening data on some selected matrix constituents and elements by WDXRF (with courtesy of S. Vaccaro).

Sample	***SiO2 (%)***	***Al2O3 (%)***	***CaO (%)***	***K2O (%)***	***Fe2O3 (%)***	***MgO (%)***	***TiO2 (PPM)***	***S (PPM)***	***P2O5 (PPM)***
Soil 2 (Lleida T.)	44.43	10.67	14.29	2.53	3.44	2.04	4116	780	3396

Sample	***Na2O (%)***	***Cl (PPM)***	***Pb (PPM)***	***Zn (PPM)***	***Cu (PPM)***	***Ni (PPM)***	***Mn (PPM)***	***Cr (PPM)***
Soil 2 (Lleida T.)	0.64	65	26	125	59	17	547	65

Table 33 – Screening data on mercury by solid-sampling cold-vapour AAS using amalgamation enrichment (with courtesy of G. Locoro).

Sample	***Hg*** *µg/g*
Soil 2 (Lleida T.)	0.10

2.6 Sludge amended soil from Essen, Germany

The German sludge-amended soil from Essen, which was provided as the three sludge materials by LUA NRW, did not feature significant concentrations of the PCB congeners 28, 52, 101, 118, 153, 105, 138, 156, 180, 170, but had detectable amounts of some PAHs.

Table 34 – Analytical screening data on the German sludge-amended soil.

Parameter	*Concentration (ng/g)*
Naphtalene	<10
Acenaphtylene	<10
Acenaphthene	<10
Fluorene	<10
Phenantrene	<10
Anthracene	<10
Fluoranthene	28
Pyrene	20
Benz(a)anthracene	24
Chrysene	47
Benz(b)fluoranthene	76
Benz(k)fluoranthene	20
Benz(a)pyrene	35
Indeno(1,2,3-c,d)pyrene	35
Dibenzo(a,h)anthracene	10
Benzo(g,h,i)perylene	26

Table 35 – Data on phthalate contents (with courtesy of S. Heise, UBA, Germany)

	DiBP	*DBP*	*DCHP*	*DEHP*	*Water*
	µg/g dm	µg/g dm	µg/g dm	µg/g dm	Wgt. %
Soil 4 (Essen)		0.011		0.302	0.55

Table 36 – Data on PDBE contents (with courtesy of D. Barceló and co-workers, IIQAB-CSIC, Barcelona, Spain)

	Soil 4 (Essen)
Tetra-BDE-47	nq
Penta-BDE-100	nq
Penta-BDE-99	nq
Hexa-BDE-154	nq
Hexa-BDE-153	nq
Hepta-BDE-183	nq
Octa-BDE-196	nq
Octa-BDE-197	nq
Octa-BDE-203	1.28
Deca-BDE-209	19.1
TOTAL	20.3

Table 37 – Screening data on some selected trace elements by ICP-AES after micro-wave assisted digestion using aqua regia (with courtesy of F. Sena). Note that these data are based on single measurements!

	Cd	Co	Cr	Cu	Mn	Ni	Pb	Sb	Tl	V	Zn
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Soil 4 (Essen)	0.52	5.45	26.1	8.05	320	4.03	27.3	2.73	< 0.05	29.5	78.1

Table 38 – Screening data on some selected matrix constituents and elements by WDXRF (with courtesy of S. Vaccaro).

Sample	SiO2 (%)	Al2O3 (%)	CaO (%)	K2O (%)	Fe2O3 (%)	MgO (%)	TiO2 (PPM)	S (PPM)	P2O5 (PPM)
Soil 4 (Essen)	79.47	4.42	0.85	0.6	0.86	0.07	2163	189	2019

Sample	Na2O (%)	Cl (PPM)	Pb (PPM)	Zn (PPM)	Cu (PPM)	Ni (PPM)	Mn (PPM)	Cr (PPM)
Soil 4 (Essen)	0.45	19	42	87	683	60	462	61

Table 39 – Screening data on mercury by solid-sampling cold-vapour AAS using amalgamation enrichment (with courtesy of G. Locoro).

Sample	Hg µg/g
Soil 4 (Essen)	0.04

2.7 Long-term sludge exposed soil from Hohenheim-Stuttgart, Germany

Similarly, an additional sludge exposed soil was sampled at the University of Hohenheim, Stuttgart, were a test soil was long-term exposed to elevated concentrations of sewage sludge.

Table 40 – Data on phthalate contents (with courtesy of S. Heise, UBA, Germany)

	DiBP	DBP	DCHP	DEHP	Water
	µg/g TM	µg/g TM	µg/g TM	µg/g TM	Wgt. %
Soil 1 (Stuttgart)		0.045		0.263	17.65

Table 41 – Data on PDBE contents (with courtesy of D. Barceló and co-workers, IIQAB-CSIC, Barcelona, Spain)

	Soil 1 (Stuttgart)
Tetra-BDE-47	nq
Penta-BDE-100	nq
Penta-BDE-99	2.30
Hexa-BDE-154	0.06
Hexa-BDE-153	0.04
Hepta-BDE-183	0.04
Octa-BDE-196	nq
Octa-BDE-197	nd
Octa-BDE-203	nd
Deca-BDE-209	498
TOTAL	500

Table 42 – Screening data on some selected trace elements by ICP-AES after micro-wave assisted digestion using aqua regia (with courtesy of F. Sena). Note that these data are based on single measurements!

	Cd	***Co***	***Cr***	***Cu***	***Mn***	***Ni***	***Pb***	***Sb***	***Tl***	***V***	***Zn***
	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Soil 1 (Stuttgart)	0.69	12.7	36.1	26.2	504	18.3	25.2	2.62	< 0.05	26.6	142

Table 43 – Screening data on some selected matrix constituents and elements by WDXRF (with courtesy of S. Vaccaro).

Sample	***SiO2 (%)***	***Al2O3 (%)***	***CaO (%)***	***K2O (%)***	***Fe2O3 (%)***	***MgO (%)***	***TiO2 (PPM)***	***S (PPM)***	***P2O5 (PPM)***
Soil 1 (Stuttgart)	71.94	10.06	1.33	1.86	3.66	0.88	7874	275	3571

Sample	***Na2O (%)***	***Cl (PPM)***	***Pb (PPM)***	***Zn (PPM)***	***Cu (PPM)***	***Ni (PPM)***	***Mn (PPM)***	***Cr (PPM)***
Soil 1 (Stuttgart)	1.23	50	47	212	85	69	991	129

Table 44 – Screening data on mercury by solid-sampling cold-vapour AAS using amalgamation enrichment (with courtesy of G. Locoro).

Sample	***Hg*** *µg/g*
Soil 1 (Stuttgart)	1.77

Annex 3:

Statistical calculations

Unit: mS/m at 20 deg

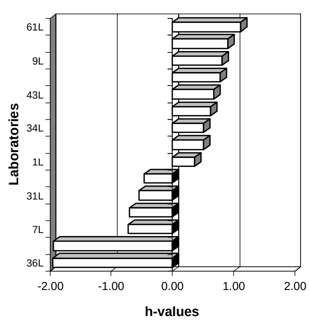
Mandel's k statistics (Compost 1 - EC)
Mandel's h statistics (Compost 1 - EC)

Compost 1 - EC -- Mean PARM = 237.2 [mS/m at 20 deg]

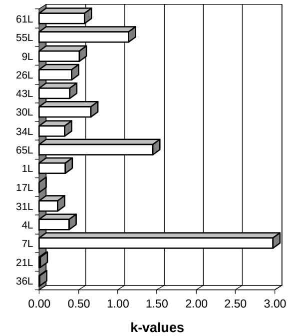
Sample: **Compost 1**

Element: **EC**

Mandel's h statistics (Compost 1 - EC)



Mandel's k statistics (Compost 1 - EC)



	General calc.parm.
T1=	1.59678E+04
T2=	4.90039E+06
T3=	64
T4=	348
T5=	6.4446E+02
n=	variabel
p=	13
N-table=	*5*

Mandel's statistics

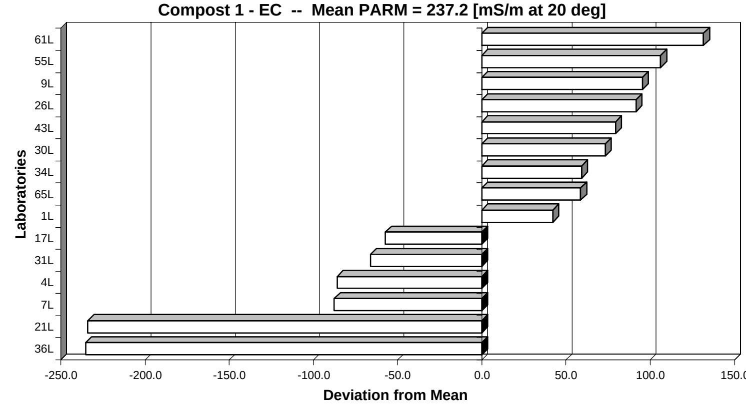
LAB	*PARM-gem*	*Stdev*	*N*	*h-mark*	*h*	*k*	*k-mark*	*\vX > AvST+2std*	*AvX < AvST-2std*
36L	1.8933	0.032	3	!	-1.96	0.00			Fail
21L	3.2517	0.087	6	!	-1.95	0.01			Fail
7L	149.5667	20.142	6		-0.72	2.97	!!		Fail
4L	151.3000	2.574	6		-0.70	0.38			Fail
31L	171.0000	1.581	5		-0.54	0.23			Fail
17L	180.0000	-	1		-0.46				Fail
1L	279.3667	2.250	3		0.37	0.33		Fail	
65L	295.8250	9.798	4		0.51	1.45		Fail	
34L	296.4667	2.203	6		0.51	0.33		Fail	
30L	310.5000	4.435	4		0.63	0.65		Fail	
43L	316.6500	2.660	6		0.68	0.39		Fail	
26L	328.8333	2.787	6		0.78	0.41		Fail	
9L	332.5000	3.450	6		0.81	0.51		Fail	
55L	343.3333	7.711	6		0.91	1.14		Fail	
61L	368.8333	3.920	6		1.12	0.58		Fail	
Tot.gem	235.288	4.545 mS/m at 20 deg		*1%-level:*	2.32	(1.76)			13
Tot.std=	119.296	5.209		*5%-level:*	1.86	(1.52)			2
									74

End Result:

LAB	*PARM*	*Stdev*	*Rej.labs*	*N*	*N-1*	*dev_mean*
36L	1.8933	0.0321		3	2	-235.33
21L	3.2517	0.0873		6	5	-233.97
7L	-	-	,7L -	-		-87.66
4L	151.3000	2.5745		6	5	-85.93
31L	171.0000	1.5811		5	4	-66.23
17L	180.0000	-		1		-57.23
1L	279.3667	2.2502		3	2	42.14
65L	-	-	,65L -	-		58.60
34L	296.4667	2.2033		6	5	59.24
30L	310.5000	4.4347		4	3	73.27
43L	316.6500	2.6599		6	5	79.42
26L	328.8333	2.7869		6	5	91.61
9L	332.5000	3.4496		6	5	95.27
55L	343.3333	7.7115		6	5	106.11
61L	368.8333	3.9200		6	5	131.61
	237.2253		(65L,7L)	13	12	

RESULTS:	**Mean =**	**237.22526** *nS/m at 20 deg*				
Repeatability variance	**S2r =**	12.63638				
Repeatability std.	**Sr =**	**3.55477**	-->	1.50%	**r =**	9.9534
Between lab variance	**S2L =**	15646.93160				
Reproducibility var.	**S2R =**	15659.56798				
Reproducibility std.	**SR =**	**125.13820**	-->	52.75%	**R =**	350.3869
Remarks:	**2 Labs rejected! (65L,7L)**					

Compost 1 - EC -- Mean PARM = 237.2 [mS/m at 20 deg]



Unit: mS/m at 20 deg

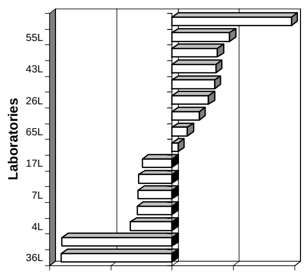
Mandel's k statistics (Compost 2 - EC)
Mandel's h statistics (Compost 2 - EC)

Compost 2 - EC -- Mean PARM = 206.8 [mS/m at 20 deg]

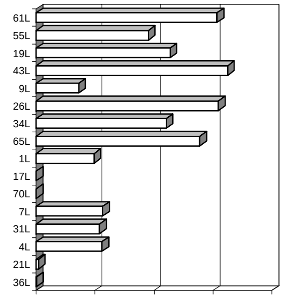
Sample: **Compost 2**

Element: **EC**

Mandel's h statistics (Compost 2 - EC)



Mandel's k statistics (Compost 2 - EC)



	General calc.parm.
T1=	1.72362E+04
T2=	4.78781E+06
T3=	78
T4=	432
T5=	1.9510E+03
n=	variabel
p=	16
N-table=	*5*

Mandel's statistics — End Result:

LAB	*PARM-gem*	*Stdev*	*N*	*h-mark*	*h*	*k*	*k-mark*	*\vX > AvST+2std*	*AvX < AvST-2std*	*PARM*	*Stdev*	*Rej.labs*	*N*	*N-1*	*dev_mean*
36L	1.6700	0.020	3		-1.81	0.00			Fail	1.6700	0.0200		3	2	-205.13
21L	2.9017	0.105	6		-1.80	0.02			Fail	2.9017	0.1050		6	5	-203.90
4L	129.5667	3.049	6		-0.68	0.56			Fail	129.5667	3.0487		6	5	-77.24
31L	142.1667	2.927	6		-0.57	0.54			Fail	142.1667	2.9269		6	5	-64.64
7L	144.0500	3.074	6		-0.55	0.56			Fail	144.0500	3.0742		6	5	-62.75
70L	145.3000	-	1		-0.54				Fail	145.3000 -			1		-61.50
17L	152.0000	-	1		-0.48				Fail	152.0000 -			1		-54.80
1L	218.2333	2.684	3		0.10	0.49		Fail		218.2333	2.6839		3	2	11.43
65L	235.2750	7.575	4		0.25	1.39		Fail		235.2750	7.5751		4	3	28.47
34L	257.1667	6.022	6		0.44	1.10		Fail		257.1667	6.0215		6	5	50.36
26L	274.5000	8.432	6		0.60	1.54	!	Fail		274.5000	8.4321		6	5	67.70
9L	285.3333	1.966	6		0.69	0.36		Fail		285.3333	1.9664		6	5	78.53
43L	288.3000	8.871	6		0.72	1.62	!	Fail		288.3000	8.8706		6	5	81.50
19L	290.8667	6.198	6		0.74	1.13		Fail		290.8667	6.1976		6	5	84.06
55L	313.3333	5.203	6		0.94	0.95		Fail		313.3333	5.2026		6	5	106.53
61L	428.1667	8.377	6	!	1.95	1.53	!	Fail		428.1667	8.3766		6	5	221.36
Tot.gem	206.802	4.607	mS/m at 20 deg	*1%-level:*	2.33	(1.76)			16	*206.8019*	()		16	15	
Tot.std=	113.375	3.042		*5%-level:*	1.86	(1.52)									

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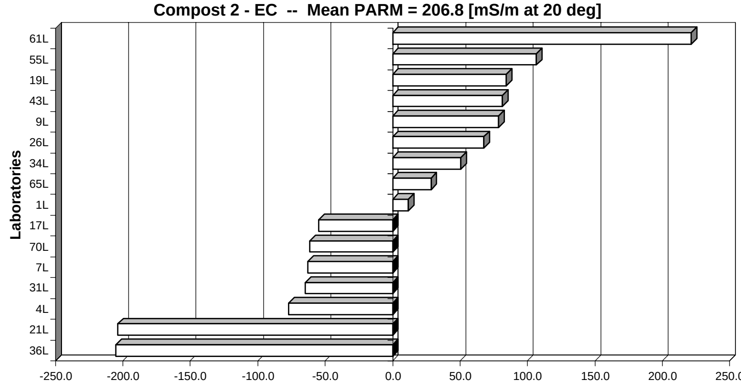
RESULTS:	**Mean =**	**206.80188** *nS/m at 20 deg*				
Repeatability variance	**S2r =**	31.46707				
Repeatability std.	**Sr =**	**5.60955**	-->	2.71%	**r =**	15.7067
Between lab variance	**S2L =**	13504.14435				
Reproducibility var.	**S2R =**	13535.61143				
Reproducibility std.	**SR =**	**116.34265**	-->	56.26%	**R =**	325.7594
Remarks:	**none**					

Compost 2 - EC -- Mean PARM = 206.8 [mS/m at 20 deg]



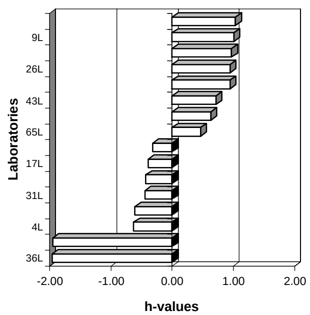
Unit: mS/m at 20 deg

Mandel's k statistics (Sludge 1 - EC)
Mandel's h statistics (Sludge 1 - EC)
Sludge 1 - EC -- Mean PARM = 319.6 [mS/m at 20 deg]

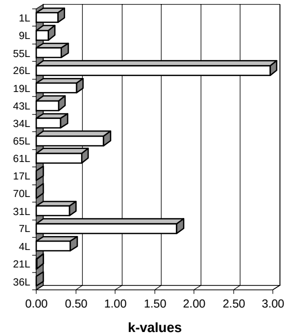
Sample: **Sludge 1**

Element: **EC**

Mandel's h statistics
(Sludge 1 - EC)



Mandel's k statistics
(Sludge 1 - EC)



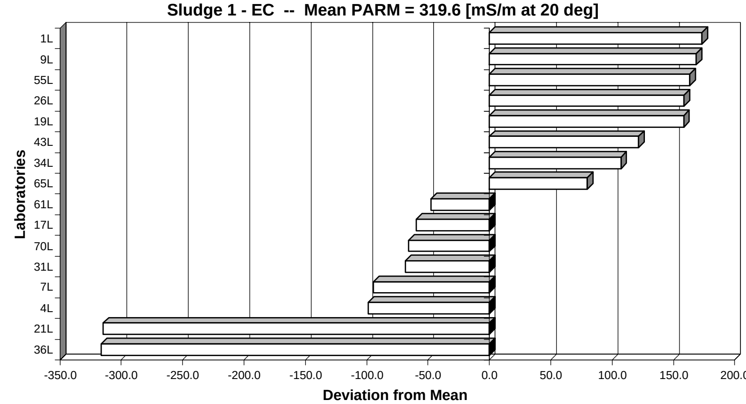
	General calc.parm.
T1=	2.19933E+04
T2=	9.07225E+06
T3=	66
T4=	360
T5=	1.3933E+03
n=	variabel
p=	14
N-table=	*5*

Mandel's statistics / End Result:

LAB	*PARM-gem*	*Stdev*	*N*	*h-mark*	*h*	*k*	*k-mark*	*AvX > AvST+2std*	*AvX < AvST-2std*	*PARM*	*Stdev*	*Rej.labs*	*N*	*N-1*	*dev_mean*
36L	3.2067	0.023	3	!	-1.96	0.00			Fail	3.2067	0.0231		3	2	-316.42
21L	4.9567	0.048	6	!	-1.95	0.00			Fail	4.9567	0.0480		6	5	-314.67
4L	221.0667	5.481	6		-0.63	0.43			Fail	221.0667	5.4815		6	5	-98.56
7L	224.8500	22.690	6		-0.60	1.78	!!		Fail	- -	,7L	-	-		-94.78
31L	251.1667	5.345	6		-0.44	0.42			Fail	251.1667	5.3448		6	5	-68.46
70L	253.6500	-	1		-0.43				Fail	253.6500 -			1		-65.98
17L	260.0000	-	1		-0.39				Fail	260.0000 -			1		-59.63
61L	271.8333	7.333	6		-0.32	0.58			Fail	271.8333	7.3326		6	5	-47.80
65L	399.5500	10.889	4		0.46	0.85		Fail		399.5500	10.8890		4	3	79.92
34L	426.7667	3.959	6		0.63	0.31		Fail		426.7667	3.9591		6	5	107.14
43L	441.0000	3.578	6		0.72	0.28		Fail		441.0000	3.5777		6	5	121.37
19L	477.9333	6.465	6		0.94	0.51		Fail		477.9333	6.4646		6	5	158.31
26L	478.1667	37.775	6		0.95	2.96	!!	Fail	-	-	,26L	-	-		158.54
55L	482.6667	4.033	6		0.97	0.32		Fail		482.6667	4.0332		6	5	163.04
9L	488.1667	1.941	6		1.01	0.15		Fail		488.1667	1.9408		6	5	168.54
1L	492.8333	3.479	3		1.04	0.27		Fail		492.8333	3.4790		3	2	173.21
Tot.gem	323.613	8.074	mS/m at 20 deg	*1%-level:*	2.33	(1.76)			14	*319.6283*		(26L ,7L)	14	13	
Tot.std=	163.349	10.237		*5%-level:*	1.86	(1.52)			2						
									78						

RESULTS:	**Mean =**	**319.62833** *nS/m at 20 deg*				
Repeatability variance	**S2r =**	26.79467				
Repeatability std.	**Sr =**	**5.17636**	-->	1.62%	**r =**	14.4938
Between lab variance	**S2L =**	28788.77519				
Reproducibility var.	**S2R =**	28815.56986				
Reproducibility std.	**SR =**	**169.75149**	-->	53.11%	**R =**	475.3042
Remarks:	**2 Labs rejected! (26L ,7L)**					

Sludge 1 - EC -- Mean PARM = 319.6 [mS/m at 20 deg]



Unit: mS/m at 20 deg

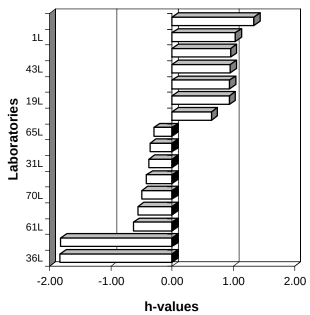
Mandel's k statistics (Sludge 2 - EC)
Mandel's h statistics (Sludge 2 - EC)

Sludge 2 - EC -- Mean PARM = 358.2 [mS/m at 20 deg]

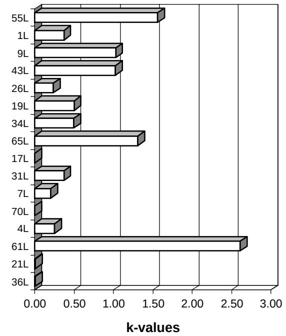
Sample: **Sludge 2**

Element: **EC**

Mandel's h statistics (Sludge 2 - EC)



Mandel's k statistics (Sludge 2 - EC)



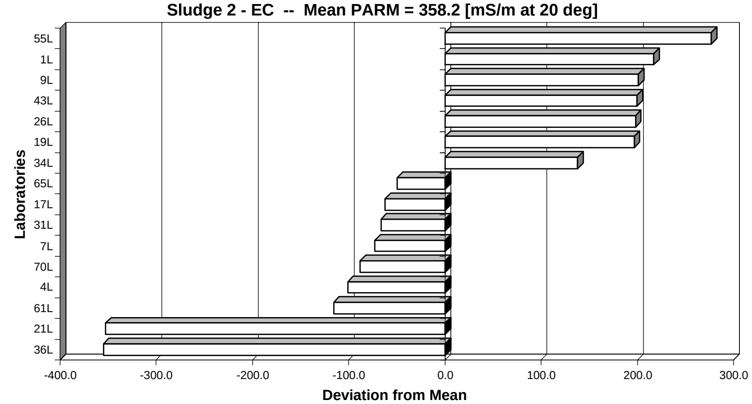
	General calc.parm.
T1=	2.21369E+04
T2=	1.03049E+07
T3=	61
T4=	317
T5=	1.6848E+03
n=	variabel
p=	14
N-table=	*5*

Mandel's statistics / End Result:

LAB	*PARM-gem*	*Stdev*	*N*	*h-mark*	*h*	*k*	*k-mark*	*\vX > AvST+2std*	*AvX < AvST-2std*	*PARM*	*Stdev*	*Rej.labs*	*N*	*N-1*	*dev_mean*
36L	3.3667	0.084	3		-1.83	0.01			Fail	3.3667	0.0839		3	2	-354.88
21L	5.6483	0.092	6		-1.82	0.01			Fail	5.6483	0.0924		6	5	-352.60
61L	242.5000	24.656	6		-0.63	2.61	!!		Fail	- -	,61L	-	-		-115.75
4L	257.1167	2.399	6		-0.56	0.25			Fail	257.1167	2.3987		6	5	-101.13
70L	269.8500	-	1		-0.49				Fail	269.8500 -			1		-88.40
7L	285.1667	1.941	6		-0.42	0.21			Fail	285.1667	1.9408		6	5	-73.08
31L	291.6667	3.502	6		-0.38	0.37			Fail	291.6667	3.5024		6	5	-66.58
17L	296.0000	-	1		-0.36				Fail	296.0000 -			1		-62.25
65L	308.6250	12.367	4		-0.30	1.31			Fail	308.6250	12.3670		4	3	-49.62
34L	495.9667	4.694	6		0.64	0.50		Fail		495.9667	4.6941		6	5	137.72
19L	554.6500	4.738	2		0.93	0.50		Fail		554.6500	4.7376		2	1	196.40
26L	556.0000	2.236	5		0.94	0.24		Fail		556.0000	2.2361		5	4	197.75
43L	557.6667	9.688	6		0.95	1.03		Fail		557.6667	9.6885		6	5	199.42
9L	558.8333	9.704	6		0.96	1.03		Fail		558.8333	9.7040		6	5	200.58
1L	574.9333	3.479	3		1.04	0.37		Fail		574.9333	3.4790		3	2	216.68
55L	634.8333	14.757	6		1.34	1.56	!	Fail	-	-	,55L	-	-		276.58
Tot.gem	368.301	6.738 mS/m at 20 deg		*1%-level:*	2.33	(1.76)			14	*358.2493*	(55L,61L)		14	13	
Tot.std=	199.383	6.874		*5%-level:*	1.86	(1.52)			2						
									73						

RESULTS:	**Mean =**	**358.24929** *nS/m at 20 deg*				
Repeatability variance	**S2r =**	35.84704				
Repeatability std.	**Sr =**	**5.98724**	-->	1.67%	**r =**	16.7643
Between lab variance	**S2L =**	40694.55099				
Reproducibility var.	**S2R =**	40730.39803				
Reproducibility std.	**SR =**	**201.81773**	-->	56.33%	**R =**	565.0897
Remarks:	**2 Labs rejected! (55L,61L)**					

Sludge 2 - EC -- Mean PARM = 358.2 [mS/m at 20 deg]



Unit: mS/m at 20 deg

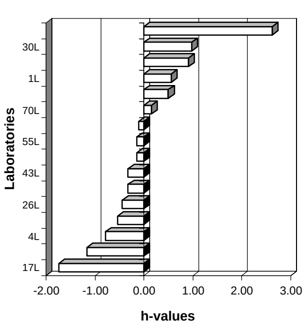
Mandel's k statistics (Soil 4 - EC)
Mandel's h statistics (Soil 4 - EC)

Soil 4 - EC -- Mean PARM = 10.29 [mS/m at 20 deg]

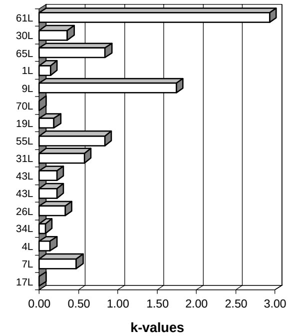
Sample: **Soil 4**

Element: **EC**

Mandel's h statistics (Soil 4 - EC)



Mandel's k statistics (Soil 4 - EC)



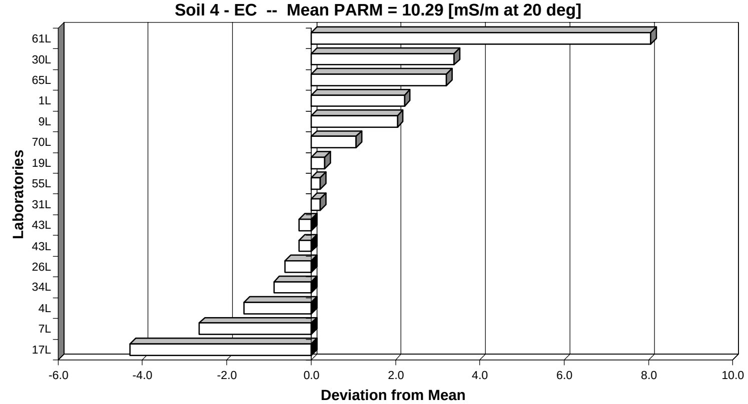
	General calc.parm.
T1=	6.32135E+02
T2=	6.62727E+03
T3=	62
T4=	320
T5=	9.4118E+00
n=	variabel
p=	14
N-table=	*5*

Mandel's statistics — End Result:

LAB	*PARM-gem*	*Stdev*	*N*	*h-mark*	*h*	*k*	*k-mark*	*\vX > AvST+2std*	*AvX < AvST-2std*	*PARM*	*Stdev*	*Rej.labs*	*N*	*N-1*	*dev_mean*
17L	6.0000	-	1		-1.74				Fail	6.0000 -			1		-4.29
7L	7.6350	0.474	6		-1.16	0.47			Fail	7.6350	0.4741		6	5	-2.65
4L	8.6958	0.140	6		-0.79	0.14			Fail	8.6958	0.1398		6	5	-1.59
34L	9.4050	0.077	6		-0.54	0.08				9.4050	0.0774		6	5	-0.88
26L	9.6733	0.333	6		-0.44	0.33				9.6733	0.3327		6	5	-0.62
43L	10.0000	0.224	5		-0.33	0.22				10.0000	0.2236		5	4	-0.29
43L	10.0000	0.224	5		-0.33	0.22				10.0000	0.2236		5	4	-0.29
31L	10.5000	0.577	4		-0.15	0.57				10.5000	0.5774		4	3	0.21
55L	10.5000	0.837	6		-0.15	0.83				10.5000	0.8367		6	5	0.21
19L	10.6050	0.189	6		-0.11	0.19				10.6050	0.1893		6	5	0.32
70L	11.3500	-	1		0.15					11.3500 -			1		1.06
9L	12.3333	1.751	6		0.50	1.74	!!			- -		,9L -	-		2.04
1L	12.5000	0.141	2		0.56	0.14				12.5000	0.1414		2	1	2.21
65L	13.5000	0.841	4		0.91	0.84		Fail		13.5000	0.8406		4	3	3.21
30L	13.6750	0.359	4		0.98	0.36		Fail		13.6750	0.3594		4	3	3.39
61L	18.3333	2.944	6	!!	2.62	2.93	!!	Fail		- -		,61L -	-		8.04
Tot.gem	10.919	0.651	mS/m at 20 deg	*1%-level:*	2.33	(1.76)			14	*10.2885*		(61L ,9L)	14	13	
Tot.std=	2.826	0.794		*5%-level:*	1.86	(1.52)			2						
									74						

RESULTS:	**Mean =**	**10.28851** *nS/m at 20 deg*				
Repeatability variance	**S2r =**	0.19608				
Repeatability std.	**Sr =**	**0.44281**	-->	4.30%	**r =**	1.2399
Between lab variance	**S2L =**	3.16063				
Reproducibility var.	**S2R =**	3.35670				
Reproducibility std.	**SR =**	**1.83213**	-->	17.81%	**R =**	5.1300
Remarks:	**2 Labs rejected! (61L ,9L)**					

Soil 4 - EC -- Mean PARM = 10.29 [mS/m at 20 deg]



Unit: mS/m at 20 deg

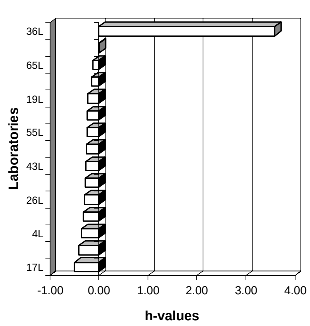
Mandel's k statistics (Soil 5 - EC)
Mandel's h statistics (Soil 5 - EC)

Soil 5 - EC -- Mean PARM = 10.26 [mS/m at 20 deg]

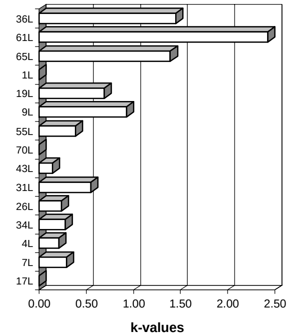
Sample: **Soil 5**

Element: **EC**

Mandel's h statistics (Soil 5 - EC)



Mandel's k statistics (Soil 5 - EC)



	General calc.parm.
T1=	5.95699E+02
T2=	6.24720E+03
T3=	58
T4=	316
T5=	1.7046E+01
n=	variabel
p=	13
N-table=	*4*

Mandel's statistics

End Result:

LAB	*PARM-gem*	*Stdev*	*N*	*h-mark*	*h*	*k*	*k-mark*	*\vX > AvST+2std*	*AvX < AvST-2std*	*PARM*	*Stdev*	*Rej.labs*	*N*	*N-1*	*dev_mean*
17L	6.0000	-	1		-0.50				Fail	6.0000 -			1		-4.26
7L	7.8600	0.306	6		-0.40	0.29			Fail	7.8600	0.3056		6	5	-2.40
4L	8.8432	0.220	6		-0.35	0.21			Fail	8.8432	0.2197		6	5	-1.42
34L	9.4783	0.294	6		-0.32	0.28			Fail	9.4783	0.2936		6	5	-0.78
26L	10.0050	0.250	6		-0.29	0.24			Fail	10.0050	0.2495		6	5	-0.25
31L	10.3333	0.577	3		-0.27	0.55			Fail	10.3333	0.5774		3	2	0.07
43L	10.4667	0.151	6		-0.27	0.14			Fail	10.4667	0.1506		6	5	0.21
70L	10.7000	-	1		-0.25				Fail	10.7000 -			1		0.44
55L	11.1667	0.408	6		-0.23	0.39			Fail	11.1667	0.4082		6	5	0.91
9L	11.1667	0.983	6		-0.23	0.93			Fail	11.1667	0.9832		6	5	0.91
19L	11.3800	0.730	6		-0.22	0.69			Fail	11.3800	0.7296		6	5	1.12
1L	12.7000	-	1		-0.15				Fail	12.7000 -			1		2.44
65L	13.2750	1.471	4		-0.12	1.39			Fail	13.2750	1.4705		4	3	3.02
61L	15.8333	2.563	6		0.01	2.43	!!		-	-	,61L	-	-		5.57
36L	84.6667	1.531	3	!!	3.59	1.45		Fail	-	-	,36L	-	-		74.41
Tot.gem	15.592	0.790 mS/m at 20 deg		*1%-level:*	2.32	(1.85)			13	*10.2596*	(36L ,61L)		13	12	
Tot.std=	19.246	0.732		*5%-level:*	1.86	(1.58)			2						

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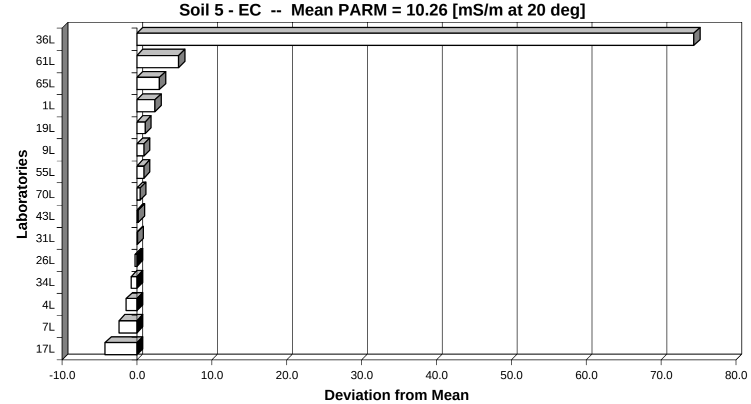
RESULTS:	**Mean =**	**10.25960** *nS/m at 20 deg*				
Repeatability variance	**S2r =**	0.37881				
Repeatability std.	**Sr =**	**0.61547**	-->	6.00%	**r =**	1.7233
Between lab variance	**S2L =**	2.36771				
Reproducibility var.	**S2R =**	2.74652				
Reproducibility std.	**SR =**	**1.65726**	-->	16.15%	**R =**	4.6403
Remarks:	**2 Labs rejected! (36L ,61L)**					

Soil 5 - EC -- Mean PARM = 10.26 [mS/m at 20 deg]



Annex 4:

Raw data submitted

Sample:	*Compost 1*
Element:	***EC***
LAB	***PARM***
4L	154.7
4L	151.2
4L	153.4
4L	148.1
4L	148.7
4L	151.7
65L	288.8
65L	295.1
65L	289.5
65L	309.9
34L	293.1
34L	299.2
34L	295.2
34L	298.3
34L	297.0
34L	296.0
7L	166.4
7L	169.3
7L	146.6
7L	127.7
7L	123.7
7L	163.7
21L	329.0
21L	335.0
21L	309.0
21L	325.0
21L	328.0
21L	325.0
55L	348.0
55L	341.0
55L	340.0
55L	353.0
55L	347.0
55L	331.0
26L	325.0
26L	329.0
26L	331.0
26L	326.0
26L	330.0
26L	332.0
1L	277.6
1L	278.6
1L	281.9
36L	193
36L	187
36L	188
61L	362.0
61L	371.0
61L	367.0
61L	371.0
61L	373.0
61L	369.0

Sample:	*Compost 1*
Element:	***EC***
LAB	***PARM***
31L	171.0
31L	172.0
31L	173.0
31L	169.0
31L	170.0
9L	328.0
9L	333.0
9L	329.0
9L	335.0
9L	333.0
9L	337.0
43L	317.7
43L	318.4
43L	318.8
43L	313.1
43L	313.4
43L	318.5
30L	312.0
30L	316.0
30L	306.0
30L	308.0
17L	180.0
70L	167.4

Sample:	Compost 2
Element:	EC
LAB	PARM
4L	127.6
4L	129.5
4L	129.5
4L	127.5
4L	135.5
4L	127.8
65L	232.6
65L	239.8
65L	225.9
65L	242.8
34L	256.0
34L	253.4
34L	250.2
34L	263.5
34L	254.4
34L	265.5
7L	142.3
7L	141.2
7L	146.7
7L	149
7L	142.7
7L	142.4
21L	303.0
21L	295.0
21L	272.0
21L	294.0
21L	286.0
21L	291.0
55L	316.0
55L	322.0
55L	312.0
55L	313.0
55L	307.0
55L	310.0
26L	274.0
26L	280.0
26L	284.0
26L	263.0
26L	266.0
26L	280.0
1L	215.2
1L	219.2
1L	220.3
36L	169
36L	167
36L	165
61L	441.0
61L	430.0
61L	428.0
61L	431.0
61L	416.0
61L	423.0

Sample:	Compost 2
Element:	EC
LAB	PARM
31L	141.0
31L	144.0
31L	145.0
31L	138.0
31L	140.0
31L	145.0
9L	286.0
9L	282.0
9L	285.0
9L	288.0
9L	285.0
9L	286.0
43L	281.0
43L	291.8
43L	295.4
43L	274.0
43L	291.3
43L	296.3
19L	287.8
19L	292.8
19L	296.0
19L	279.8
19L	292.8
19L	296.0
17L	152.0
70L	145.3

Sample:	*Sewage Sludge 1*
Element:	***EC***
LAB	***PARM***
4L	212.2
4L	219.5
4L	218.8
4L	227.4
4L	225.6
4L	222.9
65L	383.9
65L	403.3
65L	401.9
65L	409.1
34L	432.4
34L	427.7
34L	426.6
34L	420.3
34L	428.2
34L	425.4
7L	242
7L	181.1
7L	240
7L	221
7L	231
7L	234
21L	501.0
21L	497.0
21L	488.0
21L	500.0
21L	495.0
21L	493.0
55L	486.0
55L	478.0
55L	485.0
55L	485.0
55L	485.0
55L	466.0
26L	466
26L	466
26L	466
26L	464
26L	459
26L	459
1L	490.3
1L	491.4
1L	496.8
36L	322
36L	322
36L	318
61L	277.0
61L	267.0
61L	273.0
61L	268.0
61L	263.0
61L	283.0

Sample:	*Sewage Sludge 1*
Element:	***EC***
LAB	***PARM***
31L	241.0
31L	254.0
31L	255.0
31L	250.0
31L	252.0
31L	255.0
9L	488.0
9L	491.0
9L	489.0
9L	489.0
9L	486.0
9L	486.0
43L	436.0
43L	438.0
43L	441.0
43L	442.0
43L	443.0
43L	446.0
19L	471.8
19L	477.8
19L	475.2
19L	473.6
19L	489.9
19L	479.3
17L	260.0
70L	253.7

Sample:	*Sewage Sludge 2*
Element:	*EC*
LAB	***PARM***
4L	258.6
4L	257.5
4L	253.2
4L	255.6
4L	257.8
4L	260.0
65L	305.0
65L	326.7
65L	298.7
65L	304.1
34L	500.8
34L	499.5
34L	498.4
34L	490.3
34L	496.8
34L	490.0
7L	283
7L	285
7L	283
7L	288
7L	286
7L	286
21L	568.0
21L	569.0
21L	563.0
21L	572.0
21L	570.0
21L	547.0
55L	632.0
55L	654.0
55L	634.0
55L	622.0
55L	650.0
55L	617.0
26L	556.0
26L	557.0
26L	553.0
26L	555.0
26L	559.0
26L	555.0
1L	572.4
1L	573.5
1L	578.9
36L	342
36L	327
36L	341
61L	232.0
61L	232.0
61L	241.0
61L	230.0
61L	292.0
61L	228.0

Sample:	*Sewage Sludge 2*
Element:	*EC*
LAB	***PARM***
31L	290.0
31L	290.0
31L	295.0
31L	288.0
31L	290.0
31L	297.0
9L	548.0
9L	548.0
9L	555.0
9L	569.0
9L	566.0
9L	567.0
43L	548.0
43L	567.0
43L	568.0
43L	545.0
43L	556.0
43L	562.0
19L	551.3
19L	558.0
17L	296.0
70L	269.9

Sample:	*Soil 4*
Element:	***EC***
LAB	***PARM***
4L	8.6
4L	8.6
4L	8.9
4L	8.8
4L	8.6
4L	8.7
65L	12.6
65L	14.4
65L	13.0
65L	14.0
34L	9.4
34L	9.5
34L	9.3
34L	9.4
34L	9.4
34L	9.5
7L	7.7
7L	7.32
7L	7.1
7L	7.62
7L	7.58
7L	8.49
55L	12.0
55L	11.0
55L	10.0
55L	10.0
55L	10.0
55L	10.0
26L	9.2
26L	10.0
26L	10.0
26L	9.3
26L	9.8
26L	9.8
1L	12.6
36L	8.9
36L	8.79
36L	8.87
61L	17.0
61L	18.0
61L	23.0
61L	19.0
61L	14.0
61L	19.0
31L	10.0
31L	11.0
31L	10.0
31L	11.0

Sample:	*Soil 4*
Element:	***EC***
LAB	***PARM***
9L	15.0
9L	13.0
9L	12.0
9L	13.0
9L	10.0
9L	11.0
43L	9.7
43L	10.1
43L	10.3
43L	9.9
43L	10.0
19L	10.5
19L	10.6
19L	10.5
19L	10.7
19L	11.0
19L	10.5
30L	13.5
30L	14.2
30L	13.4
30L	13.6
17L	6.0
70L	11.4

Sample:	*Soil 5*
Element:	***EC***
LAB	***PARM***
4L	8.9
4L	8.9
4L	8.8
4L	9.2
4L	8.7
4L	8.573
65L	11.1
65L	13.7
65L	14.0
65L	14.3
34L	9.0
34L	9.6
34L	9.8
34L	9.4
34L	9.4
34L	9.700
7L	8.01
7L	7.68
7L	8.2
7L	7.92
7L	8.01
7L	7.34
55L	11.0
55L	11.0
55L	12.0
55L	11.0
55L	11.0
55L	11
26L	9.9
26L	10.2
26L	10.4
26L	9.7
26L	9.9
26L	9.93
1L	12.7
1L	12.4
36L	8.35
36L	8.64
36L	8.41
61L	14.0
61L	12.0
61L	16.0
61L	19.0
61L	18.0
61L	16.00

Sample:	*Soil 5*
Element:	***EC***
LAB	***PARM***
31L	10.0
31L	11.0
31L	10.0
9L	12.0
9L	12.0
9L	10.0
9L	10.0
9L	12.0
9L	11
43L	10.4
43L	10.5
43L	10.6
43L	10.2
43L	10.5
43L	10.6
19L	12.5
19L	10.8
19L	10.8
19L	12.1
19L	11.1
19L	10.94
17L	6.0
70L	10.7

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Abstract
Project HORIZONTAL is interdisciplinary aiming at a harmonisation and horizontal standardisation of test procedures, in particular for sludge, soils and biowastes. In the context of this standardization project, a series of draft technical specification were designed upon an extensive desk study, fine-tuned after expert consultations and finally validated in international intercomparisons exercise.
This report summarises the work performed within the validation study of the draft standard for the determination of specific electrical conductivity (EC) in soils, sludge and treated bio-waste using gravimetric method. It further explains the underlying statistical concept for the calculation of reproducibility and repeatability from intercomparisons data. In addition all single values, results of the statistical evaluation as well as background information on the validation materials used are described and explained.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

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