# Appendix F. QA/QC Procedure

# QUALITY ASSURANCE & QUALITY CONTROL

ALS Hong Kong is staffed with qualified chemists who conduct analytical testing using well documented procedures based on the universally recognised methodologies of USEPA, APHA, ASTM.

All laboratory procedures are regulated by comprehensive QA / QC programmes established to monitor and control every aspect of the operation. A minimum of 10% of all samples analysed by ALS Technichem are part of the Quality Assurance protocol.

The laboratory is HOKLAS accredited (Reg. No. 066) for a large range of chemical and biological tests covering environmental and food analyses.

Our QA/QC procedures are designed to ensure reliable analytical results to our clients.

## 1. INSTRUMENT CALIBRATION

All equipment and instruments meet the requirements and specifications of the documented test procedures.

### 1.1 Daily Performance Checks

The performance checks are carried out once in every 24 hour operating period for most capital instruments, such as:

- Liquid Chromatography – Mass Spectrometry/Mass Spectrometry
- Gas Chromatography – Mass Selective Detector
- Gas Chromatography – Flame Ionization Detector
- Gas Chromatography – Electron Capture Detector
- Inductively Coupled Plasma – Mass Spectrometer
- Inductively Coupled Plasma – Atomic Emission Spectrometer
- Flow Injection Mercury Analyzer
- Automatic Discret Analyzer
- Flow Injection Analyzer
- Electronic Balance

Should the instrument fail the daily check repeatedly then the appropriate maintenance is undertaken to rectify the problem prior to sample analysis.

### 1.2 Calibration

A minimum 5 point calibration covering the working range of the samples to be analysed is run with each group of samples. Laboratory Blanks are run at a frequency of 1 in every 20 samples or 1 between each analytical lot of samples, which ever is the more frequent.

A mid-range calibration standard is analysed regularly during the operating period to ensure consistency.

### 1.3 Calibration Check

A calibration standard is analysed regularly during the operating period to ensure consistency.

## 2. QUALITY CONTROL (QC) SAMPLES

QC samples comprise those which monitor and control the laboratory performance namely Laboratory Control Sample (LCS), Duplicate Control Sample (DCS), Method Blanks and those which are used for data assessment and the evaluation of matrix effects by using Surrogates, Matrix Spike (MS), Matrix Spike Duplicate (MSD) and Sample Duplicates.

Field contamination is monitored by the analysis of Trip Blanks (VOCs) and Equipment Rinsate Samples.

The organics laboratory processes field samples in QC lots of 20 according to the analysis required. These 20 samples may consist of a number of sample batches independently submitted to the laboratory.

The inorganics laboratory lots samples in groups of 20 to 50 depending on the analyte to be determined. Quality control samples such as Laboratory Blanks and Quality Control Sample, and/or Certified Reference Materials (CRM) are run at a frequency of 1 in 20 per 'lot' of samples. Sample Duplicates and Matrix Spikes are run at a frequency of 1 in 20 or 1 per batch, whichever is more frequent.

### 2.1 Laboratory Control Sample (LCS) & Duplicate Control Sample (DCS) - (Organics only)

(a) Accuracy - the closeness of agreement between an observed value and a reference value.

The observed value is the average of the LCS and the DCS values. The reference value is the spike value. The accuracy is expressed as the % Recovery and is calculated as follows:

% Recovery = (Observed Value/Spiked Value) x 100

(b) Precision - the agreement among a set of replicate results.

Precision is expressed as the Relative Percent Difference (RPD) between the LCS and DCS detected levels, against the average of these levels.

The RPD is calculated as follows:

RPD = [(Results 1 - Result 2) / Average] x 100

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The accuracy and precision data are evaluated against laboratory established control limits. (If laboratory control limits have not been established for a particular method, control limits as specified in USEPA SW 846 may be utilised).

QC results falling outside the control limits are automatically flagged.

The acceptance criterion used is that 80 percent of the precision and accuracy values must fall within the control limits. If this criterion is not met, corrective action must be taken. This may include repeat sample analysis.

### 2.2 Laboratory / Reagent Blank

For the laboratory blank to be acceptable, the concentration in the blank of any analyte of concern should not be higher than ½ of reporting limit (LOR) for that analyte.

Blank correction may be performed if the blank result is found to be greater than LOR and it is attributed to the analytical method and/or reagents involved.

### 2.3 Surrogates (Organics Only)

Surrogate results are reported as percent recovery. Since surrogate spike recoveries indicate the presence of sample specific interferences, USEPA documented recovery limits are used as a guidance only.

The surrogate standards are used for semivolatile and volatile analyses. The semivolatile analysis includes SVOC, pesticide and PCB tests. The volatile analysis includes VOC and BTEX.

### 2.4 Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

MS and MSD results are used for data assessment and evaluation of method precision and bias in a given matrix.

### 2.5 Sample Duplicate

The duplicate results are used for evaluation of laboratory precision in a given matrix.

The RPD values of the duplicates are used as the rejection or acceptance criteria.

Generally, water samples are repeated if the RPD is greater than 20 percent and there is sufficient sample for reanalysis.

The RPD for soils should be within 25 percent, however, this may be dependent upon sample homogeneity.

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## TABLE 1: QC TERMS, DEFINITIONS, PURPOSE FOR MONITORING & FREQUENCY

| QC TERM | DEFINITION | TO MONITOR | FREQUENCY |
|---|---|---|---|
| Work Order | A set of samples received from a customer for analysis. | - | - |
| QC Lot | A set of 20 samples analysed under the same analytical conditions. A QC Lot may consist of samples from a number of work orders. | - | - |
| Analytical Lot | A group of samples prepared at the same time for a given analyte. | - | - |
| Control Limits | Upper and lower limits based on statistical analysis of laboratory historical performance data. | Laboratory precision and bias. | - |
| **Laboratory Quality Control Samples** | | | |
| Method Blank *(BLK)* | An analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. | Contamination introduced in the laboratory. | 1 per QC lot of 20 samples |
| Sample Duplicate *(DUP)* | An intra-laboratory split sample randomly selected from the sample batch. | Method precision in a given sample matrix. | 1 per QC lot of 20 samples |
| Matrix Spike *(MS)* | A split sample spiked with the target analytes prior to sample preparation and analysis. | Method bias in a given sample matrix. | 1 per QC lot of 20 samples |
| Matrix Spike Duplicate *(MSD)* | An split sample spiked as per the MS. | *Ditto* | *ditto* |
| Laboratory Control Sample *(LCS)* | A known, interference free matrix spiked with target analytes. | Laboratory preparation technique. | 1 per QC lot of 20 samples |
| Duplicate Control Sample *(DCS)* | As per the SCS. | Preparation technique reproducibility (precision). | *Ditto* |
| Certified Reference Material (CRM) | A certified reference material containing target analytes with known concentrations and associated uncertainities and | Monitoring overall performance of each step during analysis, including sample preparation. For Inorganic analysis. | 1 per QC Lot, per analytical method. |
| Surrogate Spike *(organic testing only)* | Compounds similar in composition and behaviour to the target analytes but not commonly found in samples. | Matrix interference on a per sample basis. | Surrogates are added to all samples for selected organic analyses. |
| **Filed Quality Control Samples** | | | |
| Equipment Rinsate | A sample of reagent water used by client in field to rinse the sampling equipment between the decontamination and sampling steps | Equipment decontamination. | as directed by client. |
| Trip Blank *(usually VOC testing)* | A sample of analyte free media is taken from the laboratory to the sampling site and returned to the laboratory unopened. | Contamination from shipping and field handling. Most applicable to volatile analysis. | as directed by client. |

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## TABLE 2: LABORATORY QUALITY CONTROL SCHEDULES

### ORGANICS –

| QUALITY CONTROL ITEM | QCS2 | QCS3 | QCS4 |
|---|---|---|---|
| Laboratory Blank | √ | √ | √ |
| Batch Duplicate | √ | √ | √ |
| Matrix Spike (MS) | • | √ | √ |
| Single Control Sample (SCS) | √ | √ | √ |
| Duplicate Control Sample (DCS) | • | • | √ |
| Surrogate *(organics only)* | √ | √ | √ |
| Matrix Spike Duplicate (MSD) | • | • | √ |

### INORGANICS -

| QUALITY CONTROL ITEM | QCS2 | QCS3 | QCS4 |
|---|---|---|---|
| Laboratory Blank | √ | √ | √ |
| Batch Duplicate | √ | √ | √ |
| Matrix Spike (MS) | √ | √ | √ |
| Single Control Sample (SCS) | √ | √ | √ |
| Duplicate Control Sample (DCS) | • | • | √ |
| Matrix Spike Duplicate (MSD) | • | • | √ |

√ Analysis performed in the schedule.

• Analysis not performed in the schedule.