QA/QC Demystified: The Case for Quality Checks

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QA/QC guidance is often cloudy ….

But… clarity can happen because

QA/QC is a finite set of actions!

What people do to **affect** the quality of their data is different from what they need to do to **check** the quality; they need to do both and they also need to record and report the outcomes.

Data Quality Aspect	Affect (act to influence outcome)	Check (test to evaluate or verify)
Accuracy	Calibration adjustment	Comparison to Standard
Precision	Consistent operations	Repeated measurements, duplicate samples
Lack of Contamination	Decontamination, clean sampling techniques	Blanks (field, equipment)
Operator's competence	Training, mentoring, supervision	Proficiency tests, audits, reviews

Quality checks share a common principle. There is always an Expected value – which represents "the truth" – and an Observed value – which is what you found.

You always make some kind of comparison between the Expected value and the Observed value. The **Expected value can be :**

- **A "standard" number** - e.g., pH 7.00 of the Standard buffer, or 0 degrees C in a constantly-mixed ice-bath made of distilled water;
- **Zero** – e.g., concentration of an analyte in a clean sample container;

- **A numeric range** – e.g., the laboratory control chart for a given reference-toxicant and toxicity test organism combination;
- **A positive or negative** response/outcome – e.g., growth of E. coli in a given medium.

It can also be
- A measurement result – the first in a pair of replicates/duplicates
- A value required by Program – e.g., sample temperature upon arrival to laboratory

Quality checks come in a number of categories, and each category includes several types (see example table on the upper right). The common principle - Expected vs. Observed – is tabulated for several batch examples (table on right).

Take-Home Messages:

QA/QC is not a mystery. You just need to know what to do to **affect, check, record, and report** the quality of your data

Qualitative (evaluative) estimates and numeric-range categorization are **not** exempt from Quality Checks

In quality checks, everything boils down to the comparison of **expected** values to **observed** values

Expected/Observed values, plus the descriptors of the data batch, are the basic data elements for a universal data structure

Quality check category	Quality check type	Data quality aspect addressed
Comparison w Standard	Instrument accuracy check Reference instrument check Taxonomic ID check	Accuracy
Repeats	Repeated field measurement Repeated estimate Repeated categorization Field duplicates Lab replicates	Precision Reproducibility
Inspections/ verification	Lab arrival temperature Holding time Preservative concentration Instrument diagnostics	Sample integrity/ Lack of deterioration Data validity
Blanks	Trip, Field, bottles Equipment rinsate Method blank Reagent blank	Sample integrity/ Lack of contamination Sample-to-noise ratio
Spikes	Lab control sample Surrogate Matrix spike Internal standard	Recovery Batch validity
Positive/ Negative controls	Reference toxicant test Bacterial culture	Test validity

Quality Check type	Batch Type	Character-istic	Unit	Expected Value Type	Expected Result	Observed Value Type	Observed Result	Differential or Drift
Certified ref. material	Analytical lab batch	Aluminum	ug/l	Nominal conc.	56	Measured conc.	49	7
Matrix Spike	ELISA run	Diazinon	ng/l	Sample content plus spike nominal conc.	210+80	Measured conc.	260	30
Repeated field measurement	Instrument	pH	unit	Primary measurement result	7.5	Repeated measurement result	7.6	0.1
Repeated estimate	Field operator	Flow Discharge	cfs	Primary estimate	30	Repeated estimate	40	10
Field blank	Sample batch	Methyl-mercury	ng/g	Zero	<1 (MDL)	Analytical result	1.2	n/a

This publication is an outcome of a long thought-process, enhanced by numerous dialogs with colleagues, in pursuit of the unifying concepts that underlie all environmental monitoring disciplines. Thanks! The full manuscript will be available on line at www.water-science-etc.net under Products, Publications.