

# Application Note

## Micro-Volume Injection System for ICP-MS

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### INTRODUCTION & OBJECTIVES

The MVX-7100  $\mu\text{L}$  Workstation when paired with a DS-5 total consumption nebulizer creates a paradigm shift in ICP-MS sample introduction. It is a long overdue tool for trace element researchers wanting to measure elements at trace levels in microliter sized samples. In this study the MVX-7100 is used with quadrupole ICP-MS for injection of 20  $\mu\text{L}$  and 100  $\mu\text{L}$  volumes.

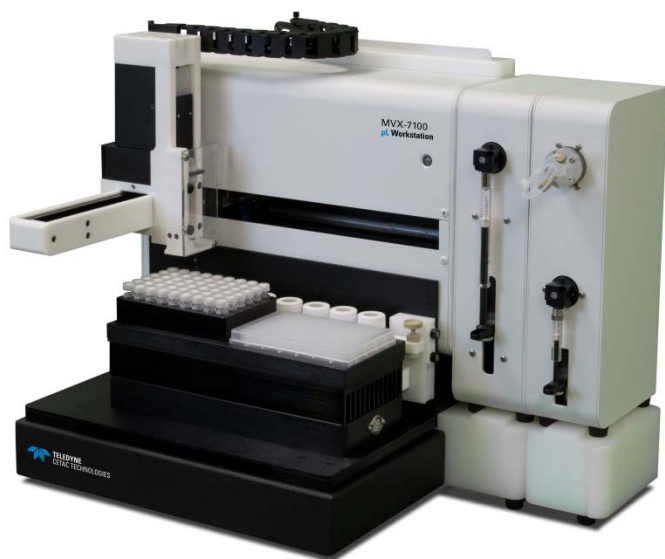
### MATERIALS & METHODS

Standards of  $^{89}\text{Y}$  were prepared in a 1%  $\text{HNO}_3$  matrix and placed into sealed septum capped vials. A quadrupole ICP-MS was used with a DS-5 total consumption nebulizer.

The MVX-7100 was used to sample and deliver 20  $\mu\text{L}$  of each standard to the ICP-MS. The sequence of events for an injection are listed in Table 1. The main components of the MVX-7100 consist of a septum piercing autosampler, a valve syringe module, and a syringe pump module (Figure 2).

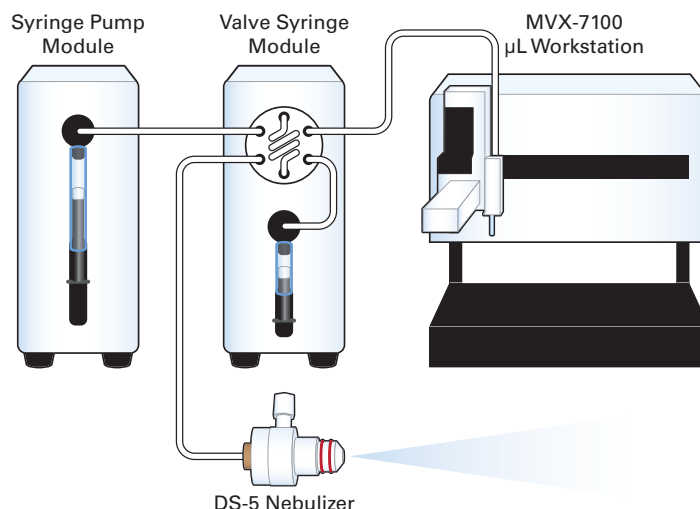
**Table 1: MVX-7100 sequence of events**

	Component	Sequence of Events
1	MVX-7100	Autosampler pierces septum capped vial
2	Valve Syringe Module	Valve switches to load position
3	Valve Syringe Module	Half height syringe pump pulls sample slug into the loop sandwiched between two air slugs
4	Valve Syringe Module	Valve switches to injection position
5	Syringe Pump Module	Full height syringe pump drives sample from the loop into ICP-MS

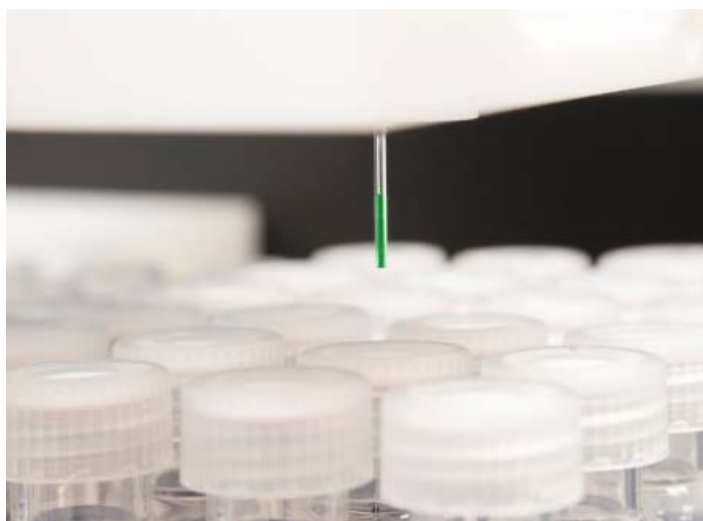


**Figure 1: MVX -7100  $\mu\text{L}$  Workstation**

When working with micro-volume samples we have found that all aspects of sample introduction must be re-considered. Four critical parts are needed for repeatable results: (1) high precision probe positioning (2) discrete aliquot sampling (3) stable sample injection (4) low flow nebulization. The MVX-7100 has been optimized for each of these critical parts with (1) encoder driven X, Y, Z autosampler able to sample 384-well plates, (2) syringe driven sample aliquot, (3) syringe driven sample injection, and (4) DS-5 total consumption nebulizer.



**Figure 2: Schematic of MVX -7100  $\mu\text{L}$  Workstation**

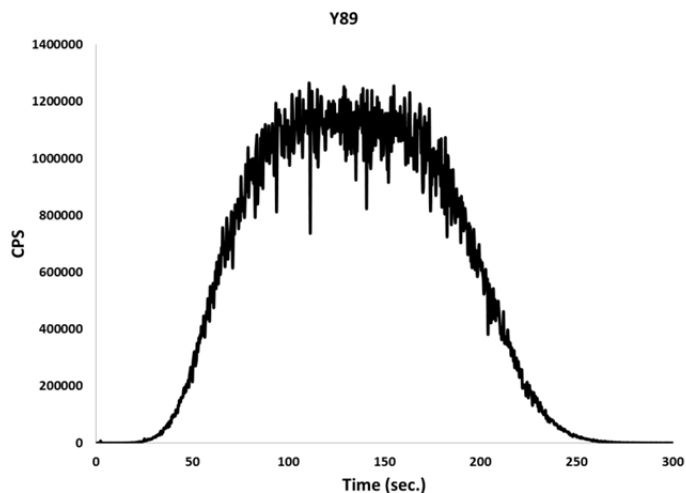


**Figure 3: Quartz needle sampling**

The system uses a quartz sampling needle which keeps the contamination for trace elements low and provides a rigid material for septum piercing 2 mL vials.

**RESULTS & DISCUSSION**

Figure 4 displays a plot of the MVX-7100 with the DS-5 total consumption nebulizer. We were able to achieve approximately 80 seconds of integration time from only 20  $\mu$ L of sample.



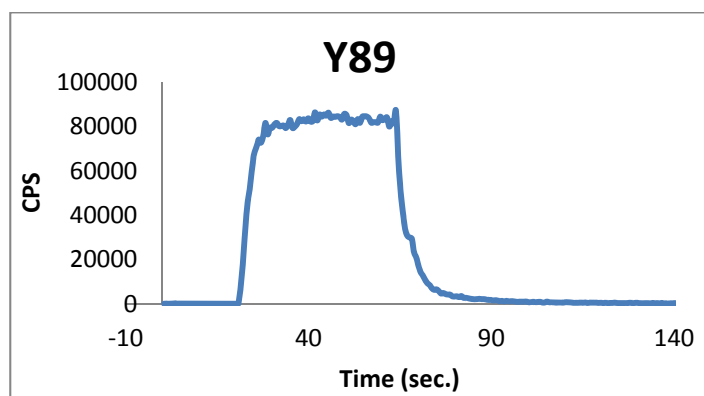
**Figure 4: 20  $\mu$ L aliquot using DS-5 total consumption nebulizer**

Figure 5 displays a plot of the MVX-7100 with a standard spray chamber. Despite not using a total consumption nebulizer the MVX-7100 cuts down considerably on wasted sample due to the discrete aliquot ability.

**Table 2: Reproducibility using MVX-7100 with DS-5 (20  $\mu$ L) and standard spray chamber (100  $\mu$ L)**

Volume ( $\mu$ L)	Replicate	Volume ( $\mu$ L)	Replicate
20	274366188	100	1365218288
20	282644005	100	1374555761
20	277757339	100	1360950781
20	272635178	100	1361440390
20	283208243	100	1351091866
20	274299895	100	1378379044
20	277205963	100	1340119324
RSDs	1.49	RSDs	0.96

From Table 2, the MVX-7100 was able to deliver 20  $\mu$ L with an RSD of 1.49% and 100  $\mu$ L with an RSD of 0.96%, giving reproducible results for small volumes.



**Figure 5: 100  $\mu$ L injection using standard spray chamber on Agilent 7700 ICP-MS**

**CONCLUSIONS**

The Teledyne CETAC MVX 7100  $\mu$ L Workstation has been demonstrated to precisely sample a specific aliquot and deliver the entire aliquot to the ICP-MS. When paired with a total consumption nebulizer such as the DS-5, aliquots as small as 20  $\mu$ L have been measured with appreciable signal, sufficient integration time for multiple replicates, and good reproducibility.