

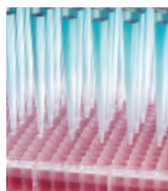
MVS[®]

**Multichannel
Verification System**





Increase liquid handling quality with easy, reliable performance verification.



Are your liquid handlers transferring critical volumes accurately and precisely?

Would you know if they weren't?

Automated liquid handlers are essential components in many laboratories. In order to increase the productivity and usefulness of these systems, it is important to understand how volume transfer steps can influence assay performance, especially for transfer of critical target volumes.

Each critical volume transfer step is directly tied to assay integrity and subsequent interpretation of the experimental results. Without knowing the exact volume transferred at each step of an assay, the concentration of species in solution is unknown, potentially leading to unreliable results, delays, and cost overruns. Utilization of the Artel MVS for performance verification can prevent problems, bolster laboratory productivity, and provide confidence in the integrity of data.



The MVS is recognized by many of our customers and is used in their own labs. It is an industry standard, so our customers know they are comparing apples to apples when they see our results. The MVS provides us with non-subjective data that builds credibility with our customers.

— Director of Applications
Robotic Liquid Handler Manufacturer

MVS[®]

Multichannel Verification System

- Takes just minutes.
- Requires no special skills.
- Saves time and labor.
- Minimizes liquid handler downtime.



Advantages of Superior Technology

Universal

Performance verification for any liquid handler, pipettor or dispenser – up to 384 channels.

Easier than other methods

Environmental controls are not required, as with gravimetry. There is no need to prepare solutions or generate standard curves.

Precision and accuracy for each tip

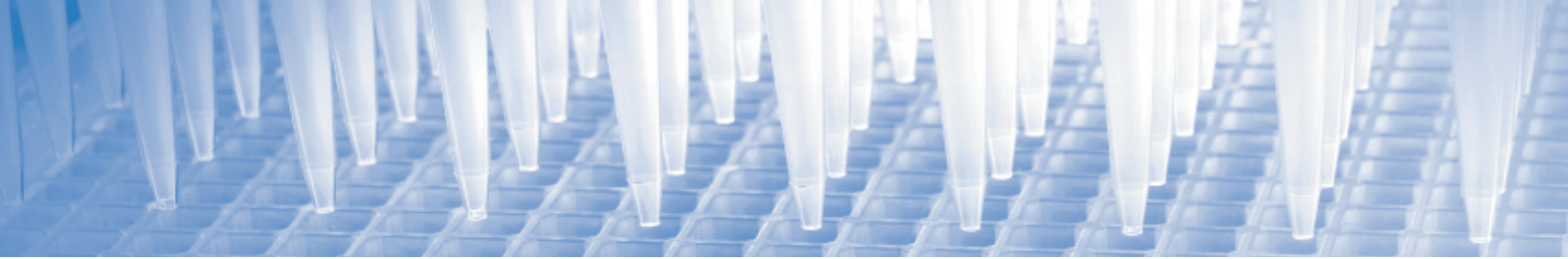
In one measurement, dual-dye ratiometric photometry assesses the **precision** (repeatability of volume transfer) and **accuracy** (closeness of transferred volume to target volume) **for each tip simultaneously** at volumes as low as 10 nL.

Standardized results

MVS measurement results are traceable to the International System of Units (SI) via standards maintained by NIST (US) and NPL (UK). This allows for direct comparison and measurement consistency between operators, methods and liquid handlers — regardless of make, model, manufacturer or location.

Simple integration

On-site validation and user training by Artel ensure efficient startup and seamless integration into your process.



With the MVS, you can:

- Measure aqueous as well as non-aqueous volume transfers of user-specific solutions such as dimethyl sulfoxide (DMSO)
- Assess step-wise dilution accuracy
- Integrate seamlessly with liquid handlers for walk-away, in-process QC
- Facilitate scale-up and method transfer
- Troubleshoot assays and methods
- Ensure reproducibility of replicate plates
- Monitor all critical target volumes in an assay or process
- Compare factory to site acceptance testing for new liquid handlers
- Establish baseline performance of any liquid handler
- Minimize waste of expensive or rare reagents
- Develop, optimize and validate liquid handler methods
- Verify target volumes dispensed into any container including tubes, v-bottom or non-optically clear microtiter plates
- Monitor the impact of repeated tip usage on liquid handler performance
- Verify liquid handler performance before and after maintenance
- Evaluate the effect of tip type on liquid handler performance
- Measure residual volumes remaining in a plate after sample aspiration
- Assess performance of other essential liquid handling equipment such as plate shakers, plate washers and bulk dispensers.

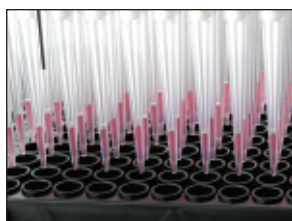
...and much more.



We have used several different methodologies [to calibrate our liquid handling robots], from gravimetric readings to our own dye system. The Artel MVS has simplified this process and improved the quality of our results.

— Jay Snable
Genomic Health

Simple volume verification with automatic reporting.



1. Dispense Solutions.
Dispense the Sample Solution and Diluent into a Verification Plate and mix.



2. Read Plate.
Measure the absorbance values with the plate reader.



3. Know Performance.
Results indicate the performance of the liquid handler.

ARTEL MVS TEST REPORT Data Manager

Protocol ID, date/time stamp, test criteria

Traceability stamp, including MVS system performance specifications

Traceable Results* MVS Specifications		
Volume Range	Inaccuracy	Imprecision
xxxx µL - 350.0 µL	X%	XX%
0.10000 µL - xxxxx µL	Y%	Yy%

Overall liquid handler performance relative to user-defined tolerance limits

Accuracy and precision values for each tip

Group 1 Summary Results					
Target volume (µL)	100				
Target solution	Range A				
Number of data points per channel	12				
Mean volume for all channels (µL)	99.7				
Inaccuracy for all channels	-0.30%				
Standard deviation for all channels (µL)	1.3				
Coefficient of variation (CV) for all channels	1.30%				
Relative inaccuracy pass/fail limit	5%				
Coefficient of variation pass/fail limit	5%				
Status based on channel results	Passed				
Status based on run statistics	Passed				

Group 1 Channel Statistics					
Channel	Mean Volume	Inaccuracy	Standard Deviation	CV	Status
1	99.2	-0.80%	1.2	1.21%	
2	100.2	0.20%	1.5	1.50%	
3	99.3	-0.70%	1.6	1.61%	
4	99.6	-0.40%	1.3	1.30%	
5	100.3	0.30%	0.8	0.80%	
6	99.5	-0.50%	1.4	1.40%	
7	99.4	-0.60%	1.5	1.51%	
8	100.0	0.00%	1.0	1.00%	
9	99.7	-0.30%	1.4	1.40%	

Group 1 Dispense Order Statistics										
Dispense	Mean Volume	Inaccuracy	Standard Deviation	CV	...	...	...	...	...	...
1	99.83	-0.17%	5.6	5.66%	...	...	...	...	...	...
2	100.3	0.30%	1.5	1.50%	...	...	...	...	...	...
3	99.1	-0.90%	0.7	0.71%	...	...	...	...	...	...
4	99.3	-0.70%	1.3	1.31%	...	...	...	...	...	...
5	100.5	0.50%	0.7	0.70%	...	...	...	...	...	...
6	98.5	-1.44%	3.8	3.84%	...	...	...	...	...	...
7	99.4	-0.60%	1.5	1.51%	...	...	...	...	...	...
8	100.0	0.00%	1.0	1.00%	...	...	...	...	...	...
9	99.7	-0.30%	1.4	1.40%	...	...	...	...	...	...

Group 1 Well Volumes (µL)										
	1	2	3	4	5	6	7	8	9	...
A	105.0	100.1	99.3	98.6	99.9	98.0	99.0	99.0	99.8	...
B	105.1	98.7	100.4	98.7	101.1	102.0	99.0	99.0	99.8	...
C	94.9	100.2	98.2	101.9	101.2	97.9	99.0	99.0	99.8	...
	94.5	101.9	99.6	99.9	99.4	98.9	99.0	99.0	99.8	...
	94.0	102.0	99.1	100.3	100.5	101.4	99.0	99.0	99.8	...
	105.2	97.9	99.5	98.9	99.9	98.7	101.7	101.7	99.2	...
	105.1	101.5	98.4	97.9	100.8	101.1	100.1	100.9	99.3	...
	94.8	99.8	98.5	98.2	101.4	98.5	101.3	99.1	98.7	...

Results outside of the tolerance limits are highlighted

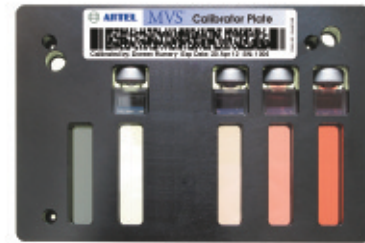
Full report also contains lot numbers, materials used, expiration dates, electronic signatures, comments, etc.



Unique MVS components

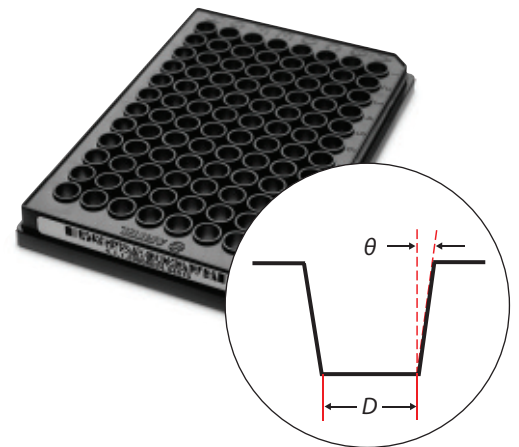
Calibrator Plate

The Calibrator Plate is used to correct for day-to-day performance variations in the plate reader. The plate is composed of neutral density glass and five sealed cuvettes containing solutions made with the same dyes used in the Sample Solutions. Absorbance measurements of the Calibrator Plate are compared to the bar code, which contains the absorbance values for each of the cuvettes, as measured in the Artel reference spectrophotometer which is calibrated to standards maintained by NIST (US) and NPL (UK).



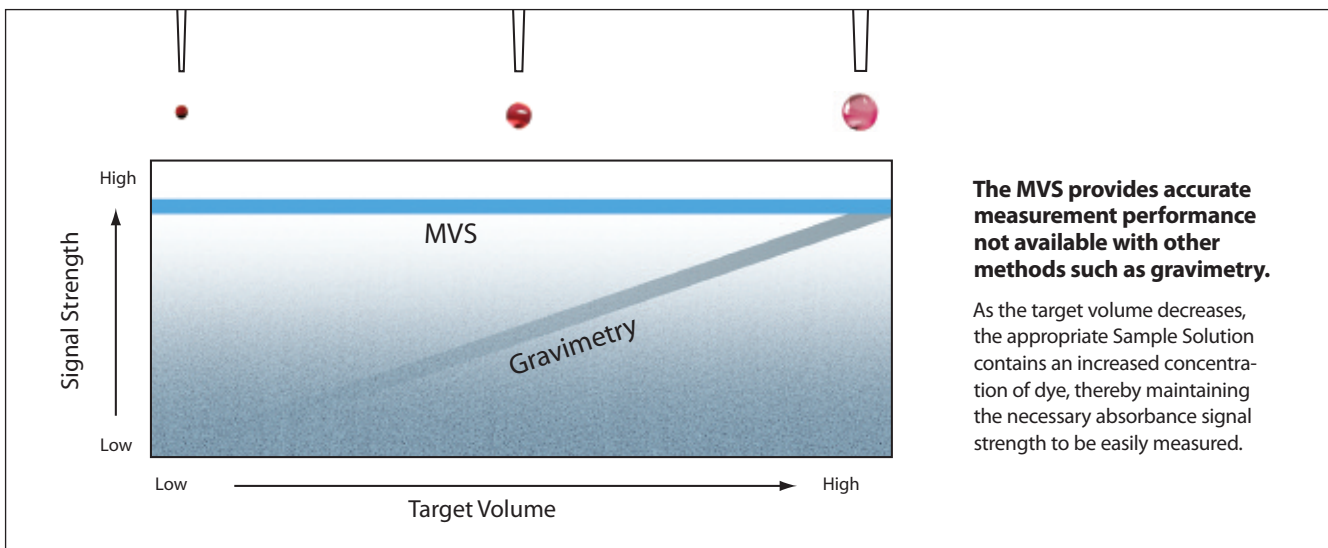
Verification Plates

By measuring the dimensional qualities and performance characteristics of microtiter plates for each manufactured lot, Artel has minimized the uncertainty associated with the plate used in the volume verification process. The bottom diameter (D) and taper angle of the side wall (θ) are measured by a NIST-traceable coordinate measuring machine, and lot-specific information is stored on the bar codes.



Sample Solutions

MVS Sample Solutions are manufactured to strict tolerances to ensure lot-to-lot consistency. The Sample Solutions are supplied at different concentrations to enable volume measurements as low as 10 nL.



We selected MVS because it will allow us to comply with cGLP initiatives, due to the NIST-traceability and 21 CFR Part 11 software. In addition, we will be able to standardize our laboratory sites worldwide by using a single technology to calibrate all of our automated liquid handlers.

— Senior Scientist
Multinational Biopharmaceutical Company

...and dual-dye ratiometric photometry provide confidence and control.

MVS uses unique components and dual-dye ratiometric photometry to measure the volume transfer performance of liquid handlers. The liquid handler being tested dispenses Sample Solution containing both red and blue dyes into the dimensionally-characterized Verification Plate. The wells are filled to a working volume by adding a non-quantitative amount of Diluent, which contains blue dye at the same concentration as the blue dye in the Sample Solution.

The Beer-Lambert Law relates the measured absorbance (A) of a solution at a given wavelength (λ) to the molar absorptivity (ϵ) of the solution at wavelength λ , the concentration (C) of dye in the solution, and the pathlength of light (l) through the solution: $A_\lambda = \epsilon_\lambda \cdot C$.

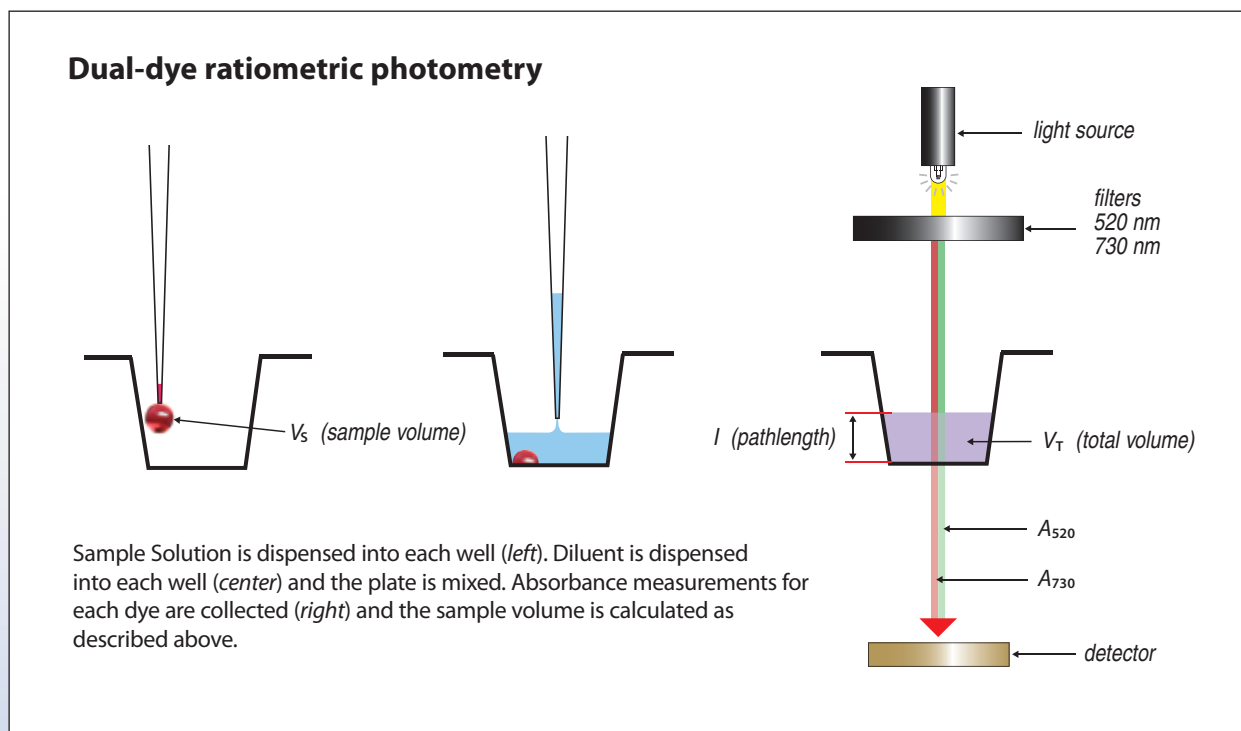
The concentration and the molar absorptivity are combined into a new term called the absorbance per pathlength (a_λ), which is embedded in each solution bar code, and is defined by the equation: $a_\lambda = \epsilon_\lambda \cdot C$.

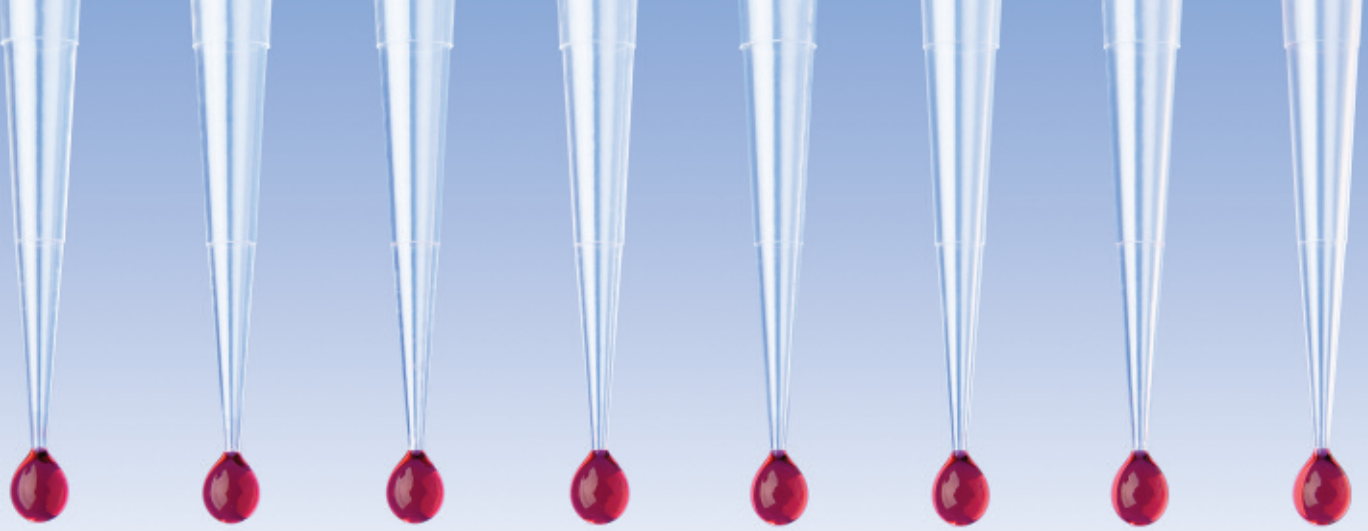
Independent determination of sample volume for each well proceeds via three calculations:

1. The blue dye, with absorbance per unit pathlength (a_b) at 730 nm, is used to calculate the pathlength: $l = A_{730}/a_b$
2. Based on this pathlength, MVS calculates total well liquid volume (V_T) using the plate dimensions θ and D contained on the plate bar code.
3. Using the ratiometric equation, the volume of Sample Solution (V_S) is calculated from this total volume, the known absorbances per pathlength (a_r and a_b), and the measured absorbances from the plate reader (A_{520} and A_{730}):

$$V_S = V_T \left(\frac{a_b}{a_r} \right) \left(\frac{A_{520}}{A_{730}} \right)$$

This result is independent of the amount of Diluent added.





Artel is the worldwide leader in liquid handling quality assurance. Since 1982, Artel systems have been proven in daily use in thousands of pharmaceutical, clinical, forensic, public health, government, academic, and environmental laboratories. These leading laboratories depend on Artel technology to meet their objectives for quality, productivity, and regulatory compliance.

ISO 9001-Certified QMS

MVS PATENTS

The MVS and its components are covered by patents:
US 6,741,365; US 7,187,455; US 7,791,716; US 7,998,747;
US 8,003,405; US 7,061,608; EP 1 454 125;
DE 602 37 167.8; JP 4303594; JP 4578486;
and other US and Foreign Patents Pending.



Trust Your Results

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