

# Technical Note

## Rapid-Throughput USP-232/233 by Inductively Coupled Plasma Mass Spectroscopy

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### INTRODUCTION

The United States Pharmacopeia (USP) is developing new General Chapters relating to the determination of elemental impurities in the pharmaceutical industry. These new chapters will replace the current gravimetric method with modern methodology. This includes closed vessel microwave digestion and ICP-OES and ICP-MS. This note describes how the Teledyne CETAC ASXPRESS® PLUS rapid sample introduction system can improve sample analysis times for USP-232/233, while maintaining both precision and accuracy.

The Teledyne CETAC ASXPRESS® PLUS rapid sample introduction system, when coupled with an autosampler, optimizes sample throughput, while reducing material, power, maintenance and labor costs. The system combines multiple sample introduction functions into single steps, thus reducing sample run times and associated expenses.

Traditional sample introduction uses a single peristaltic pump to draw sample, introduce sample to nebulizer, and rinse the flow pathways before sampling. The ASXPRESS® PLUS utilizes a peristaltic and a high speed vacuum pump. The 6-port valve allows the system to use both pumps simultaneously, resulting in significant time savings.



Figure 1: ASXPRESS® PLUS Rapid Sample Introduction System

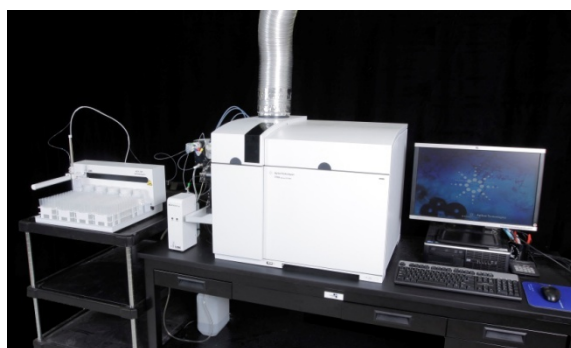


Figure 2: ASXPRESS® PLUS with Agilent 7700 ICP-MS

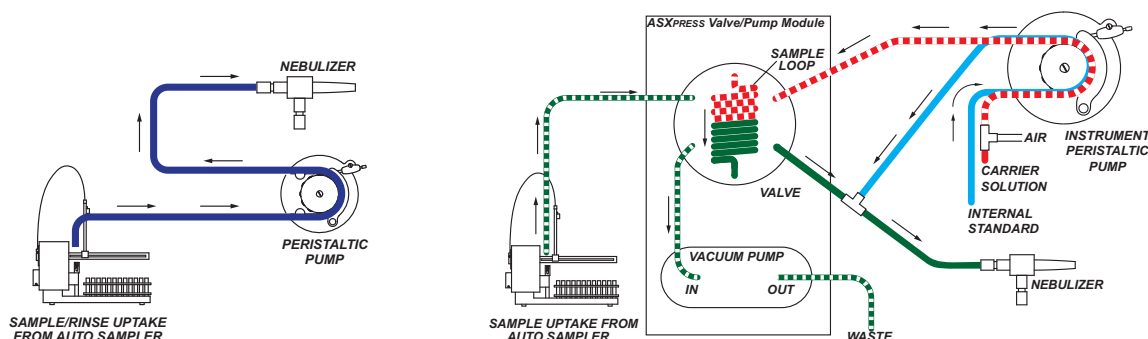


Figure 3: Standard analysis system setup (left); Analysis setup with ASXPRESS® PLUS (right)

The valve effectively divides the sample analysis time into two separate stages. The first stage has the valve in the Load position. In this position the vacuum pump is loading the loop while the peristaltic pump is rinsing the nebulizer and spray chamber with carrier solution. Continuously pumping carrier solution into the spray chamber ensures that the plasma will maintain stability and will not require extra stabilization time. During the second stage of the process, the valve is in the Inject position. The roles of the pumps have now switched, with the vacuum pump rinsing the probe line and the peristaltic pump pushing the sample into the nebulizer with the carrier solution.

### DATA QUALITY

Instrumentation parameters such as gas flow, plasma power, mode stabilizations times and data collections settings are not modified during installation of the *ASXPRESS® PLUS*. As a result the only settings that have been changed are the flush, uptake, and rinse delays. The flush and rinse time are no longer needed. The uptake delay was reduced by 15 seconds. The addition of the *ASXPRESS® PLUS* resulted in a 35% increase in sample throughput without changing original data quality. Sample run times are tabulated in Figure 4.

### RESULTS

Sample	Standard Sample Introduction Run Times (s)	<i>ASXPRESS® PLUS</i> Run Times (s)
1	212	138
2	215	142
3	214	139
4	217	138
5	212	141
6	211	135
7	213	139
Average	213.4	138.9

Figure 4: Comparison of analysis times between traditional and ASXpress sample introductions. The ASXpress system is 35% more efficient than traditional sample introduction.

Calibration precision and accuracy is not degraded with the use of the *ASXPRESS® PLUS* sample introduction system. The calibration results are tabulated in Figure 5.

	Standard Sample Introduction	<i>ASXPRESS® PLUS</i>
m/z Element	Coefficient	Coefficient
51 V	1.0000	1.0000
60 Ni	1.0000	1.0000
62 Ni	0.9999	0.9999
63 Cu	1.0000	1.0000
65 Cu	1.0000	1.0000
75 As	1.0000	1.0000
95 Mo	0.9999	1.0000
97 Mo	1.0000	0.9999
101 Ru	1.0000	1.0000
103 Rh	1.0000	1.0000
105 Pd	1.0000	1.0000
111 Cd	0.9999	0.9999
114 Cd	0.9999	1.0000
188 Os	0.9994	0.9997
189 Os	0.9995	0.9997
191 Ir	1.0000	1.0000
193 Ir	1.0000	1.0000
194 Pt	1.0000	1.0000
195 Pt	1.0000	1.0000
200 Hg	1.0000	1.0000
201 Hg	1.0000	1.0000
202 Hg	1.0000	1.0000
206 Pb	1.0000	1.0000
207 Pb	1.0000	1.0000
208 Pb	0.9996	0.9999

Figure 5: Calibration data showing that both precision and accuracy are maintained when utilizing the *ASXPRESS® PLUS* sample introduction system.

Sample precision and accuracy are shown in Figures 6. The data represents the percent recovery of each standard when compared to the actual concentration.

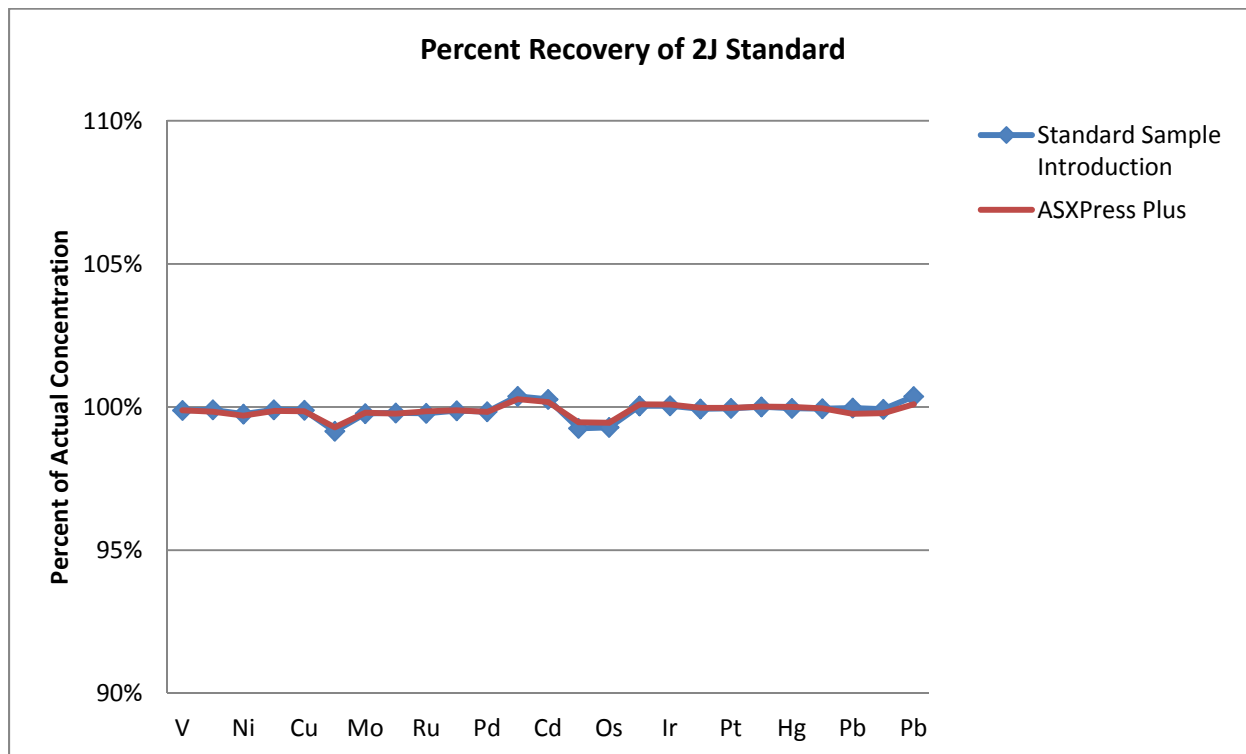


Figure 6: Precision and Accuracy of the 2J Standard.

Sample to sample stability is represented in Figure 7. Data represents five analyses of the 2J Standard.

Element	ASXPRESS® PLUS (%RSD)	Standard Sample Introduction (%RSD)	Element	ASXPRESS® PLUS (%RSD)	Standard Sample Introduction (%RSD)
V	1.2	3.6	Os	2.4	2.1
Ni	0.9	3.3	Os	2.2	2.1
Ni	1.1	3.4	Ir	1.1	1.3
Cu	0.8	3.5	Ir	1.4	1.1
Cu	0.8	3.6	Pt	1.4	1.2
As	0.9	3.7	Pt	1.4	1.1
Mo	0.9	2.9	Hg	1.3	0.7
Mo	0.8	2.9	Hg	1.4	0.7
Ru	0.7	2.9	Hg	1.3	0.6
Rh	0.7	2.8	Pb	1.3	1.3
Pd	1.0	2.5	Pb	1.2	1.5
Cd	1.2	1.9	Pb	1.4	1.5
Cd	0.9	2.3			

Figure 7: Percent RSD based on five analyses of 2J standard

## LOW MAINTENANCE COST

The *ASXPRESS® PLUS* is constructed out of durable and inert materials, resulting in less maintenance and down time. The valve does require some routine maintenance, which consist of disassembling the valve and using compressed air to blow out the sampling ports on a bi-weekly basis.

The *ASXPRESS® PLUS* extends ICP-MS component life spans by limiting exposure to the sample matrix. The peristaltic pump tubing life is also extended because the sample never comes into contact with the tubing.

## CONCLUSION

As shown in the data, the *ASXPRESS® PLUS* increases sample throughput without sacrificing data quality and decreases operating cost by reducing material and labor cost.