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Qualification of a UV-Visible Spectrophotometer

Practical 15 - Bench practical

Aim

To evaluate wavelength, photometric and other relevant performance characteristics of a UV-visible spectrophotometer.

Principle

Instrument qualification uses appropriate traceable materials to test performance characteristics separately. A wavelength check concerns the location of spectral features; a photometric check concerns the accuracy of measured absorbance or transmittance.

The required materials, conditions and tolerances depend on the instrument, intended use and adopted compendial or laboratory procedure. A single absorbance reading cannot establish complete instrument qualification.

Materials and Requirements

- Identified UV-visible instrument and cells
- Suitable certified wavelength and photometric reference materials
- Method-required blanks and stray-light materials
- Qualification protocol and controlled raw-data forms

Procedure

1. Define the intended spectral range and the performance tests required for that application.
2. Record instrument configuration, software version, reference certificates, cell path length and environmental conditions.
3. Perform baseline and readiness checks before qualification measurements.
4. Measure certified spectral features under their specified conditions and calculate wavelength differences.
5. Assess photometric performance at the specified levels and, where required, linearity, resolution, stray light and repeatability.
6. Compare each result with the applicable criterion and investigate failures by an approved process.
7. Issue a qualification report linking raw data to each test, conclusion and next review condition.

Observations and Record

Enter actual measurements or the supplied teaching data. Record the method, material identity, conditions and units.

Test	Assigned value	Observed value	Error / conclusion
Wavelength feature	Certificate value	Record	Calculate difference
Photometric level	Certificate value	Record	Calculate difference
Repeatability	Protocol criterion	Record	Calculate variation
Other required test	Protocol criterion	Record	Evaluate

Calculations

- Wavelength error = observed wavelength - assigned wavelength
- Photometric error = observed absorbance - assigned absorbance

• RSD (%) = standard deviation / mean x 100

Worked Example

Illustrative wavelength feature: assigned 287.50 nm, observed 287.70 nm; error = +0.20 nm.

Illustrative photometric level: assigned absorbance 0.500, observed 0.503; error = +0.003.

The certificate uncertainty and adopted tolerance are part of the assessment. These illustrative values are not universal acceptance limits.

Result and Interpretation

• Report results by characteristic, rather than giving a single unsupported pass statement.
• Include any restriction on the qualified range or operating mode.
• Confirm suitability after relevant repair, relocation or configuration change according to the quality system.

Precautions

• Use the certificate conditions for each reference material.
• Keep cell orientation and cleanliness controlled.
• Avoid treating a calibration solution as a general-purpose reference outside its certified conditions.
• Preserve failed results and the investigation record.

Viva Questions and Answers

Are wavelength and absorbance accuracy the same?

No; they are different instrument characteristics.

Why assess stray light?

Unwanted light can bias high-absorbance measurements.

What must a qualification conclusion identify?

The tested configuration, range, criteria and supporting results.

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