

Extending ICP-MS Dynamic Range

Agilent's 7500cx Measures Beyond 2000ppm

Quadrupole ICP-MS instruments use electron multiplier detectors which typically have a dynamic range of 8 orders of magnitude, giving a measurable concentration range of 0.5ppt to 50ppm, for a fully-ionized, monoisotopic element (assuming good quality reagent blanks). An 8 orders of magnitude range is 9 calibration standards, i.e. 0.5, 5, 50ppt, 0.5, 5, 50ppb, 0.5, 5, 50ppm.

Older pulse-count only ICP-MS detectors were limited to 6 orders of magnitude, but on modern instruments this is extended by 2 further orders, to give the 8 orders range typically specified. This is achieved by switching automatically to analog mode for high signals, or by decreasing the detector gain in pulse count mode. In both methods, detector cross calibration is required.

The Agilent 7500cx features a unique log amplifier detector circuit, which gives an extra order of magnitude dynamic range compared to other ICP-MS, providing 9 orders of magnitude detector range, or 10 orders of concentration – from 0.5ppt to 500ppm. This is genuinely the detector count-rate range, so there is no need to change detector gain voltages, quadrupole resolution settings, or reduce sensitivity with “High Matrix/Low Transmission” interface cones, which of course can't be changed mid-run.

7500cx - Widest Analytical Working Range

While the working range of the 7500cx is sufficient for the vast majority of ICP-MS applications, and significantly reduces re-runs due to over-range samples, the upper working range of the 7500cx can be further increased with Extended Dynamic Range (EDR). This works by operating the Octopole Reaction System in helium collision mode (He mode) to measure concentrations up to and above 2000ppm. In this case, elements can be measured in both no-gas and He mode and the modes combined to cover the full concentration range. Concentrations above 500ppm are over-range in no-gas mode, but are reported using the

ICP-MS Detector Type	Dynamic Range	Max Measurable Concentration
Pulse-count only	10E6	~0.5ppm
Conventional PC/Analog	10E8	~50ppm
Agilent 7500cx PC/Analog	10E9	~500ppm
Agilent 7500cx - He mode EDR	>10E9	>2500ppm

Table 1 Dynamic range comparison

He mode data. Table 1 shows the comparison of conventional pulse counting, conventional extended range, the standard 7500cx dynamic range, and 7500cx with EDR.

The capability of He mode to extend the upper working range of the 7500cx is illustrated in Figure 1. A Na calibration of 0, 0.5, 1.0, 10, 25 and 50mg/L (ppm) was performed, and solutions of 0.3% and 0.6% NaCl (equivalent to 1:10 and 1:5 diluted seawater) were then measured. These samples were added to the calibration using calculated values of 1180 and 2360mg/L Na respectively, to give the complete calibration shown. Excellent linearity demonstrates the robustness of the 7500cx and complete freedom from ionization suppression even at 2360ppm Na.

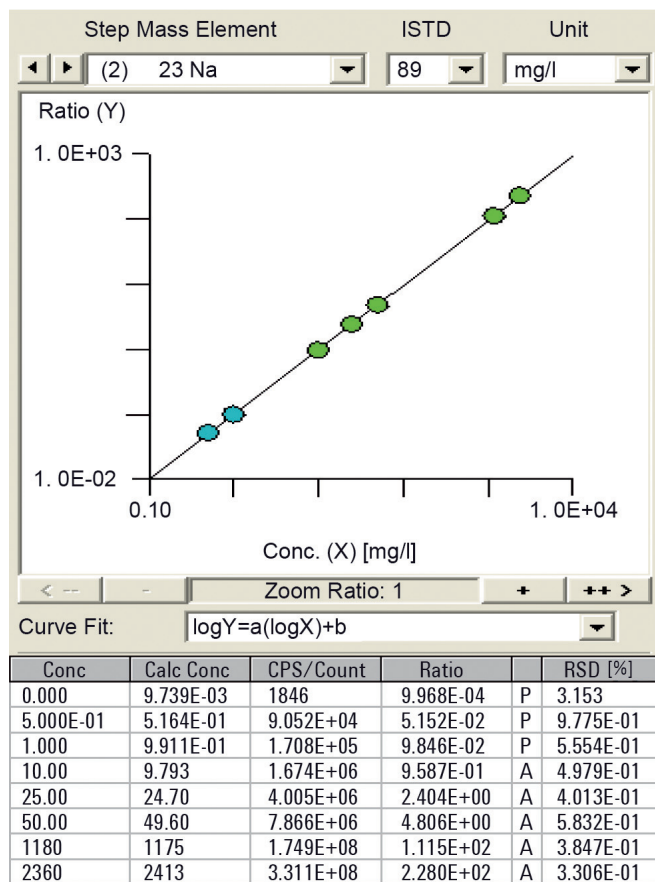


Figure 1 Na calibration: linearity to > 2000ppm

