Reducing Costs by Improving Liquid Handling

Dana Campbell, Tanya Knaide*
Keith Roby**

Abstract

Lowering costs and reducing repeat testing are common interests in all areas of life science. Removing sources of variability from test processes reduces error leading to rework, lowers risk and increases reliability of results. One likely source of variability, which is easily controlled, is liquid handling. By understanding and optimizing a liquid handler's performance, the volume transfer may be ruled out as a source of assay variability, allowing laboratories to reduce the amount of time spent on repeat testing and troubleshooting tasks.

A reliable method for measurement of liquid handler performance that is easy to use, requires little training and does not absorb technician time is crucial to efforts for reducing liquid handling variability in assays. The Beckman Coulter Biomek 4000 and the Artel MVS combine expertise in liquid handling and liquid volume measurement needed to provide confidence in liquid handling as part of laboratory processes. This presentation describes the use of the Artel MVS to measure and facilitate the optimization of a Beckman Coulter Biomek 4000 liquid handler in combination with commonly used tools and disposable tips. The results of this study will show that the performance of the Biomek 4000 may be adjusted to meet the specifications set by the manufacturer which allows users to reduce liquid handling variability in their processes.

Materials & Methods

During this study, the accuracy and precision of dispensed volumes using four pipetting tools on one Biomek 4000 (B4K) were measured using the Artel MVS with specified volume and tip combinations to cover the dispensing range of the instrument.

From Beckman Coulter:	
Biomek 4000	
Biomek Software	version 4.0.20
Biomek 4000 P20 Single-Tip Pipette Tool	Part No. 987367
Biomek 4000 MP20 Eight-Tip Pipette Tool	Part No. 391900
Biomek 4000 P200L Single-Tip Pipette Tool	Part No. 987368
Biomek 4000 MP200 Eight-Tip Pipette Tool	Part No. 986146
Labware:	
Biomek AP96 P20 Tips (non-sterile)	Part No. 717254
Biomek P50 Tips (non-sterile)	Part No. A21578
Biomek AP96 P250 Tips (non-sterile)	Part No. 717251
Frame for Reservoir	Part No. 372795
Qtr. Reservoir, Polypropylene, Divided by Length	Part No. 372788

From Artel:	
MVS with Data Manager Software	version 3.1
96-well Verification Plates	Part No. MVS-230
MVS Calibrator Plate	Part No. MVS-615
Sample Solutions	Part No. MVS-203-207
Diluent	Part No. MVS-202

Other Materials:	
Rainin 8 channel pipette	for non-quantitative solution addition

Procedure

The pipetting technique within the Biomek software combines a variety of pipetting parameters that can be user defined.[1] The software also contains predefined default techniques to help guide users to quickly and easily develop methods. In this study, Biomek methods were created from default parameters to test a variety of volume transfers. Minor adjustments to the default parameters were initially made to optimize the transfer. For example, the tip touching routine was removed and the aspirate and dispense tip heights were adjusted to 4 mm below the liquid level.

The Artel MVS was employed by pre-filling Artel Verification Plates with Diluent solution using a handheld, 8-channel pipette. Next, the B4K performed the pipetting transfer of the appropriate Artel Sample Solution into the Verification Plate using a specified Biomek tool and tip combination for the target volume of interest. The solutions in each plate were mixed on the MVS plate shaker to properly homogenize the solutions. The absorbances of both dyes were then measured at specific wavelengths using the MVS plate reader to ultimately determine the volume of transferred sample solution.[2]

Three data points for each target volume were initially measured to determine the accuracy and provide a baseline value. The Biomek software makes it very simple to quickly and easily improve the accuracy by adjusting a software parameter called the offset value which is located in the calibration tab of any pipetting technique.[1] Essentially, this is the process of calibration. The offset value was adjusted if needed and an additional 8 measurements were taken for each target volume as shown in Table 1. It should be noted that to save time when testing multiple volumes, the initial default offset value of zero does not have to be used. At times throughout this study, the previously determined offset value was used as the initial starting point. It may not be necessary to adjust the offset value if the initial accuracy is within desired specification. Figures 1-4 depict each tool's before and after accuracy measurement. Note the absolute value for the accuracy is used to simplify viewing the bar graphs.

Results

Performance with two tip types for each tool was measured before and after optimization of the method. All numerical data is displayed in Table 1. Manufacturers performance specifications for the B4K are displayed in Table 2 and graphical illustrations of a portion of the data set are shown in Figures 1-4 which show the before and after optimization volume measurements from the tools with one tip type.

Measured Performance of Biomek 4000 Liquid Handler					
Target Vol. (µL)	Biomek Tool	Tip Type	Relative Inaccuracy (%) Before	Relative Inaccuracy (%) After	Imprecision CV (%)
1	P20	P20	-3.47	2.83	5.6
2	P20	P20	0.4	0.35	1.45
5	P20	P20	0.3	0.29	1.02
25	P20	P20	-1	-0.5	0.2
1	P20	P50	3.39	3.1	6.97
10	P20	P50	13	-0.9	0.22
25	P20	P50	-0.5	-0.48	0.14
1	MP20	P20	-30	2.07	2.53
2	MP20	P20	-13	1.3	1.75
5	MP20	P20	-1.23	-0.54	1.25
25	MP20	P20	-5.2	-0.4	0.3
1	MP20	P50	1.5	2.24	2.41
2	MP20	P50	8.2	-0.53	2.08
5	MP20	P50	10	0.51	0.59
10	MP20	P50	-1.3	-0.68	0.27
25	MP20	P50	1.3	0.32	0.34
10	P200L	P50	-3	-0.28	0.59
80	P200L	P50	3.5	0.13	0.3
10	P200L	P250	8.8	1.5	0.58
100	P200L	P250	-5	-0.34	0.09
200	P200L	P250	-4	0.02	0.09
10	MP200	P50	19.1	0.45	0.32
80	MP200	P50	4.5	-0.45	0.21
10	MP200	P250	-4.9	0.66	1.07
100	MP200	P250	-1.14	0.44	0.15
200	MP200	P250	-1.3	-0.77	0.17

Table 1. Accuracy and precision (%CV) results for each tool/tip combination measured by MVS

Biomek 4000 Instrument Performance Specifications				
Transfer Volume	Pipetting Tool	Biomek Pipette Tip	Inaccuracy +/- (%)	Imprecision ≤ (%)
1 µL	P20 & MP20	P20	5	7
2 µL	P20 & MP20	P20	3	5
5 µL	P20 & MP20	P20	3	3
100 µL	P1000SL & MP1000	P1000	4	2
200 µL	P200L & MP200	P250	3	2
1000 µL	P1000SL & MP1000	P1000	2	5

Table 2. Manufacturer's Performance Specifications

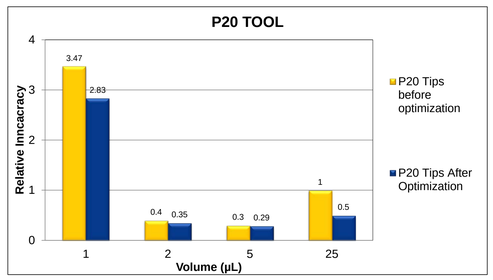

Figure 1. P20 Tool with P20 tips accuracy summary of before and after optimization.

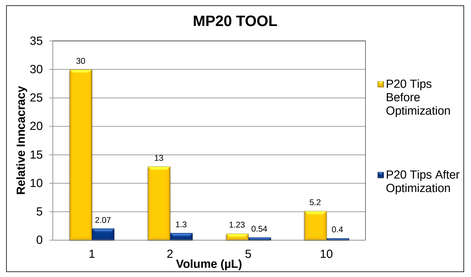

Figure 2. MP20 Tool with P20 tips accuracy summary of before and after optimization.

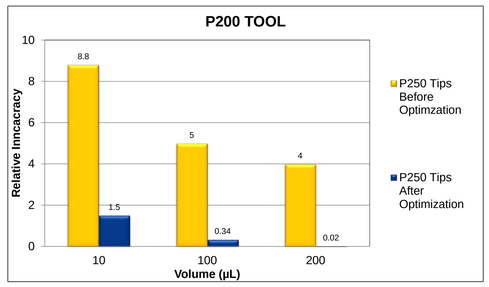

Figure 3. P200 Tool with P250 tips accuracy summary of before and after optimization.

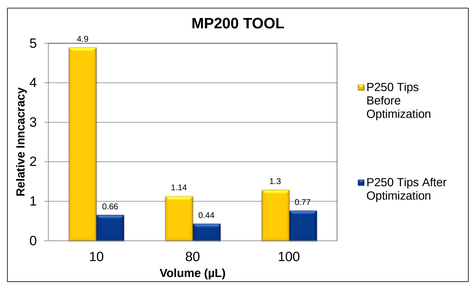

Figure 4. MP200 Tool with P250 tips accuracy summary of before and after optimization.

Conclusion

There is often a choice regarding the tool/tip combination to use for dispensing a specific volume of interest with the B4K. It may be that one tip type is more appropriate than another because of the tip length or volume capacity. For example, the P50 and P250 tips are longer than a P20 tip and may access deeper labware. Many of the combinations overlap and the choice is often left to the user to decide. The data presented in Table 1 show that the performance of the tested B4K tools and corresponding tip types proved better than the manufacturer's stated performance specifications regardless of the tool/tip combination selected. The data also demonstrates that highly accurate and repeatable pipetting transfers are achievable with the B4K and that the Artel MVS facilitates this achieving this performance.

This study concludes that employing the B4K in combination with Artel MVS allows users to significantly reduce variability from liquid handling in their overall testing processes within the laboratory leading to reductions in re-work and associated costs, lower risk and increased reliability of assay results.

References

1. Artel application note entitled, "Optimizing Accuracy Performance on a Beckman Coulter Biomek Using the Artel MVS" Doc #12A6478, 2013.

2. Dong, H.; Ouyang, Z.; Liu, J.; Jamal, M.: The Use of a Dual Dye Photometric Calibration Method to Identify Possible Dilution From an Automated Multichannel Liquid Handling System. J. Assoc. Lab. Autom., 2006, 11, 60-64.

* Artel Inc., 25 Bradley Drive, Westbrook Maine 04092 phone: 1-888-406-3463 • email: info@artel-usa.com web: www.artel-usa.com

** Beckman Coulter, Inc., 5350 Lakeview Parkway S Drive, Indianapolis Indiana 46268 phone: 1-800-742-2345 web: www.beckmancoulter.com