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Brief

The prepFAST is a fully-automated inline dilution system for ICP and ICPMS instruments. Three powerful functions of prepFAST for environmental applications include: 1) inline autocalibration, 2) inline autodilution of samples, and 3) fully integrated inline QC over range autodilution.

Features:

- Autocalibration
- User defined autodilution
- QC over range autodilution
- Seamlessly integrated with instrument software
- Perfect for high throughput environmental labs
- High capacity
- Sample vacuum loaded
- Sample syringe injected

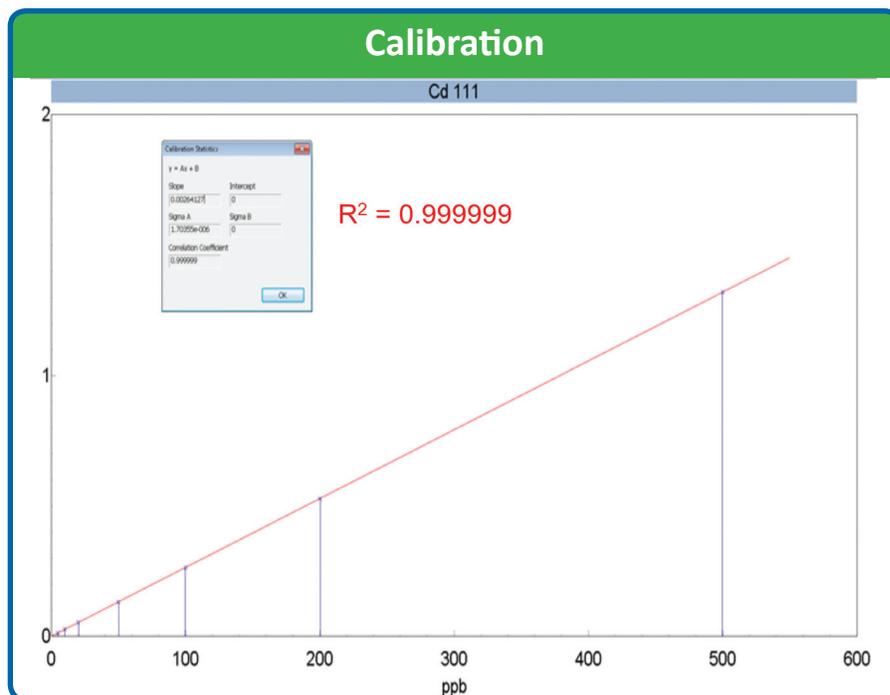


Figure 1. Predefined dilution factors for a single multi-element standard are used to build calibration curves ($R^2 = < 0.9999$).

Introduction

Organic ligand concentration, complexation, pH and ionic strength, are major factors that control the partitioning of metals between the dissolved ($< 0.45 \mu\text{m}$) and particulate ($> 0.45 \mu\text{m}$) phases in ground, surface and estuarine waters. Most transition row metals have high K_d 's in near neutral pH meteoric waters and therefore high affinity for particle surfaces resulting in low dissolved metal concentrations. Autocalibration curves covering the full range of natural variability for environmentally important metals are generated from a single or multiple multi-element stock standard solution with calibration coefficients greater than 0.9999. Accuracy of dissolved metal concentrations determined for NIST 1643e are in excellent agreement ($< 4\%$) with certified values. Omaha tap water is used as the EPA 200.8 defined, Laboratory Fortified Matrix (LFM) and Quality Control Standard (QCS). Recovery of 95-105% and precision of less than $\pm 3\%$ greatly exceed EPA requirements of 70-130% and $\pm 10\%$, respectively.

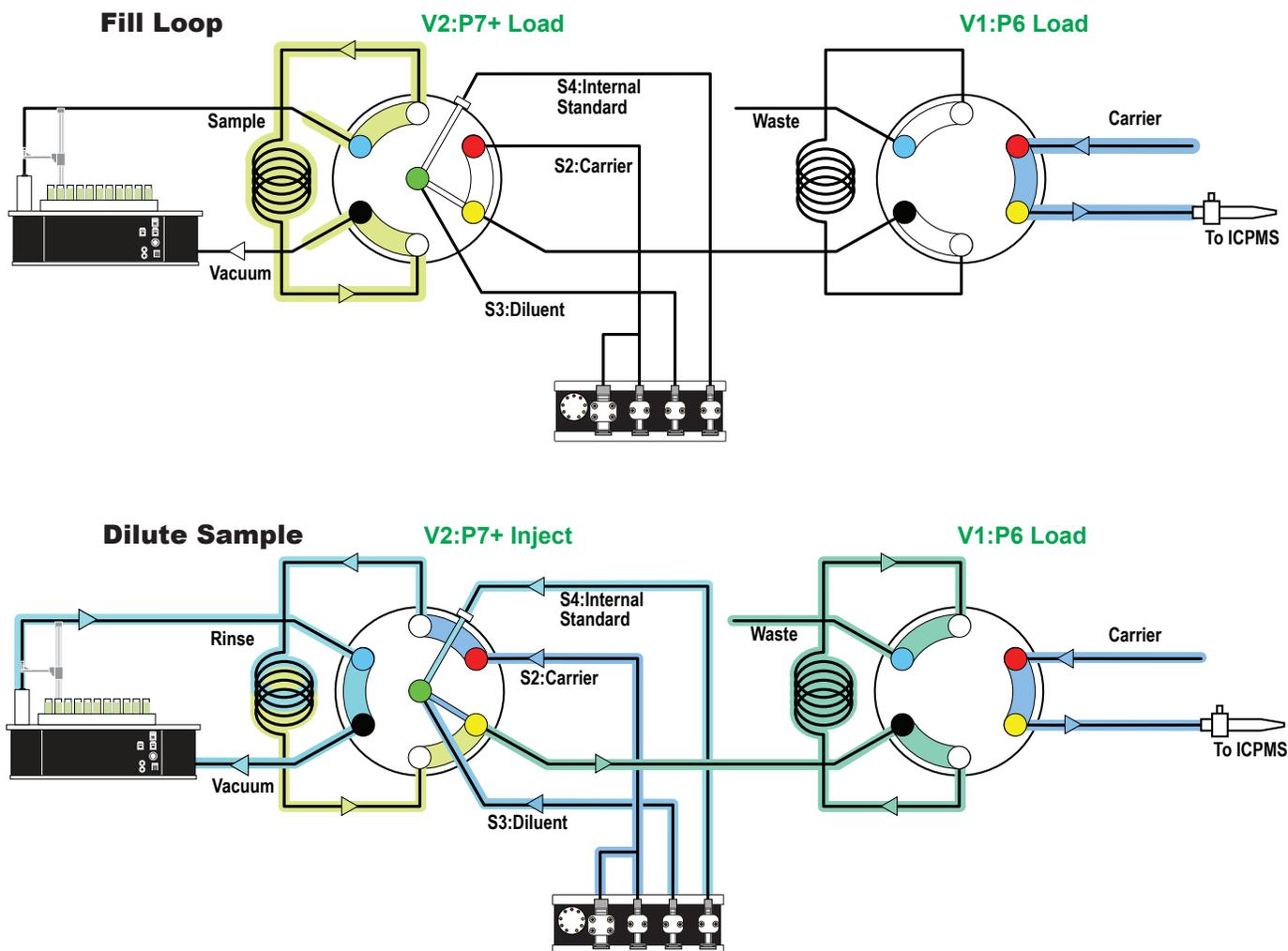
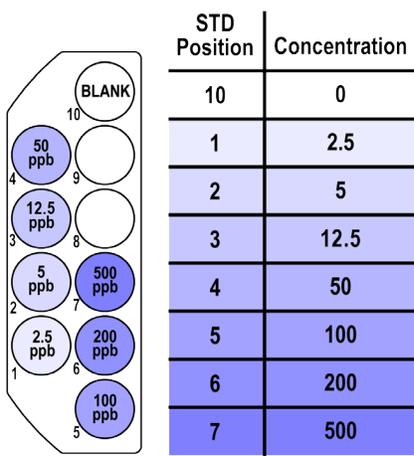


Figure 2. The prepFAST system schematic illustrating 1) sample loading during spray chamber rinse and 2) sample injection dilution and internal standardization.

Conventional Calibration vs prepFAST Autocalibration

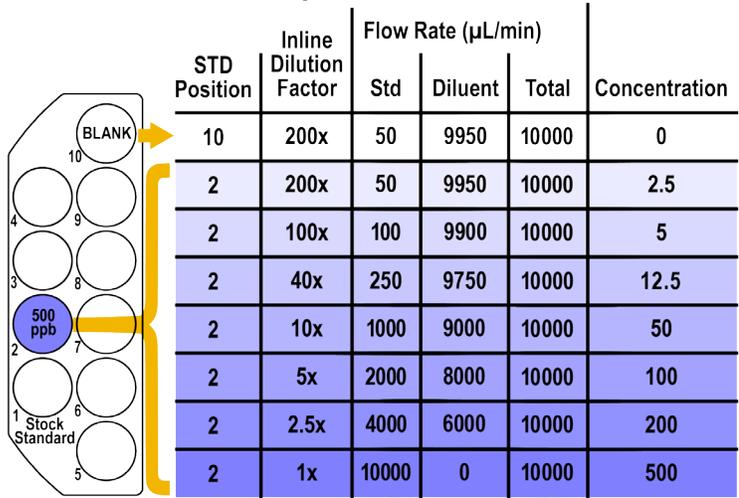
Conventional Calibration (seven points)

Offline Prep: 1 Blank + 7 Standards



prepFAST Autocalibration (seven points)

Inline Prep: 1 Blank + 1 Standard



prepFAST Calibration: Blank can be analyzed diluted or undiluted.

Figure 3. Illustration of conventional calibration vs. prepFAST autocalibration function using a single multi-element standard.

Linearity

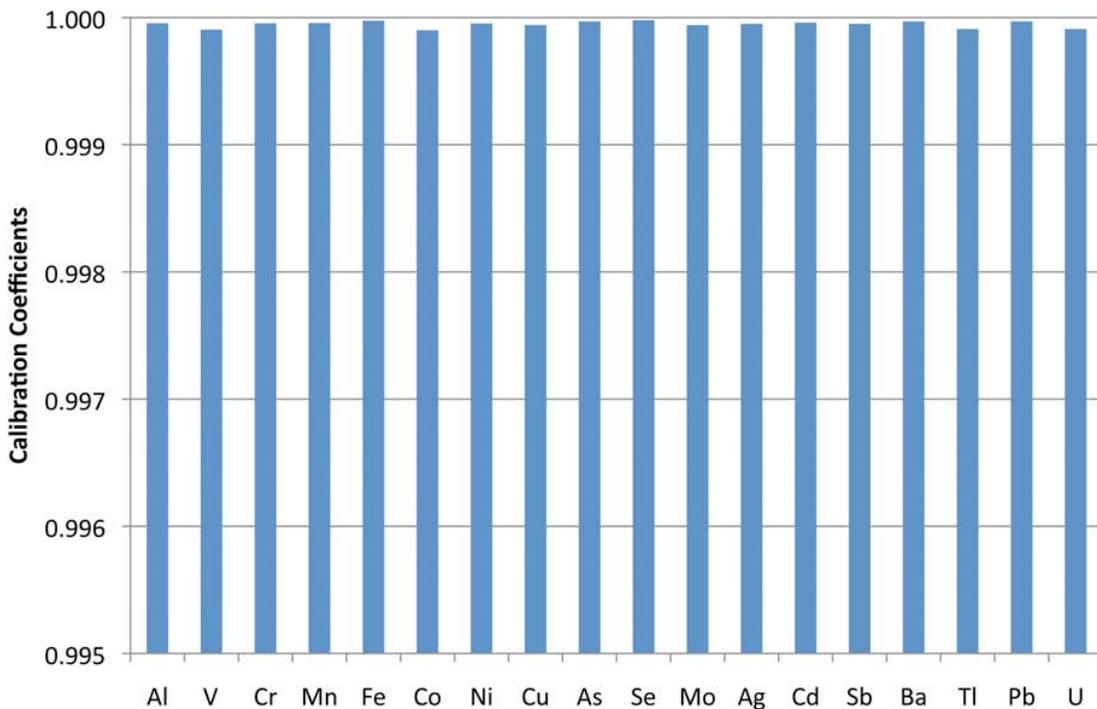


Figure 4. Calibration curves for all elements in the dissolved method have excellent linearity ($R^2 = < 0.9999$) illustrating the accuracy of autodilution.

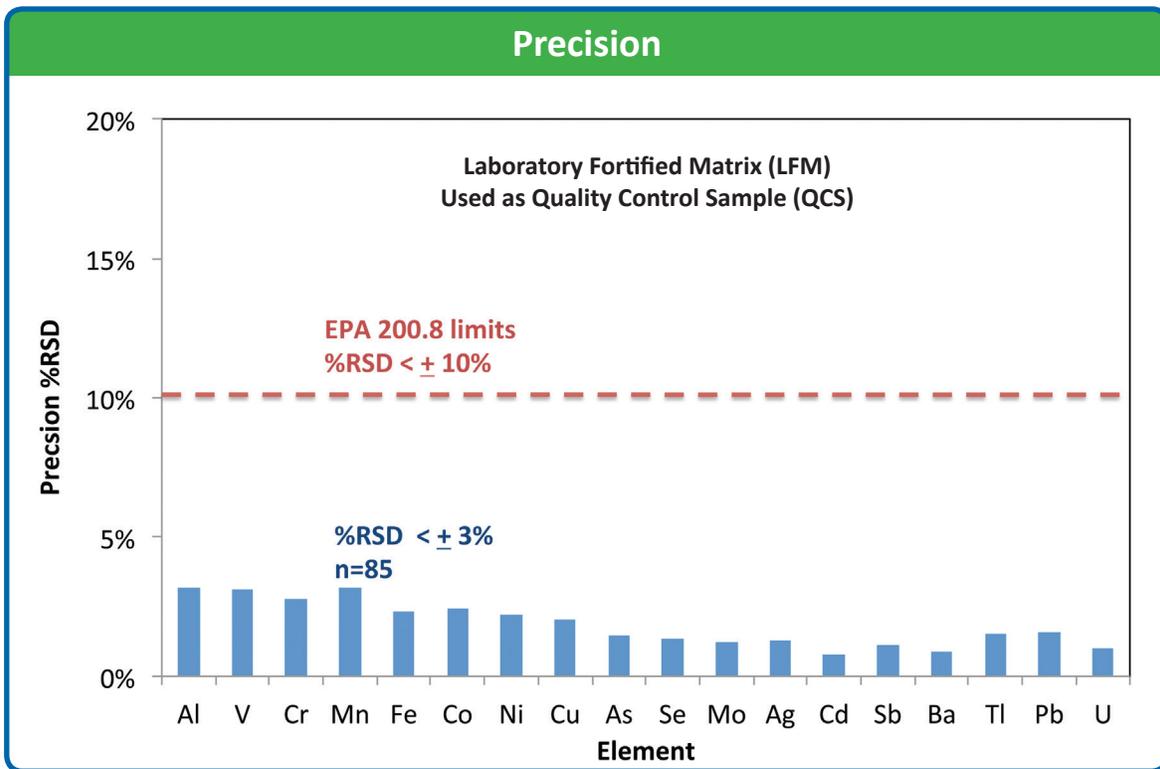


Figure 5. Omaha tap water is used as the EPA 200.8 defined, Laboratory Fortified Matrix (LFM) and Quality Control Standard (QCS). Precision of less than ± 3% greatly exceeds EPA requirements of ± 10%.

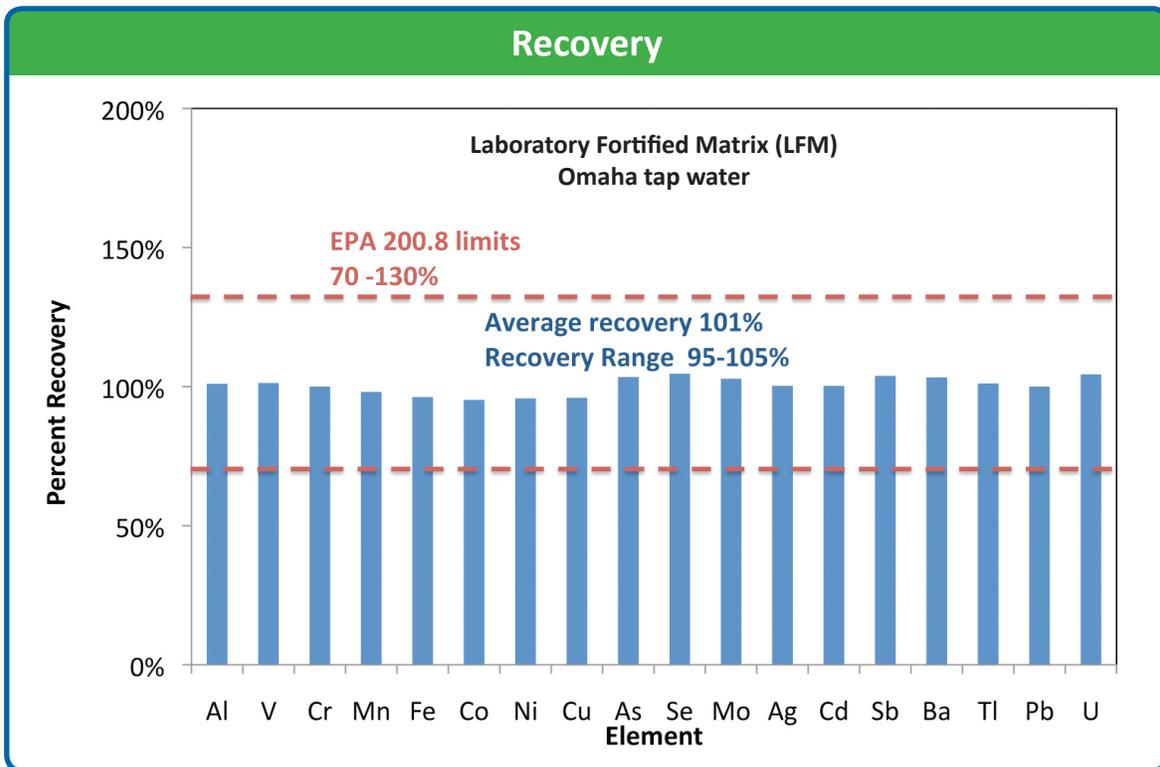


Figure 6. Omaha tap water is used as the EPA 200.8 defined, Laboratory Fortified Matrix (LFM) and Quality Control Standard (QCS). Recovery of 95-105% greatly exceeds EPA requirements of 70-130%.

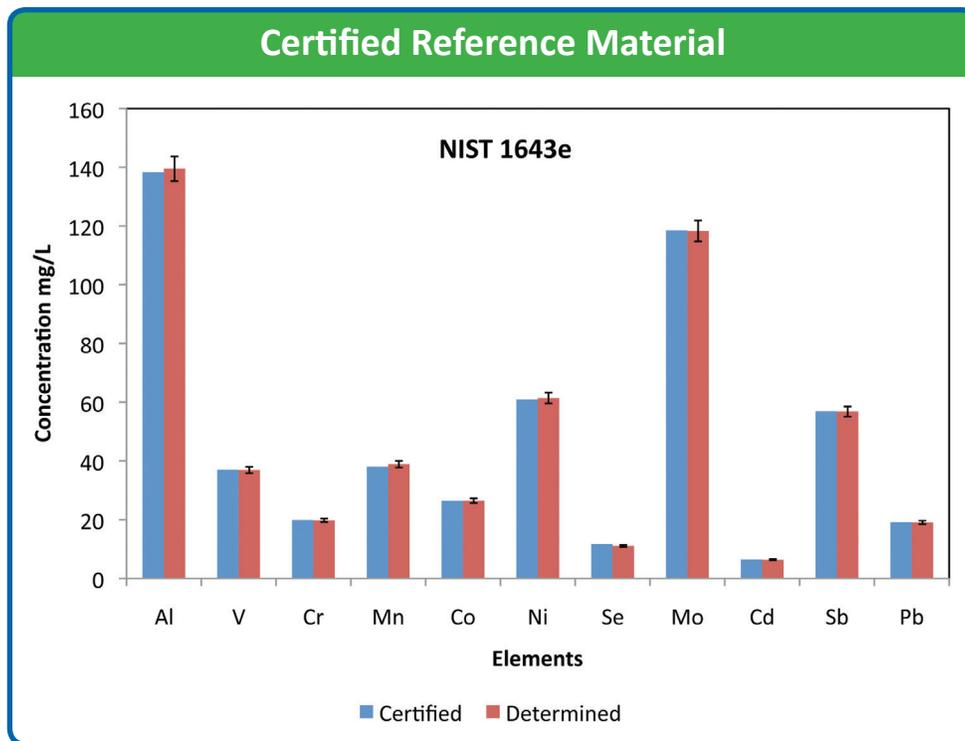


Figure 7. Precision and accuracy are demonstrated by the determination of metal concentrations in a Trace Metals in Water Certified Reference Material (CRM, NIST 1643e).

Element	Safe Drinking Water Act	Omaha Tap Water	Missouri River Water
Al	200	81.9	27.3
V		2.31	2.27
Cr	100	1.53	0.06
Mn	50	0.86	6.37
Fe	300	3.14	26.3
Co		0.03	0.08
Ni		0.84	2.97
Cu	1300	1.19	1.87
As	10	0.62	2.51
Se		1.05	1.51
Mo		3.30	3.27
Ag	100	0.02	
Cd	5	0.01	0.05
Sb	60	0.44	0.56
Ba	2000	17.2	50.9
Tl		0.01	0.02
Pb	15	0.09	0.02
U		1.21	4.30

Figure 8. Both Omaha Tap water and Missouri river water have low levels of metals well within the calibration range for dissolved metals and below values defined by the Safe Drinking Water act.

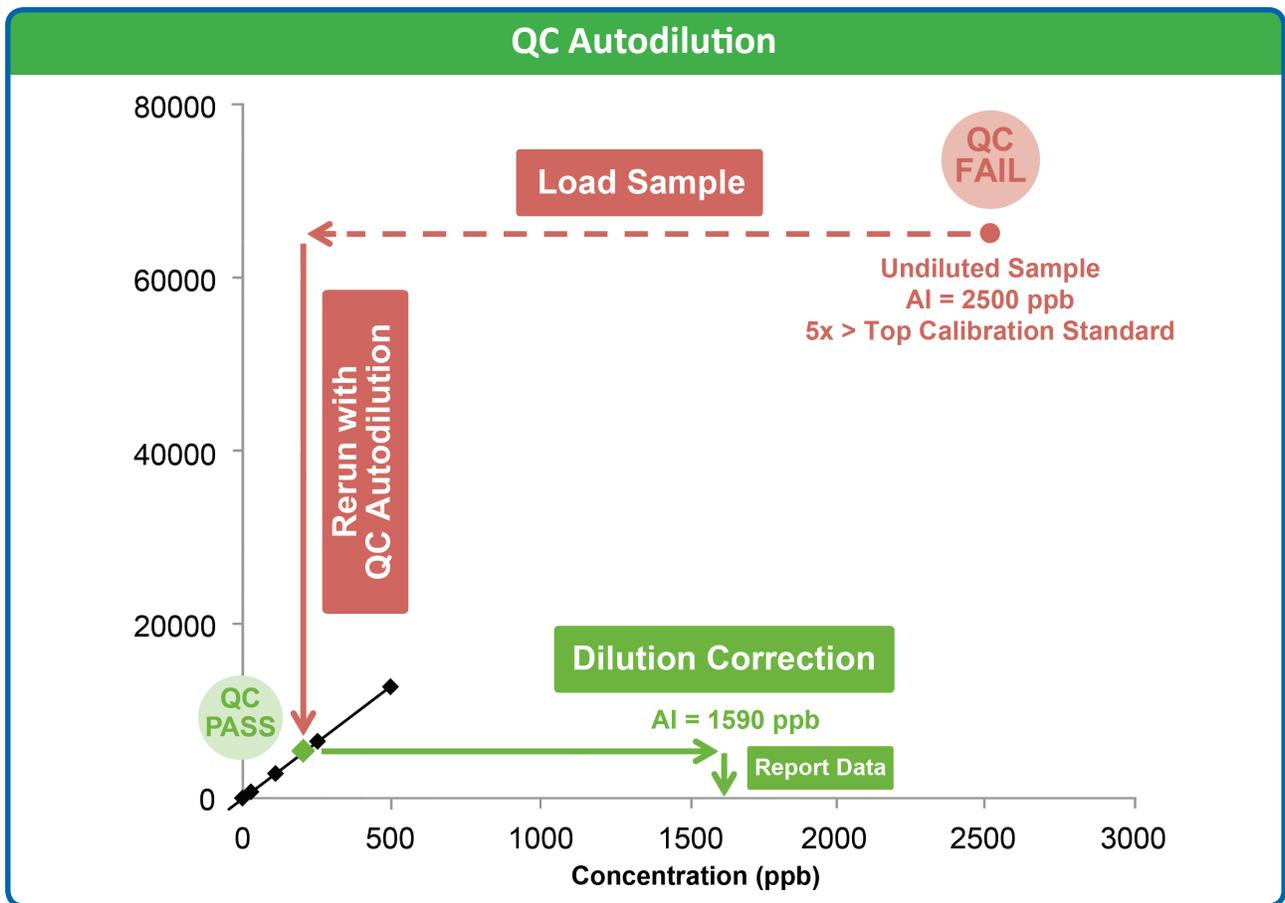
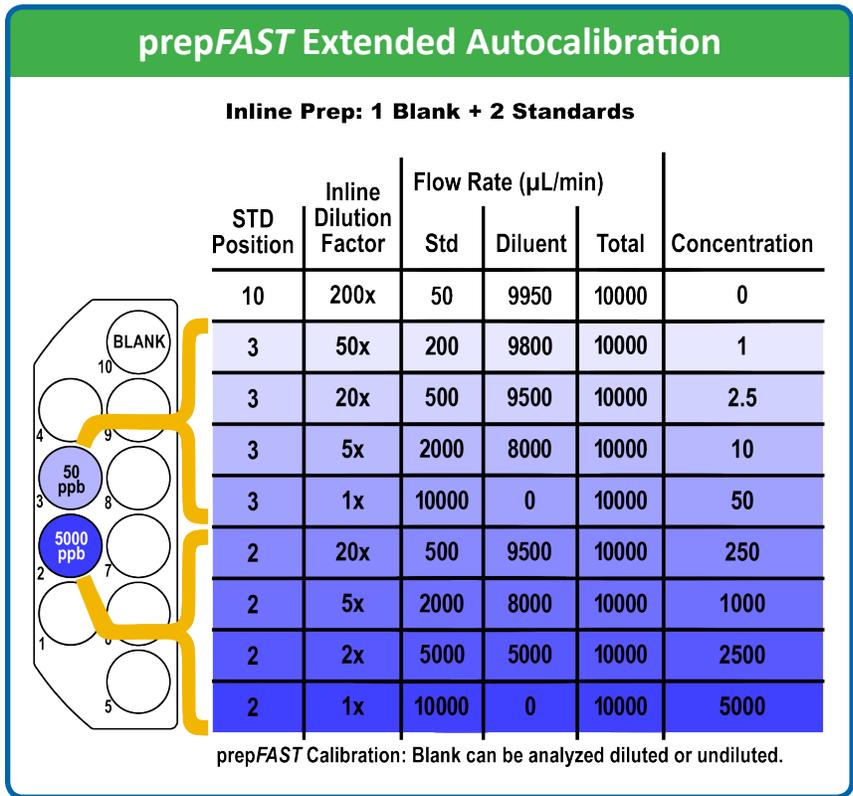


Figure 9. prepFAST autodilution in combination with ICPMS QC software eliminates in run QC over range failures. To illustrate QC over range functionality, a digested (EPA 200.8) Missouri river water is run against the dissolved metal calibration curve (high standard AI = 500 ppb). Aluminum liberated from the particulate phase results in a calibration over range failure, a new sample is inserted into the sample list and prepFAST automatically reruns the sample at a greater dilution (10x user defined). The intensity of the diluted sample is now within the calibration range the concentration is determined and corrected for dilution.

Figure 10. Measuring a variety (dissolved, total recoverable, total digests) of sample types with a large range in natural variability requires a greatly extended calibration range. prepFAST autocalibration function can calibrate over a large (5000x) linear range by using two calibration standards. The first standard (S1) for the low concentration range is diluted 1-50x and a second standard (100x S1) is diluted 1-20x.



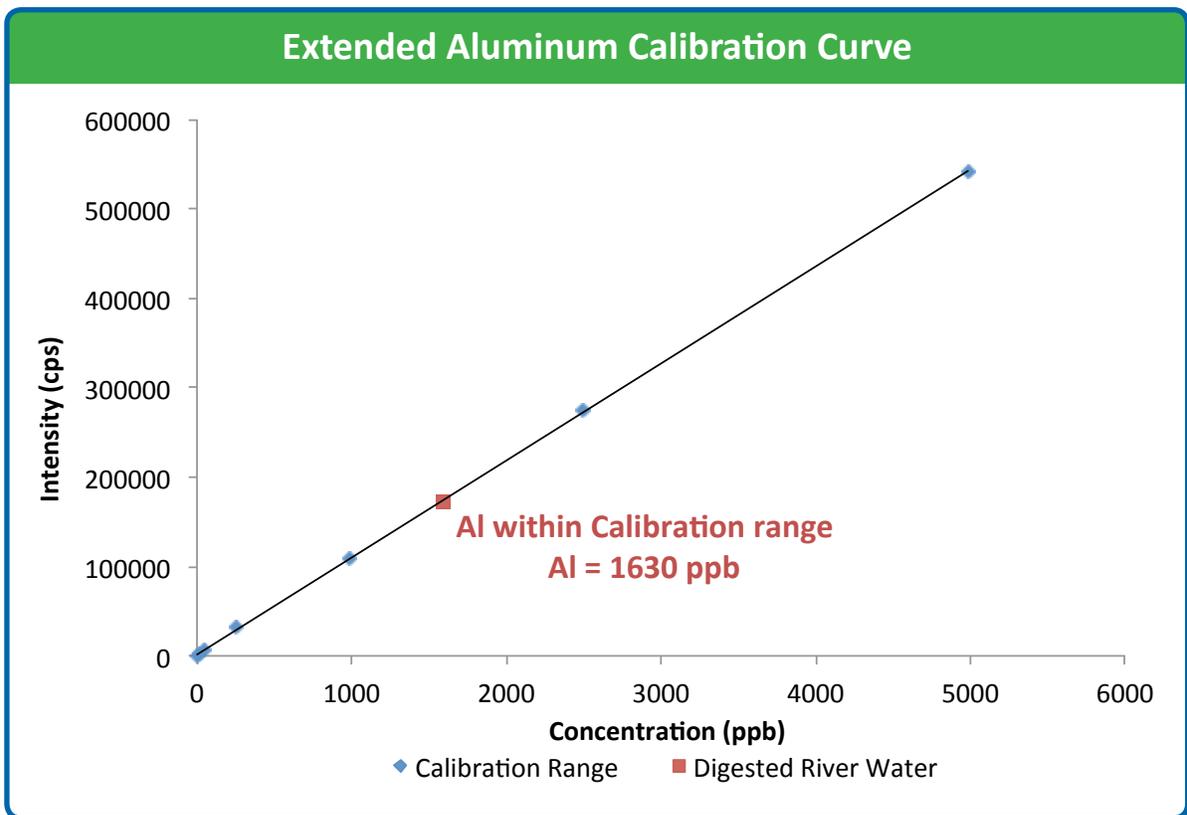


Figure 11. One extended (5000x) linear (0.9999) calibration curve is automatically generated from two multi-element standards. The total recoverable aluminum from figure 7 now falls in the middle of the calibration curve and does not generate a QC over range failure.

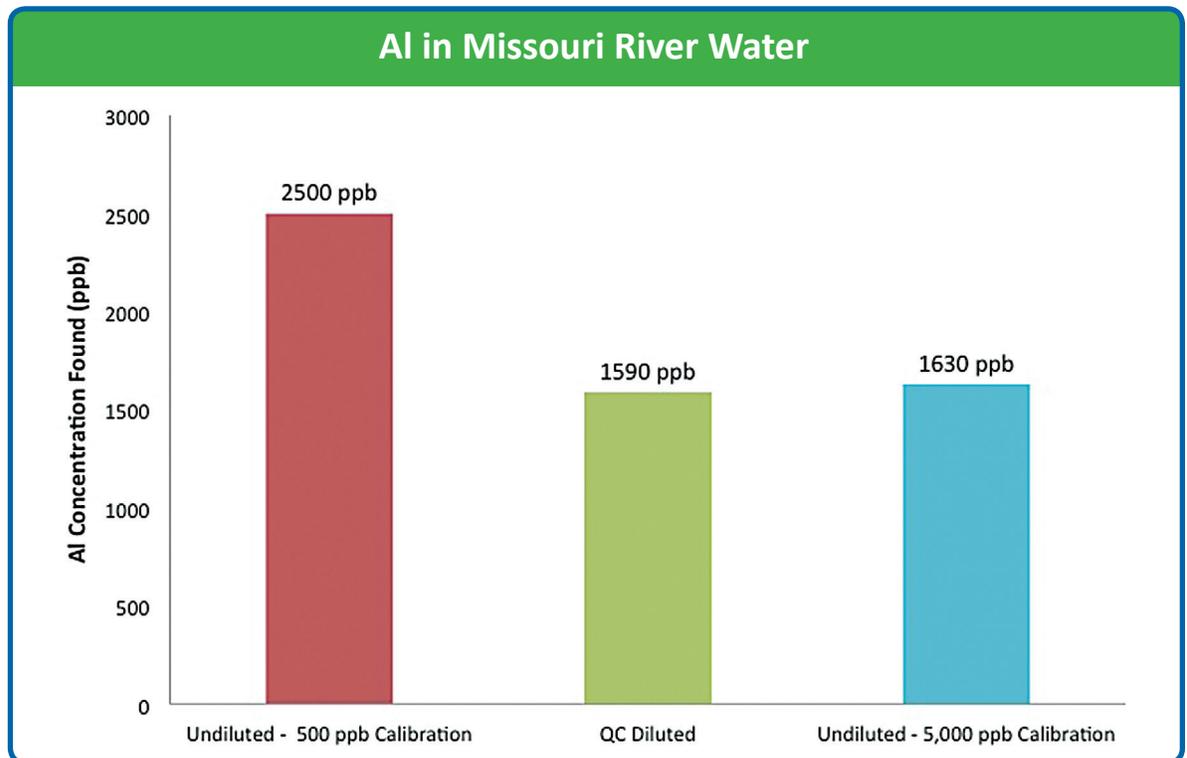


Figure 12. Comparison of Al concentrations for digested Missouri River water calculated using 500 ppb calibration range, QC over range, auto QC dilution (Figure 7) and extended calibration range up to 5,000 ppb (Figure 8). Excellent agreement indicates both methods are valid while also showing the 500 ppb calibration to be insufficient between the QC autodilution and the extended calibration data.

Benefits:

- prepFAST Autocalibration
 - Single multi-element standard
- prepFAST Extended autocalibration
 - Two multi-element standards
- prepFAST Auto QC over range dilution
 - Eliminate QC failure generated reruns
- Exceeds EPA 200.8 criteria



SC-2 DX prepFAST System

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