

# Technical Note

## Rapid-Throughput Oil Analysis for Inductively Coupled Plasma Atomic Emission Spectroscopy

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The Teledyne CETAC Technologies ASXPRESS® PLUS Rapid Sample Introduction System, when coupled to a Teledyne CETAC autosampler, optimizes sample introduction by significantly increasing sample throughput and reducing costs of materials, power, maintenance and labor for ICP-AES analysis. The system is designed to allow multiple functions to occur simultaneously which would otherwise take place separately.



Figure 1. ASXPRESS® PLUS Rapid Sample Introduction System



Figure 2. ASXPRESS® PLUS with Thermo iCAP ICP-AES

A standard analysis system relies upon a single peristaltic pump to both deliver samples to the nebulizer and rinse the sample flow path between sample deliveries (Figure 3). The ASXPRESS® PLUS system utilizes a high speed vacuum pump in addition to the ICP-AES peristaltic pump. The 6-port valve allows the use of both pumps simultaneously, reducing total sample analysis time significantly (Figure 4).

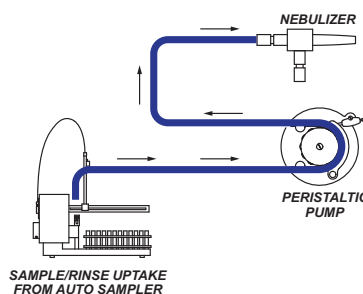


Figure 3. Standard analysis system setup

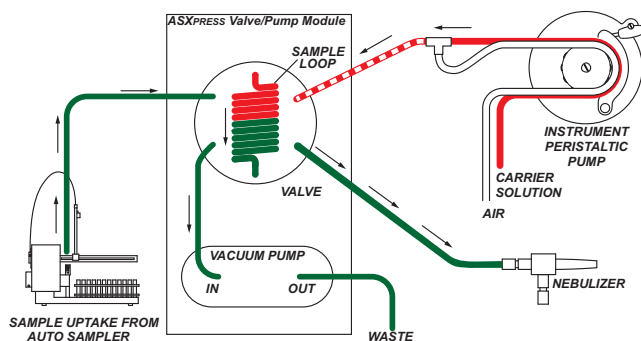


Figure 4. Analysis setup with ASXPRESS® PLUS

The use of the valve effectively divides each analysis into two stages. First, while the valve is in the load position, the vacuum pump rapidly fills the sample loop, while the ICP-AES peristaltic pump simultaneously transports carrier solution, keeping the plasma stable. In the second position, the loaded sample is pushed into the nebulizer for analysis via the carrier solution flowing through the ICP-AES peristaltic pump. Simultaneously, the autosampler probe is moved to the rinse station and the uptake flow path is flushed with rinse solution via the vacuum pump.

The sample introduction approach used by the ASXPRESS® PLUS has particular implications for oil applications.



## DATA QUALITY

Tests of the ASXPRESS® PLUS system showed good precision with < 2% RSD's for 2 replicate measurements over all elements tested.

Calibration curves with correlation coefficients of 0.9999 or better are readily achievable over the concentration ranges expected in mining applications. Production sample correlation data before and after the ASXPRESS® PLUS is shown in Figure 5.

Use of the ASXPRESS® PLUS system increases the frequency of passing QC samples.

Carryover is also reduced to a negligible amount for oil analysis by the use of a segmented stream of rinse solution. Kerosene and air are combined together to act as the overall carrier solution allowing for more effective cleaning of the loop and other tubing without compromising the overall analysis time.

With the use of the ASX-1400 autosampler (Figure 5), each sample is stirred before analysis ensuring a homogenized sample is introduced to the spectrometer.

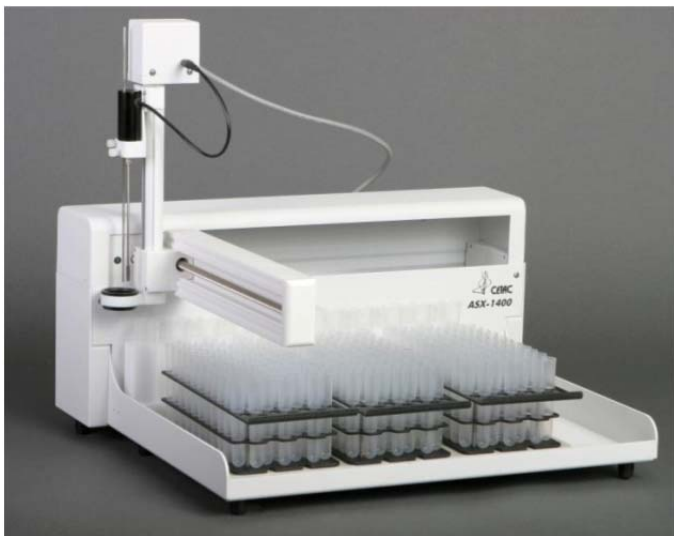


Figure 5. ASX-1400 Autosampler

## STABILITY AND LONGEVITY

The ASXPRESS® PLUS equipment itself is very stable and the system can be taken apart and reassembled or even stored for extended periods of time only to realize the same resulting data quality once reintegrated into the system.

Depending upon sample matrix, the 6-port valve is capable of lasting well over 100,000 samples. Low cost service components are readily available.

## TIME SAVINGS

Existing analysis methods without the ASXPRESS® PLUS or Thermo iTEVA Sprint analysis mode have been found to run samples up

to 2 minutes per sample to meet analysis criteria such as throughput, precision, passing QC's and accuracy of results.

Various time tests were conducted using the ASXPRESS® PLUS with the Thermo iCAP ICP-AES. Sampling time was cut to 27 seconds per sample when using the ASXPRESS® PLUS system while still meeting all the criteria. Figure 6 illustrates how time savings are achieved throughout sample analysis using the ASXPRESS® PLUS.

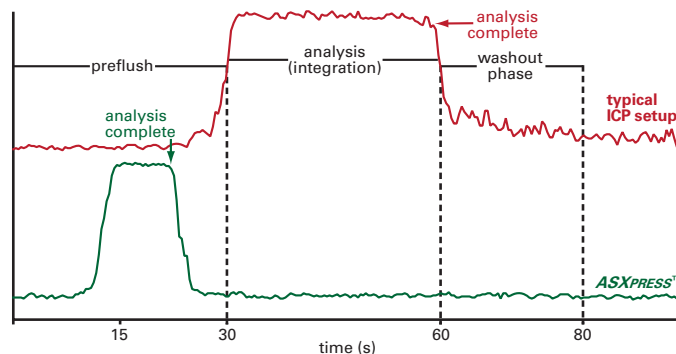


Figure 6. Time comparison, typical ICP setup vs. ASXPRESS® PLUS

## LOW MAINTENANCE COST – TIME & MONEY

Only simple and quick maintenance procedures are required for the ASXPRESS® PLUS system. Routine maintenance includes disassembling the valve body and using compressed air to blow out the sampling ports and the rotor on a weekly to bi-weekly basis, depending on sample volume and matrix.

Operation with the ASXPRESS® PLUS greatly extends the service life of ICP components, reducing nebulizer and spray chamber maintenance by reducing exposure to the sample matrix. Since peristaltic pump tubing is never exposed to the sample matrix, its service life is also greatly extended.

## EASE OF INSTALLATION

An easy, out-of-the-box set of instructions and initial configuration parameters have been developed for the ASXPRESS® PLUS to allow the utmost ease of installation. The ASXPRESS® PLUS integrates quickly and easily into the sample flow path, without modification to the analysis method. A simple and convenient Windows® based configuration tool is used to store parameters to the system's on-board processor. No additional software is required. Installation by an authorized service representative is available; please contact Teledyne CETAC or Thermo for details.

## CONCLUSION

Using Thermo iTEVA Sprint analysis mode for the Thermo iCAP along with the stirring ASX-1400 autosampler and the ASXPRESS® PLUS, quality oil analysis data is obtained in sampling times of less than 30 seconds per sample. This combination of products offers a complete oil analysis package.