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Evaluation of the Eppendorf ep*Motion*® Pipetting Tools using the Artel MVS®

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Abstract

The performance of the ep*Motion* 5070 has been fully characterized using the third-party Artel MVS. Both single and multi-channel tools were employed to determine the accuracy and precision of the instrument dispense at multiple volumes over the tool's range.

As illustrated by the results, the instrument was capable of achieving an average inaccuracy of less than 1% and average precision of less than 0.75% for all tools at all volumes tested.

Introduction

With budgets forever tightening and patient samples being limited, reduction of repeat testing has become a common goal of almost all laboratories regardless of their operation. Many factors contribute to assay variability, one of which is instrumentation. Removing this source of error in the testing process is a tangible way of controlling risk.By understanding and optimizing the performance of liquid handlers these instruments may be ruled out as a source of variability reducing time spent on troubleshooting and reducing repeat testing overall.

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. The combination of the ep*Motion* 5070/5075 workstations and the Artel MVS achieve both of these goals.

The Eppendorf ep*Motion* 5070/5075 is equipped with six pipetting tools covering 1–1,000 µL that are commonly used in biological laboratories. To achieve the best performance, single-channel pipetting tools with three volume ranges (1–50 µL, 20–300 µL and 40–1,000 µL) are used to meet the most rigorous requirements on accuracy and precision for daily liquid handling. Moreover, each tool comes in 8-channel format as well for higher throughput. These pipetting tools are compatible to all ep*Motion* 5070/5075 systems, ensuring universal performance regardless of specific workstations.

The MVS is an easy-to-use, universal system that provides performance assessment for every liquid handling instrument used in the assay 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 and 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) was used to measure the performance of the ep*Motion*. 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 350 µL to 30 nL. The smaller the volume to be measured, the higher the concentration of red dye in the sample solution. MVS diluent contains only the blue dye at the same concentration as in the sample solutions. The workflow for an MVS experiment involves aspirating and dispensing a target volume of the appropriate sample solution using the liquid handler and protocol under test. The MVS diluent is used to bring the wells to an optimal total solution volume which is necessary for making pathlength measurements in each well. 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* 5070 system (Eppendorf AG, Hamburg, Germany) was utilized with the following components: ep*Motion* 5070, software, dispensing tools (TS-50, TS-300, TS-1000, TM 50-8, TM 300-8, TM 1000-8), epT.I.P.S.® *Motion*, and 30 mL reagent reservoirs. The ep*Motion* 5070 was programmed to dispense a series of target volumes.

MVS sample solutions were aspirated from the appropriate 30 mL reagent reservoir and dispensed into the characterized 96-well microtiter plates.

Target volumes were selected to span the entire volume range of the dispensing tool. In experiments using the 8-channel dispensing tools (TM 50-8, TM 300-8, TM 1000-8), an entire plate was filled (n=96). In the single-channel dispensing tools experiments (TS-50, TS-300, TS-1000), two columns of the plate were filled (n=16). The ep*Motion* was used in a non-environmentally controlled laboratory setting to deliver both the sample and the diluent solutions. Tips were changed between each solution type. The values, as reported by the MVS, were compared to the published ep*Motion* 5070/5075 technical specifications.

Results

The technical specifications for the epMotion 5070/5075 single- and multichannel dispensing tools can be found in Table 1. The experimental data determined by the MVS for the single-channel dispensing tools and the multichannel dispensing tools 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 50	5.0	10.0	4.0
TS 50	25.0	2.0	0.8
TS 50	50.0	1.0	0.4
TS 300	30.0	7.0	3.0
TS 300	150.0	1.6	0.6
TS 1000	100	4.0	1.5
TM 50-8	5.0	15.0	6.0
TM 50-8	25.0	3.0	1.2
TM 50-8	50.0	1.5	0.6
TM 300-8	30.0	10.0	4.5
TM 300-8	150.0	3.0	1.2
TM 1000-8	100	6.0	2.3

Table 2: Measured performance of the ep*Motion* single-channel tool.

Dispensing Tool	Target Vol. (µL)	Average Vol. (µL)	Relative Inaccuracy%	CV%
TS 50	1.0	1.0543	5.43	1.58
	5.0	5.1330	2.66	0.29
	10.0	10.0690	0.69	0.25
	25.0	25.1600	0.64	0.12
	50.0	50.32	0.64	0.20
TS 300	20.0	19.83	–0.85	0.20
	30.0	29.95	–0.17	0.10
	100.0	99.70	–0.30	0.07
	150.0	149.90	–0.07	0.13
	300.0	302.10	0.70	0.13
TS 1000	40	39.67	–0.82	0.23
	45	44.74	–0.58	0.25
	50	49.76	–0.48	0.30
	100	100.94	0.94	0.25
	200	202.70	1.35	0.10

Table 3: Measured performance of the ep*Motion* multichannel tool.

Dispensing Tool	Target Vol. (µL)	Average Vol. (µL)	Relative Inaccuracy%	CV%
TM 50-8	1.0	0.9945	–0.55	1.30
	5.0	5.0530	1.06	0.42
	10.0	10.0830	0.83	0.26
	25.0	25.1300	0.52	0.16
	50.0	50.00	0.00	0.32
TM 300-8	20.0	19.63	–1.85	1.53
	30.0	29.15	–2.83	1.48
	100.0	99.55	–0.45	0.31
	150.0	149.70	–0.20	0.27
	300.0	301.10	0.37	0.20
TM 1000-8	40	39.86	–0.35	0.50
	45	44.89	0.24	0.65
	50	49.62	–0.76	0.52
	100	100.09	0.09	0.31
	200	201.00	0.50	0.10

Conclusion

Third-party evaluation of a system against its claimed 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 the 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 use of the Artel MVS to measure the performance of the Eppendorf ep*Motion* 5070/5075 automated liquid workstation provided the means by which to determine that the instrument easily exceeds Eppendorf's specifications for the accuracy and precision for all volumes and all tools analyzed. These results demonstrate that the ep*Motion* 5070/5075 can produce both accurate and precise liquid dispensing results with the advantages of an automated device, while avoiding common errors that can be associated with manual pipetting and thereby may reduce the need for repeated work and unnecessary spending.

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