How to check the performance, accuracy and precision of your liquid handlers, robots and pipettes?

Problem
Laboratories often assume that their liquid handling instruments, from pipettes to automated liquid handlers, are operating within specifications. However, because data integrity for applications, from drug discovery to molecular diagnostics, relies on accurate and precise liquid delivery, this is a risky assumption with potentially high failure costs.

Liquid-delivery instrumentation can be verified using gravimetry, which measures liquid weight on analytical balances. This method is adequate for larger volumes, but does not verify low volumes effectively. Indeed, the accuracy of gravimetric processes is impacted by a variety of environmental factors, including evaporation, static electricity and vibration. This uncertainty grows as test volumes decrease.

Other methods, including fluorometry and single-dye absorbance photometry, have limitations as well. In single-dye absorbance QC methods, the dynamic range of the chromophore is too narrow to evaluate all of the dilutions steps required to make the dose response curve. In contrast fluorometry provides the required sensitivity, but lacks the traceability associated with absorbance methods. These limitations often force users to make assumptions about the repeatability of the liquid handler over multiple aspirations and dispense cycles.

Solution
Ratiometric photometry—using measured light absorption at two wavelengths to determine delivered volume—has emerged as a reliable solution to the accuracy risks posed by other established methodologies. Highly accurate and precise, even at low volumes, ratiometric photometry provides laboratories with an easy-to-use method to quickly validate liquid handling performance enhance laboratory efficiency. This translates into greater data confidence, more reliable regulatory compliance, and cost reductions due to elimination of repeated assays and remedial action.

While the science behind ratiometric photometry for volume verification is complex, Maine-based Artel has been using it to lead the way in liquid handling quality assurance technology for the past 28 years. The company has evolved ratiometric photometry into the core of its technological strengths by integrating it into easy-to-use, robust, and rapid measurement systems for liquid handling equipment. Artel’s volume verification systems - the PCS® Pipette Calibration System and the MVS® Multichannel Verification System - employ ratiometric photometry through dual-dye, dual-wavelength absorbance measurements to determine a target volume of sample solution dispensed from a pipette or liquid handler.

Two colorimetric dyes, with distinct absorbance maxima at 520 nm (red dye) and 730 nm (blue dye), are used to make this measurement possible. Volume measurements are determined by applying the Beer-Lambert Law, which states that the measured absorbance of a dye is proportional to the concentration of a dye, the molar absorptivity of the dye, and the pathlength of the sample holder. If both the molar absorptivities and concentrations of the dyes are known and closely controlled, which is the case with Artel Sample Solutions, the law can be used to determine an unknown pathlength traversed by a photometric light beam. By measuring the pathlength through the solution and by knowing the dye concentrations in the Artel Sample Solutions, the unknown volume can be calculated through a series of equations.

The need for liquid delivery quality assurance is more critical than ever. Even as the regulatory environment in the life sciences becomes more stringent, budgets and staff continue to shrink. More than ever, laboratories require a more accurate, precise and convenient methodology to verify the performance of liquid handling instrumentation.

By providing labs with a user-friendly approach to ratiometric photometry, Artel’s volume verification systems strengthen confidence in assay results and enhance data quality. For more information, visit http://www.artel-usa.com/.

Rodrigues, G., Laboratory Manager, July 2010, 98.