Applications

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Measuring the Accuracy and Precision of the epMotion® 5070 Workstation using the Artel Multichannel Verification System (MVS®)

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Abstract

The Artel MVS has been utilized to provide inaccuracy and imprecision data for the ep*Motion* 5070 automated liquid handler. The results for an entire set of single and multichannel dispensing tools were all within the specified performance claims of the ep*Motion* system. These results demonstrate that the ep*Motion* 5070 can produce both accurate and precise liquid dispensing results while providing the advantages of an automated device at the same time.

Introduction

In response to the need to automate molecular biology methods, automated liquid handling technology has been the focus of extensive research and development. The ep*Motion* 5070 (Figure 1) is a new state of the art liquid handling platform. Based on the air cushion piston stroke system, a technology that has been proven for decades, the ep*Motion* is designed to optimize liquid handling requirements. These platforms are not only easy to use, but they reduce contamination and perform with high accuracy and precision over a large volume range (from 1,000 µl down to 1.0 µl).

As automated liquid handling technology advances, the need to ensure quality in a laboratory process has become increasingly important. Knowing the exact volume transferred will help produce accurate and precise analysis of the experiment (i.e., the results can be trusted). Too often, however, the importance of liquid delivery is overlooked. In these situations, imprecise or inaccurate dispensing may not be diagnosed and may lead to a false sense of performance for either the assay or the automated liquid handler.

As throughput increases and assay volumes decrease, there are more demands for accuracy and precision of each volume transfer task. A volume verification system, such as the Artel MVS (Multichannel Verification System, Figure 2), can be used to rapidly quantify most, if not all, of the critical volume transfers associated with an assay. The analysis performed herein is based upon a dual-dye ratiometric photometry approach employed by the Artel MVS. When the MVS is employed as a diagnostic tool, liquid handler performance becomes clear, which in turn can reduce downstream troubleshooting, resource requirements, and economic loss. The study reported herein illustrates how an MVS can be utilized as a diagnostic tool for an automated liquid handler, the Eppendorf ep*Motion* 5070.

Materials and Methods

For this study, an MVS (Artel, Inc., Westbrook, Maine) 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 96-well microtiter plates, and system-specific software (Data Manager 2.1 Advanced).

The five different MVS sample solutions contain a fixed concentration of blue dye, but variable concentrations of red dye, and can test over a volume range of 200 µl to 0.1 µl. MVS diluent contains the same concentration of blue dye as in the sample solutions but no red dye. The basic 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 total solution volume in each test well up to 200 µl. 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. Results are traceable to NIST, with system specifications of Inaccuracy < 3% and Imprecision < 1.5 % CV. Thus by measuring the absorbance of both dyes in each test well, the MVS can determine both the accuracy and precision of the volume delivered by each channel of a multichannel liquid delivery device in a single experiment.
An ep*Motion* 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 Filtertips, 40 mm height adapter, and 30 ml reagent reservoirs. The ep*Motion* 5070 was programmed to dispense varying volumes of MVS sample solutions from the appropriate 30 ml reagent reservoir into the characterized 96-well microtiter plates. For the 8-channel dispensing tools (TM 50-8, TM 300-8, TM 1000-8), an entire plate was filled (n=96). For the single channel dispensing tools (TS-50, TS-300, TS-1000), two columns were filled (n=16). Tips were changed between sample solutions and before delivering Diluent solution. Target volumes were selected to not only correspond to the technical specifications/values published in the ep*Motion* 5070 Manual, but to span the entire volume range of the dispensing tool.

The ep*Motion* 5070 was used, in a non-environmentally controlled laboratory setting, to dispense both the Sample and Diluent solutions into characterized 96-well microtiter plates. The plate reader measured the absorbance of both dyes in each test well in each plate, and the average volume (µl), relative inaccuracy for all channels (%), and coefficient of variation for all channels (%), were determined by the Data Manager software. The values, as reported by the MVS, were compared to the published ep*Motion* 5070 technical specifications.

Results

The technical specifications for the ep*Motion* 5070 single channel dispensing tools 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 & 3.

Table 1: Technical specifications for the ep*Motion* 5070 single and multichannel dispensing tools.

Dispensing Tool	Target Vol. (µl)	Relative Inaccuracy ± (%)	Coefficient of Variation ≤ (%)
TS 50	5	10	4
TS 50	25	2	0.8
TS 50	50	1	0.4
TS 300	30	7	3
TS 300	150	1.6	0.6
TS 1000	100	4	1.5
Dispensing Tool	**Target Vol. (µl)**	**Relative Inaccuracy ± (%)**	**Coefficient of Variation ≤ (%)**
TM 50-8	5	15	6
TM 50-8	25	3	1.2
TM 50-8	50	1.5	0.6
TM 300-8	30	10	4.5
TM 300-8	150	3	1.2
TM 1000-8	100	6	2.3

Table 2: : MVS data for the ep*Motion* 5070 single channel dispensing tools.

Dispensing Tool	Target Vol. (µl)	Average Vol. (µl)	Relative Inaccuracy (%)	Coefficient of Variation (%)
TS 50	1	0.9089	-9.1100	1.9364
	2	1.9863	-0.6850	0.3272
	5	4.8914	-2.1720	0.3435
	8	7.8552	-1.8100	0.5563
	10	9.8917	-1.0830	0.5085
	25	24.8988	-0.4048	0.3105
	45	44.8842	-0.2573	0.2651
	50	50.0230	0.0460	0.2773
TS 300	20	19.8278	-0.8610	0.4428
	30	30.0193	0.0643	0.4201
	40	39.8654	-0.3365	0.7232
	50*	50.2333	0.4666	0.5542
	100	100.0910	0.0910	0.3590
	150	150.2507	0.1671	0.3089
	200	199.1691	-0.4155	0.3169
TS 1000	40	39.9003	-0.2492	0.6719
	45	44.6249	-0.8336	0.8713
	50	50.2114	0.4228	0.3933
	100	100.1696	0.1696	0.3551
	200	199.5379	-0.2310	0.3331

Table 3: MVS data for the ep*Motion* 5070 multichannel dispensing tools.

Dispensing Tool	Target Vol. (µl)	Average Vol. (µl)	Relative Inaccuracy (%)	Coefficient of Variation (%)
TM 50-8	1	0.8865	-11.3500	1.6356
	2	1.9123	-4.3850	0.8785
	5	4.8712	-2.5760	0.6733
	8	7.8574	-1.7825	0.5511
	10	9.9148	-0.8520	0.5961
	25	24.9009	-0.3964	0.6341
	45	44.8466	-0.3409	0.3853
	50	49.7874	-0.4252	0.4632
TM 300-8	20	20.2442	1.2210	1.9714
	30	29.9717	-0.0943	1.5648
	40	39.8476	-0.3810	1.1245
	50*	50.0592	0.1184	1.6626
	100	100.5359	0.5359	1.8243
	150	149.0992	-0.6005	0.5656
	200	197.4680	-1.2660	0.4147
TM 1000-8	40	39.6420	-0.8950	1.0136
	45	44.5612	-0.9751	0.8047
	50	49.6733	-0.6534	0.6980
	100	98.9835	-1.0165	0.4480
	200	198.3391	-0.8304	0.3811

* There are no published technical specifications, for the TS 300 and TM 300-8, at 50 µl. The values found in Table 1 for this volume apply only to the TS 50 and TM 50-8 dispensing tools.

Conclusion

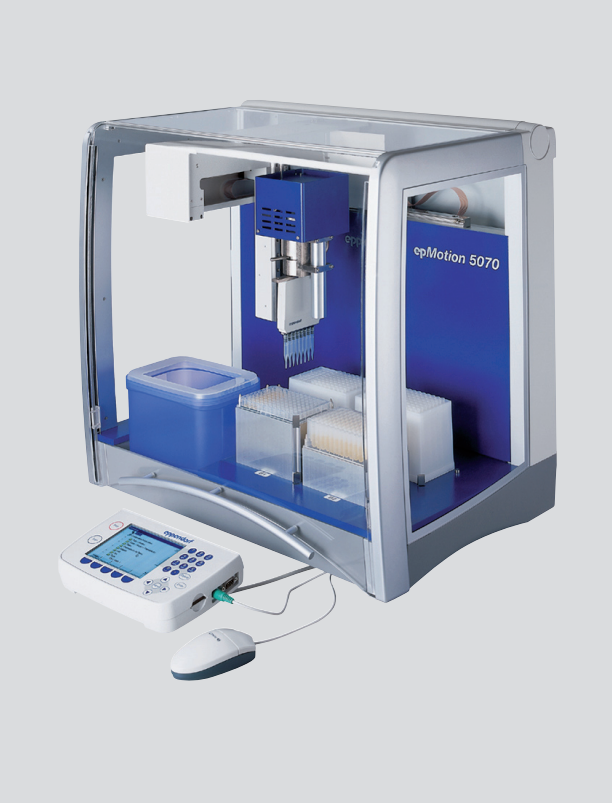

Figure 1: Eppendorf ep*Motion* 5070 - Automated Pipetting System

In this study, the MVS has been utilized to provide relative inaccuracy and coefficient of variation data for the ep*Motion* 5070 automated liquid handler. Specifically, an entire set of single and multichannel dispensing tools were tested over their volume ranges. The results, for both relative inaccuracy and coefficient of variation, are all within the specified performance claims of the ep*Motion* system. These results demonstrate, that the ep*Motion* 5070 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. In summary, the results generated by the MVS clearly show that the ep*Motion* 5070 system meets or exceeds all of Eppendorf's specifications for both relative inaccuracy and coefficient of variation.

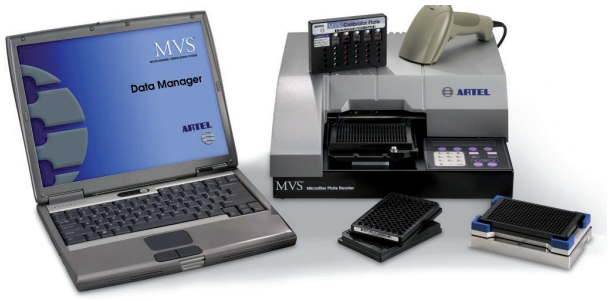

Figure 2: Artel Multichannel Verification System (MVS)

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