DQM Standard Operating Procedure (SOP) 9.2.1.2 (V2)

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Use of the DQM Calibration and Accuracy Checks Data Sheet

(This paragraph is common to all DQM SOPs. If you have seen it already, please skip to Section 1 below). This is a new type of guidance, created as part of the Data Quality Management (DQM) System implemented by the Clean Water Team (CWT) to support collection of reliable data of known quality in a fully documented, scientifically defensible manner.

1.0 About this SOP

(If you have seen SOP-9.2.1.1 go to Section 2 below).. This SOP provides instructions for entering information and data into selected boxes within the formal Data Sheet provided as part of the SOP. The guidance augments instrument-specific guidance that has been provided elsewhere (in the appropriate standard operating procedures, or SOPs) by the CWT. The current version of this SOP is focused on measurements of temperature, dissolved oxygen, conductivity, pH, and transparency or turbidity in the field, with kits and instruments commonly used by citizen monitoring groups.

This SOP has been written for you, the Field Operator who conducts measurements, calibrations, and accuracy checks in the field; in some Projects you also collect and dispatch samples for analysis off-site. In addition to the sampling and testing equipment, make sure you have the following pieces of "paperwork":

1. Hardcopies of instrument-specific SOPs for all the kits and instruments used by your team of field operators (For example, the SOP for the conductivity meter).
2. SOP-9.2.1.1(Field): hardcopy form and instructions on how to fill every cell of the DQM "Field Data Sheet for Water Quality Monitoring"
3. SOP-9.2.1.2(Calib) (this SOP): hardcopy form and instructions on how to fill every cell of the DQM "Calibration and Accuracy Checks Sheet"; these instructions are generic and written to match guidance in the instrument-specific SOPs.

2.0 Generic Instructions for use of the DQM "Calibration and Accuracy Checks Sheet"

This guidance section tells you how to use the DQM Calibration and Accuracy Checks Sheet (included in this SOP) for keeping records of your water quality monitoring. Different instruments may require different procedures for

controlling and checking the accuracy of scientific measurements. The procedures for recording and reporting are also specific to an instrument, so your instrument-specific SOP (number 1 above) is your **essential PRIMARY guidance** that should be followed when filling out this DQM Calibration & Accuracy Checks Data Sheet. The explanation below provides some definitions to clarify what each term means, and provides generic information regarding the content of each field.

2.1 Relevant Definitions:

These terms are defined here because they are essential for understanding the instructions. The same definitions are also given in the Glossary at the end of the SOP (Section 4).

Instrument: a probe, electrode, reagent kit, indicator strip, or any other type of device used for field or laboratory measurements.
Calibration: modification of the output of an adjustable-reading instrument, to make it reflect a value that represents the "true value" (as manifested by a given Standard or by a natural value).
Accuracy Check: Comparison of the reading, or output, of a measurement device with a value believed the "true" value. The "true" value may be represented by known natural conditions (e.g., freezing point) or by a Standard Solution. An "Accuracy Check" is different from a Calibration, since it is only a comparison and does not result in an adjustment (calibration) of an instrument or procedure.
Standard Solution: A solution containing a known concentration of a substance or has a known property, prepared or purchased for use in the analytical laboratory or in the field. Each bottle of these types of Standards has a **unique Standard ID,** for example "STB-EC2". Every bottle of Standard has a unique ID and can be described in one or more of the following definitions:

- "**Resident Standard**" – solutions that each monitoring entity owns and uses routinely for calibration and/or accuracy checks;
- "**Calibrator Standard**" – the specific solution used for calibration of a given adjustable pH or conductivity meters (etc.) on a given Calibration event. Most groups use their Resident Standards to for routine Instrument calibration, but External Standards may be used for calibration during special events;
- "**External Standards**" - solutions used in regional Intercalibration Exercises, some can be used as Calibrator Standards if desired;
- "**Certified Standards**" include any Standard that is traceable to NIST or ASTM. Resident, Calibrator, and External Standards can all be Certified Standards as well. A Certified Standard is considered the "ultimate authority" if valid, i.e., if the bottle was (a) used before the expiration date; (b) has been stored tightly capped; and (c) has not been exposed to extreme temperatures.

All of these Standards have placeholders in the DQM Calibration & Accuracy Checks Data Sheet, but the decision which Standard ID to enter in which cell depends on the actual activity. You may need to fill in more than one "record" for one instrument (for example, if you calibrate your pH meter against your Resident Standard buffers and then do an "Accuracy Check" to see what it reads in an External Standard). So use as many records and sheets as needed. Be sure to add sheet page numbers in sequence and total number of pages when done.

If you are conducting Accuracy Checks on equipment that cannot be calibrated, ignore fields (boxes) K, L, M, and N below (or write "nap", meaning "not applicable", in all of them).

Note: You will see the term **"Standard Reagent"** for a solution or a suspension or particles of known properties that is provided with a test kit and used as part of the measurement procedure itself (e.g., reagent for turbidity comparisons in the dual cylinder kit). This solution would not have a Standard ID but will be accounted for through the kit's unique Instrument ID.

All the results that you record should be read after you have allowed the instrument to stabilize in the Standard solution or the other tested material.

2.2 Cell contents:

box	FIELD NAME	CONTENT/INSTRUCTIONS	EXAMPLES
A	**Instrument ID**	Write the instrument ID as it is written on the instrument	DOW-STB!
B	**Parameter**	Write the name of the parameter you are measuring or calibrating	Dissolved oxygen; pH
C	**Unit**	Write the measurement unit	Degree C, pH, mg/l; uS
D	**Date** of Calibration or Accuracy Check	Write the date (mm/dd/yy)	04/25/01
E	**Time** of Calibration or Accuracy Check	Write the time of day, to the nearest minute, preferably using a 24 hour clock (but AM PM is OK if you add that).	14:36, 4:30 PM
F	**Intent or associated event**	(optional)	Routine; Pre-Snapshot
G	**Temperature** at Calibration or Accuracy Check	Write the temperature as measured at the same time inside the solution used for Calibration or Accuracy Check (this is essential for dissolved oxygen and conductivity, optional for pH, not relevant for turbidity). Write "nap" (not applicable) for temperature accuracy checks).	25 C
H	**"True" value of Standard** [see on the	Write the value specified for the Standard, or the value expected at the natural reference point used as the Tested	7.0; 1413 @ 25 C

	label] **or natural point**	Material	
Are you calibrating an Instrument with adjustable readings? If Yes - skip to box K; if No - do Accuracy Checks (boxes I, J) and O,P.			
I	**Tested Material** (enter ID, or saturated water, or distilled water, or ice bath)	Write the ID of the Standard Solution or the NIST thermometer you are checking against, or the material that represents your natural reference point.	EPA-7pH23; Ice-water bath;
J	**Reading (result) in Tested Material**	Write the result that the instrument shows in the tested material after you have allowed it to stabilize (check your instrument-specific SOP for the number of "significant digits", i.e., how many digits in the Result have a number that is meaningful).	9.8
Use boxes K,L,M,N below when calibrating an Instrument that has adjustable readings.			
K	**Calibrator Standard ID**	Write the unique Standard ID that you intend to use for calibration (it can be the Resident or an External Standard)	SLC-EC2
L	**Reading before calibration**	Write the result that the instrument shows in the Standard above, before you have changed anything (check your instrument-specific SOP for the number of "significant digits", i.e., how many digits in the Result have a number that is meaningful).	1370
M	**Action taken**	Write "none" if you have not adjusted the reading and skip the next field; Write "manual cal" if you have adjusted the reading manually, or "auto cal" if the instrument has an automatic calibration feature.	None; cal
N	**Reading after calibration**	Write the result that the instrument shows in the Calibrator Standard above, after you have adjusted the reading (it should be similar to the True value, above)	1410
Use for all calibration and accuracy checks			
O	**Calibration Operator**	Write your first initial and full last name	D. Johnson
P	**Comments**	Write anything that you deem important to share with your leader, QA/QC officer, or data user	The Standard was not at 25 C

2.3 Exceptions, notes, and comments

Instrument-specific considerations or information can be recorded as Notes (for example, related to dissolved oxygen electrode calibration) or in the Comment box. If you are performing accuracy checks for nutrient kits, and the Standard Stock solution has been diluted for the test, write the name of the dilution preparer in the comment box.

3.0 How your records will be used

The calibration and accuracy checks information you have recorded on this Data Sheet is vital for generation of data of known quality. Your records will be

entered into a Project File database, and Your Trainer or Technical Leader will use them to calculate the accuracy of all the measurements you have performed with your Instruments.

4.0 Glossary for This SOP

Accuracy: The extent of agreement between an observed value (measurement result) and the accepted, or true, value of the parameter being measured.

Accuracy Check: Comparison of the reading, or output, of a measurement device with a value believed the "true" value. The "true" value may be represented by known natural conditions (e.g., freezing point) or by an established Standard. An "Accuracy Check" is different from a Calibration, since it is only a comparison and does not result in an adjustment (calibration) of an instrument or procedure.

Blank (Sample): A sample that contains pure water and is analyzed concomitantly with a set of environmental samples. Blanks usually include field blanks and trip blanks to assure that there was not contamination during sampling and shipping, as well as laboratory method blanks and reagent blanks, tested within the analytical procedures

Buffer (capacity): the property of a solution to resist changes in pH. A good buffer is a substance that is present in an equilibrium between two or more forms (e.g., ionized and unionized) and can compensate for changes in pH by changing its equilibrium to restore the original hydrogen ion concentration. Also see Standard pH Buffer

Certified Standard: any Standard that is traceable to NIST or ASTM (also see "Standard Solution" below). Resident, Calibrator, and External Standards can all be Certified Standards as well. A Certified Standard is considered the "ultimate authority" if valid, i.e., if the bottle was (a) used before the expiration date; (b) has been stored tightly capped; and (c) has not been exposed to extreme temperatures.

Calibration: The action of adjusting the readings of an instrument to have them match a "true" value as represented by known natural conditions (e.g., freezing point) or by a Standard Solution (e.g., Standard pH buffer).

Data Quality Objectives (DQOs): Statements about the level of uncertainty in data that a decision-maker is willing to accept to support a particular decision. DQOs include measurement quality objectives (precision, accuracy, detection limit, and resolution) as well as measures of completeness, representativeness, and comparability.

Data Validation: The process to assure data meets requirements and quality objectives and that the test or analysis used to generate the data was valid.

Duplicate Samples: two samples taken at the same time from the same site that are carried through all assessment and analytical procedures in an identical manner.

Instrument: a probe, electrode, reagent kit, indicator strip, or any other type of device used for field or laboratory measurements.

Parameter: A property or substance to be measured within a medium. Parameters include properties such acidity (pH) or electrical conductivity, particulates such as suspended solids or bacteria, and analytes such as ammonia or heavy metals.

Precision: A measure of how close repeated measurements are to each other.

Resolution: The smallest increment that can be discerned on the scale of a measuring device, or the capability of a method to discriminate between measurement responses.

Significant digits - digits in a numerical Result that have a number that is meaningful. In most cases three significant digits are fine, e.g., 10.4 mg/l DO (all three digits are significant) or 1560 uS (the first three are significant, the last one provides the order of magnitude but the difference between zero and, say, 2, is not significant).

Standard Operating Procedure (SOP): A written document providing step-by step instructions for performing a procedure (sampling, measurement, or other).

Standard pH Buffer: A well-buffered solution used for calibration or for accuracy checks of pH measuring devices (also see "Standard Solution" below).

Standard Reagent: A solution or a suspension or particles or known properties, such as concentration or turbidity, that is provided with a test kit and used as part of the measurement procedure (e.g., reagent for turbidity comparisons in the dual cylinder kit).

Standard Reference Materials (SRM): An SRM is a certified material or substance with an established, known and accepted value for the analyte or property of interest. Many SRMs are produced by the U. S. National Institute of Standards and Technology (NIST) and characterized for absolute content independent of any analytical method. They are often used as an external "Accuracy Check" to determine if there is any bias due to the materials used for calibration, or to validate the internal Laboratory Control Standards. Some people use the term "Certified Reference Material" for the same entity.

Standard Solution: A solution containing a known concentration of a substance, prepared or purchased for use in the analytical laboratory or in the field. It is used in calibrations and in quality control checks on procedures and instruments. This category includes "Calibrator Standards" used for calibration of adjustable pH and conductivity meters (etc.), usually as the "Resident Standards" that each monitoring entity uses, as well as SRMs and "External Standards" such as those used in regional Intercalibration Exercises. Each bottle of these types of Standards has to have a unique ID.

5.0 Sources and Resources

(This section is common to all DQM-SOPs). This SOP is an integral part of the Data Quality Management (DQM) system implemented by the Clean Water Team, the Citizen Monitoring Program of the State Water Resources Control Board.

6.0 The Form

(see next page)

DQM Calibration and Accuracy Checks Data Sheet **Event** _____

Project ID _____ Page _____ of _____

		Record 1	*Record 2*	*Record 3*
A	**Instrument ID**			
B	**Parameter**			
C	**Unit**			
D	**Date** of Calibration or Accuracy Check			
E	**Time** of Calibration or Accuracy Check			
F	**Intent or associated event**			
G	**Temperature (C)** at Calibration or Accuracy Check, (and thermometer ID)			
H	**"True" value of Standard** *[see on the label]* **or natural point**			

Are you calibrating an Instrument with adjustable readings? If Yes - skip to box K; if No - do Accuracy Checks (boxes I, J) and O,P.

I	**Tested Material** *(enter ID of Standard or NIST thermometer, or saturated water, or distilled water)*			
J	**Reading** (result in Tested Material)			

Use boxes K,L,M,N below when calibrating an Instrument that has adjustable readings.

K	**Calibrator Standard ID**			
L	**Reading before calibration**			
M	**Action taken**			
N	**Reading after calibration**			

Use for all calibration and accuracy checks

O	**Cal/AccurCheck Operator** *(your name)*			
P	**Comments**			

Note: If you are calibrating an oxygen electrode, write "air" or "saturated water" in the "Calibrator Standard ID" box above.

If you calibrate in air and can measure the absolute barometric pressure, write the value and unit here _____ *otherwise please indicate your elevation above sea level* _____.