WTW

a xylem brand

Photometry Compendium

in cooperation with G.I.T. LABORATORY JOURNAL

AQA

Analytical Quality Assurance

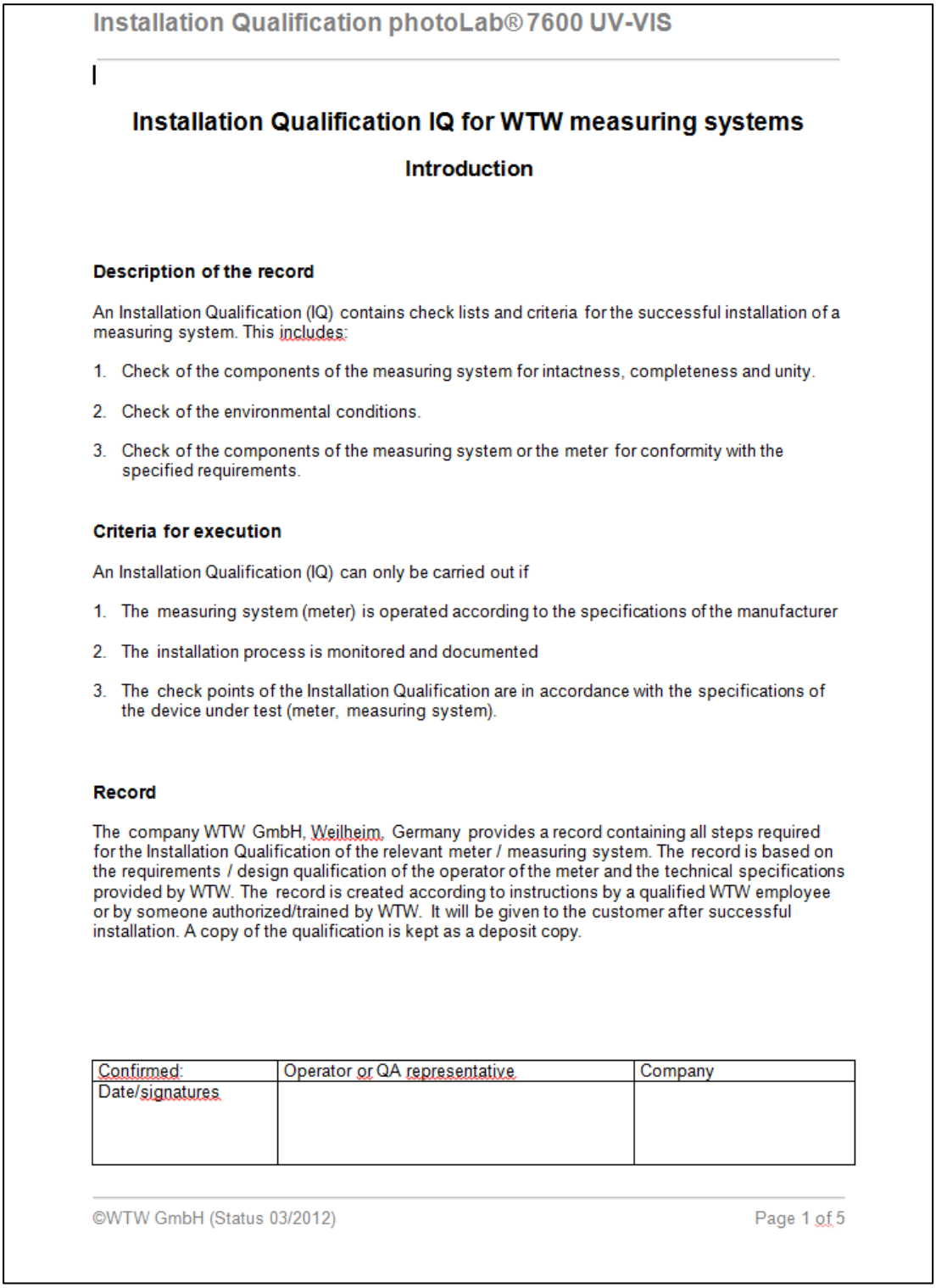
Proving the Plausibility of Readings

To prove that a measurement result is correct and to exclude or recognize potential error sources, many testing equipments and procedures are available. Especially in the analysis of wastewater and drinking water, legal regulations often explicitely prescribe the requirements or forms of self-checks that have to be completed. In manufacturing industries, service and research laboratories, standard procedures of operation (SOP) for internal quality control and device checks are common. This includes mainly:

- Installation of the instrument by “Installation Qualification” (IQ)
- Instrument Check
- Assurance of Measurement Plausibility

1.) Installation of the Instrument

Usually the installation is defined by a company specific "Installation Qualification" (IQ) procedure . The purpose is to make sure that the instrument is suitable for the given requirements and has the appropriate specifications. Frequently, the IQ is linked to a subsequent „Operation Procedure" (OP), which can be similar to a „ basic operation training".



Installation Qualification photoLab® 7600 UV-VIS

Installation Qualification IQ for WTW measuring systems

Introduction

Description of the record

An Installation Qualification (IQ) contains check lists and criteria for the successful installation of a measuring system. This includes:

1. Check of the components of the measuring system for intactness, completeness and unity.
2. Check of the environmental conditions.
3. Check of the components of the measuring system or the meter for conformity with the specified requirements.

Criteria for execution

An Installation Qualification (IQ) can only be carried out if

1. The measuring system (meter) is operated according to the specifications of the manufacturer
2. The installation process is monitored and documented
3. The check points of the Installation Qualification are in accordance with the specifications of the device under test (meter, measuring system).

Record

The company WTW GmbH, Weilheim, Germany provides a record containing all steps required for the Installation Qualification of the relevant meter / measuring system. The record is based on the requirements / design qualification of the operator of the meter and the technical specifications provided by WTW. The record is created according to instructions by a qualified WTW employee or by someone authorized/trained by WTW. It will be given to the customer after successful installation. A copy of the qualification is kept as a deposit copy.

Confirmed:	Operator or QA representative	Company
Date/signatures		

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Image 1: Sample of a IQ, page 1

2.) Instrument Check

Most instruments carry out a self-check upon turning-on: Depending on the instrument, e.g. the lamp is checked and a wavelength calibration is carried out.

For additional re-examination in daily routine use, many other testing equipments suitable for different instrument types are available:
Certified colour solutions like photoCheck® are for filter and spectrophotometers of the photoLab® Series as well as for the portable colorimeters of the photoFlex® Series. photoCheck® is an easy-to-handle testing equipment for many applications. The set is made up of 12 coloured solutions, to be measured at 3 wavelengths with 4 different absorbance levels. They prove photometric accuracy and wavelength accuracy.

Especially for spectrophotometers, there are a lot of highly sophisticated tools, reaching from glass to liquid filters provided by different manufacturers for testing wavelength accuracy, stray light, reproduceability etc. Many meters, like WTW's photoLab® 7600 UV-VIS are supporting the AQA tools by specific and easy to handle menus.

Image 2:

Selection of AQA testing equipments in the user menu of photoLab® 7600 UV-VIS

AQA1 setup	05/28/15 13:52
PhotoCheck	Active
CertiPUR® UV-VIS 1	Inactive
CertiPUR® UV-VIS 1A	Inactive
CertiPUR® UV-VIS 2	Inactive
CertiPUR® UV-VIS 3	Inactive
CertiPUR® UV-VIS 6	Inactive
User defined filter 1	Active
User defined filter 2	Inactive
User defined filter 3	Inactive
Lambda check 1	Inactive
Lambda check 2	Inactive
	Apply

3.) Assuring correct measurement results

a.) User administration and periodical monitoring intervals

Many lab meters allow to set intervals for tests with different testing tools and at different test levels. The programme automatically asks for the appropriate standard solution or performs an instrument self-check using the specific testing equipments, e.g. liquid or glass filters.

In bigger companies, the execution of the prescribed tests and checks is usually supervised by an administrator. Spectrophotometers like the photoLab® 7000 Series allow operational level settings for either administrator, user or guest access, thereby ensuring the company's quality definitions.

Image 3:

Sample test report of an AQA test with photoCheck® and photoLab® 7600 UV-VIS

Sample printout:

```
photoLab 6600 UV-VIS 09130512 1.30-WTW-1.60 Administrator
AQA1                                        OK
Protocol ID                                 9
Executed by:                                Administrator
Executed                                    22.05.2007
Valid until:                                26.06.2007

PhotoCheck          OC479094                OK
445-1               0.200 +- 100            0.192
445-2               0.500 +- 200            0.511
445-3               1.000 +- 200            1.006
445-4               1.500 +- 200            1.526
525-1               0.200 +- 200            0.247
.....               ............            .....
.....               ............            .....
(etc.)
```

If the AQA system is activated, the measurement results are marked with a AQS identification. At the end of the AQA interval, the settings either do not allow any more measurements at all, or allow only measurements without an AQA identification. The latter is the better option in many cases, since otherwise the instrument is blocked for ongoing measurements.

b.) Pipette Check

Pipettes always should be handled with care. A correct upright handling position prevents the contamination of the pipette's inner walls by traces of former samples. By maintenance and periodical pipette volume check with an analytical balance or a pipette testing equipment such as PipeCheck®, errors can be avoided that might derange the complete measuring system. In the worst case, the contamination might even disturb the chemical reaction in the cuvette.

c.) Control Standard Solutions

Performing a test with control standard solutions of default concentrations within the tolerance limits are the easiest way to check the entire system for accuracy and plausibility: If you find the correct value of the control standard within the given tolerance range, you can assume the photometer and the test kit are OK.

For the sample measurement itself, at least a duplicate reading is required to recognize outliners.

All results – samples and control standard – are an excellent verification of a correct measurement system. Wrong readings of the standard solutions are an evidence of a systematic measuring errors and support error investigation, e.g. by spiking.

d.) Matrix Check or Spiking

Adding a defined amount of standard solution, the reading must increase accordingly: if not, there is a disturbance in the sample matrix, leading to wrong results.

4.) Definition of Errors

Source: Operating Instructions of photoLab® S12, Part 1: General Information (www.wtw.com)

As a matter of principle, measurement results may be defective. This applies equally to standardized methods of analysis (reference methods) and to routine analysis. The discovery and the minimization of errors must be the objective here. A distinction is made between **systematic errors and random errors**.

Systematic errors are present when all the results of an analysis deviate from the true value by the same algebraic sign. Examples here include: a wrong sample volume, a wrong pH, a wrong reaction time, a sample matrix influence, etc.

- Systematic errors thus affect the accuracy of the method of analysis.
- Accuracy = Deviation of the measured concentration from the true concentration

Random errors manifest themselves in the form of a wide range of deviation of the results of a given sample. These can be kept to a minimum by ensuring good operating techniques and multiple determinations with calculation of the mean value. Random errors make the result of the analysis unreliable; they influence the **precision**.

- Precision = Dispersion of the results among each other

The following diagram illustrates the aspects of accuracy and precision: