# Pipetting Performance Testing of a Beckman Coulter Biomek 4000 with the Artel MVS®

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**ABSTRACT:**

A common interest in all areas of life science: lower costs and reduce repeat testing. Removing sources of variability from test processes reduces error leading to rework, lowers risk and increases reliability of the 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.

This application note 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. According to this study, the performance of the Biomek 4000 may be adjusted to easily meet the specifications set by the manufacturer allowing users to reduce liquid handling variability in their processes.

## INTRODUCTION:

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 the expertise in liquid handling and liquid volume measurement needed to provide confidence in liquid handling as part of laboratory processes.

The modular deck configuration of the Biomek 4000 allows users to set up the work surface with the standard eight positions and is expandable to 12. Improved tools enable higher throughput for assays requiring high volume transfers. Additionally, Beckman Coulter manufactures tips that provide optimal performance for the Biomek 4000.

The MVS is an easy-to-use, third party volume measurement system that provides performance assessment for every liquid handling instrument used in the assay workflow. The MVS dramatically reduces the time and effort needed to ensure that liquid handling instrumentation is performing optimally by determining accuracy and precision performance on a tip-by-tip and well-by-well basis. The MVS produces results that are traceable to the International System of Units (SI).

## MATERIALS & METHODS:

During this study, the accuracy and precision of four pipetting tools on one Biomek 4000 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 |
| QualAssure 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 build and develop methods. In this study, the Biomek methods used to complete pipetting transfers utilized default techniques and the default liquid type of water to complete basic volume transfer steps. Throughout this experiment, only small adjustments were made to the default parameters. Those adjustments included a tip height adjustment to allow the tips to aspirate and dispense 4 mm below the liquid level and the tip touching routine was removed.

Artel Verification Plates were pre-filled with Diluent solution using a handheld, 8-channel pipette. Artel QualAssure solutions at the volumes of interest were then wet-dispensed into the Diluent filled wells. For this evaluation, the tools that accommodate the volume range of 1 – 200 µL were studied. After volume transfer, each plate was shaken on the MVS shaker to properly mix the dyes and the absorbance of both dyes was measured at specific wavelengths using the MVS to ultimately determine the amount of transferred volume.[2]

Initially, three data points for each target volume were measured to determine a baseline performance level for the Biomek tool and respective tip type. Adjustments were subsequently made to the offset volume within in the calibration tab of the technique, which is one method to improve transfer accuracy[1]. Once the parameter was adjusted, at least 8 data points were collected for each target volume.

## RESULTS & DISCUSSION:

In all test cases, using default parameters with one adjustment to the offset value at each volume, the inaccuracy and imprecision (%CV) performance measured by the MVS (Table 1) is better than the published performance specifications (Table 2) for the Biomek 4000. In the test cases where the Biomek 4000 performance of the instrument is not specified by the manufacturer, this experiment indicates only measured performance for the volume/tool/tip combination.

| Measured Performance of Biomek 4000 Liquid Handler | | | | |
|---|---|---|---|---|
| Target Vol. (µL) | Biomek Tool | Tip Type | Relative Inaccuracy (%) | Imprecision CV (%) |
| 1 | P20 | P20 | 2.83 | 5.6 |
| 2 | P20 | P20 | 0.35 | 1.45 |
| 5 | P20 | P20 | 0.29 | 1.02 |
| 25 | P20 | P20 | -0.5 | 0.2 |
| 1 | P20 | P50 | 3.1 | 6.97 |
| 10 | P20 | P50 | -0.9 | 0.22 |
| 25 | P20 | P50 | -0.48 | 0.14 |
| | | | | |
| 1 | MP20 | P20 | 2.07 | 2.53 |
| 2 | MP20 | P20 | 1.3 | 1.75 |
| 5 | MP20 | P20 | -0.54 | 1.25 |
| 25 | MP20 | P20 | -0.4 | 0.3 |
| 1 | MP20 | P50 | 2.24 | 2.41 |
| 2 | MP20 | P50 | -0.53 | 2.08 |
| 5 | MP20 | P50 | 0.51 | 0.59 |
| 10 | MP20 | P50 | -0.68 | 0.27 |
| 25 | MP20 | P50 | 0.32 | 0.34 |
| | | | | |
| 10 | P200L | P50 | -0.28 | 0.59 |
| 80 | P200L | P50 | 0.13 | 0.3 |
| 10 | P200L | P250 | 1.5 | 0.58 |
| 100 | P200L | P250 | -0.34 | 0.09 |
| 200 | P200L | P250 | 0.02 | 0.09 |
| | | | | |
| 10 | MP200 | P50 | 0.45 | 0.32 |
| 80 | MP200 | P50 | -0.45 | 0.21 |
| 10 | MP200 | P250 | 0.66 | 1.07 |
| 100 | MP200 | P250 | 0.44 | 0.15 |
| 200 | MP200 | P250 | -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**

## CONCLUSIONS:

There is often a choice regarding the tool/tip combination to use for dispensing a specific volume of interest. It may be that one tip type is more appropriate because of the tip length. 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 may go to the user for their specific needs. The data presented in Table 1 indicate that the performance of the Biomek 4000, tools and corresponding tip types are superior to the claimed performance regardless of the combination selected, giving confidence to the user when making these selections.

Using default parameters and only minimal adjustments to the offset volume values, highly accurate and repeatable pipetting transfers were achieved. The ability to optimize performance of the liquid handler using the information from the MVS with subsequent adjustments to the instruments offset values allows users to significantly reduce variability from liquid handing in their overall testing processes within the laboratory.

## REFERENCES

1. Artel application note entitled, "Optimizing Accuracy Performance on a Beckman Coulter Biomek Using the Artel MVS" Doc #12A6478, 2013. https://d1wfu1xu79s6d2.cloudfront.net/wp-content/uploads/2013/09/12A6478_Biomek-Optimization-Application-Note.pdf

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. https://journals.sagepub.com/doi/pdf/10.1016/j.jala.2006.02.005

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