Evaluation of the Eppendorf ep*Motion*® 10 µL Pipetting Tools Using the Artel® MVS®

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Abstract

The performance of the ep*Motion* automated liquid handling system with 10 µL dispensing tools was characterized using the third-party Artel MVS (Multichannel verification system). The single and the multichannel tools were employed to determine the accuracy and precision of the dispensing at multiple volumes over each tool's range. The combination of the Artel MVS and ep*Motion* systems effectively demonstrated that delivering sub-microliter volumes with high accuracy and precision is achievable.

Introduction

The ability to minimize sample and reaction volumes has become increasingly popular as a means to reduce laboratory reagent costs. For most operations, sample and budget limitations necessitate the reduction of repeat testing. Many factors contribute to assay variability and when handling small volumes precise liquid handling instrumentation is critical. Removing this source of error in the testing process is a tangible way of controlling risk. Evaluating the performance of liquid handlers allows researchers and industry professionals to rule out instrumentation as a source of variability, thereby reducing time spent on troubleshooting and reducing repeated procedures. A method for measurement of instrument performance that is fast, easy, and reliable is crucial to the effort to reduce re-work through increased reliability of liquid handlers. Additionally, the liquid handling instrumentation must be able to achieve acceptable performance for small volumes. The combination of the ep*Motion* workstations and the Artel MVS achieves both of these goals.

The Eppendorf ep*Motion* 5075 can be equipped with eight pipetting tools covering 0.2 µL–1,000 µL. To achieve the best performance, single-channel pipetting tools with four volume ranges (0.2–10 µL, 1–50 µL, 20–300 µL and 40–1,000 µL) are used to meet the most rigorous requirements for accuracy and precision for daily liquid handling. Moreover, tools are available in an 8-channel format for higher throughput. These automatically exchangeable pipetting tools are compatible with all ep*Motion* 5070/5073/5075 systems, ensuring universal performance regardless of specific workstations.

The Artel MVS is an easy-to-use, universal system that provides performance assessment for every liquid handling instrument used in an assay's workflow. With its ability to determine accuracy and precision performance on a tip-by-tip, or well-by-well basis, the MVS dramatically reduces the time and effort needed to ensure that liquid handlers, mixers, or plate washers are performing optimally. The MVS produces results that are traceable to the International System of Units (SI).

Materials and Methods

For this study, an MVS (Artel, Westbrook, ME, USA) was used to measure the performance of the ep*Motion* 10 μL tools. The MVS is comprised of the following components: a microtiter plate reader, a bar code reader, a microtiter plate shaker, a calibrator plate, sample and diluent solutions, dimensionally characterized microtiter plates, and system-specific software (Data Manager 3.0 Advanced). The six different MVS sample solutions contain a fixed concentration of blue dye and red dye that is in a specific concentration relating to a specific volume measurement range which spans from 350 μL to 30 nL. For the tests presented here, we used four different solutions. The smaller the volume to be measured, the higher the concentration of red dye used in the sample solution. MVS diluent contains only the blue dye at the same concentration as in the sample solutions. The diluent is used to bring the wells to an optimal total solution volume which is necessary for making comparable pathlength measurements in each well. The workflow for an MVS experiment involves aspirating and dispensing a target volume of the appropriate sample solution into a vessel containing the diluent solution. After mixing the sample and diluent solutions, the absorbance values of both dyes are measured in each test well and the system software calculates the volume of sample solution present in each well. The MVS reports both the accuracy and precision of the volume delivered by each channel of an instrument in a single experiment. Results are traceable to the International System of Units (SI) through reference standards developed and maintained by the National Institute of Standards and Technology, USA (NIST). The system reports inaccuracy < 2 % and imprecision < 0.4 % CV for most volumes.

An ep*Motion* 5075 system (Eppendorf AG, Hamburg, Germany) was utilized with the following components: ep*Motion* 5075, software, dispensing tools (TS 10 and TM 10-8), epT.I.P.S.® Motion, 1.5 mL tubes, 10 mL reservoir and Eppendorf twin.tec ® 96 well skirted PCR plates. The ep*Motion* 5075 was programmed to dispense a series of target volumes (0.2, 0.5, 1.0, 5.0, and 10 μL). Volumes ≥ 1 μL were delivered with free-jet dispensing and volumes ≤ 0.5 μL were delivered by contact dispensing. The values, as reported by the MVS, were compared to the published ep*Motion* 5070/5073/5075 technical specifications shown in Table 1 that were measured by gravimetric methods based on ISO 8655.

Results

The technical specifications for the ep*Motion* 5070/5073/5075 single- and multichannel 10 μL dispensing tools can be found in Table 1. The experimental data determined by the MVS for the single-channel dispensing tool and the multichannel dispensing tool can be found in Tables 2 and 3 respectively.

Table 1: Technical specifications for the ep*Motion* single- and multichannel tools

Dispensing tool	Target volume (μL)	Relative inaccuracy %	CV %
TS 10	0.2	25	19.8
TS 10	1	5	3
TS 10	5	2.4	0.5
TS 10	10	1.2	0.25
TM 10-8	1	7.5	5
TM 10-8	5	2.5	2
TM 10-8	10	2	0.6

MVS sample solutions were aspirated from the appropriate sources and dispensed into the characterized 96-well microtiter plates. Target volumes were selected to span the entire volume range of the dispensing tool (200 nL–10 μL). In the single-channel dispensing tools experiments, three columns of the plate were filled (n=24). In experiments using the 8-channel dispensing tool, 32 wells (four columns) were filled. Tips were changed prior to each aspiration from the source vessels. The ep*Motion* was used in a non-environmentally controlled laboratory setting to deliver the solutions. Prior to automated dispensing the test solutions, the diluent solution (200 μL) was added with a multichannel pipette (Eppendorf Research® plus 8-channel, 30–300 μL).

Table 2: Measured performance of the ep*Motion* 10 μL single-channel tool TS 10 (n=24)

Target volume (μL)	Average volume (μL)	Relative inaccuracy %	CV %
0.2	0.21632	8.16	1.76
0.5	0.51365	2.72	0.7
1	1.01133	1.13	0.64
5	4.97323	-0.55	0.14
10	10.03763	0.37	0.27

Table 3: Measured performance of the ep*Motion* 10 μL multichannel tool TM 10-8 (n=32)

Target volume (μL)	Average volume (μL)	Relative inaccuracy %	CV %
0.2	0.21508	7.54	3.42
0.5	0.49783	-0.43	2.14
1	1.0031	0.31	1.97
5	5.0498	1.0	0.31
10	9.98904	-0.11	0.34

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Conclusion

Third-party evaluation of a system against its claimed technical specifications is perhaps the most valuable method of assessing the instrument's true capability. Artel specializes in third-party testing of manual and automated liquid handler performance as these instruments are used in everyday practice. A number of makes and models of liquid handlers have been subjected to the highly reliable MVS performance assessment, and this test has become an indispensable part in validation protocols of many regulated laboratories. In this study, the Artel MVS was used to determine that the ep*Motion* liquid handling system equipped with the 10 µL dispensing tools easily exceeded the vendor specified accuracy and precision for all volumes and tools analyzed. These results demonstrate that the ep*Motion* 10 µL dispensing tools can produce both accurate and precise liquid dispensing results with the advantages of an automated device. The ep*Motion* system avoids common errors that can be associated with manual pipetting and thereby will reduce the need for repeated work, lower the volumes of reagents required, and reduce unnecessary spending.

Ordering information

Description	Catalog No.
TS 10 single-channel dispensing tool	5280000100
TM 10-8 multichannel dispensing tool	5280000304
epT.I.P.S.® Motion pipette tips, with filter, 10 µL	0030014391
10 mL reservoir for use with ep*Motion*® reservoir rack	0030126521