A Fully Ceramic Torch and other Accessories for Maintaining QC in the ICP Laboratory

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Glass Expansion D-Torch

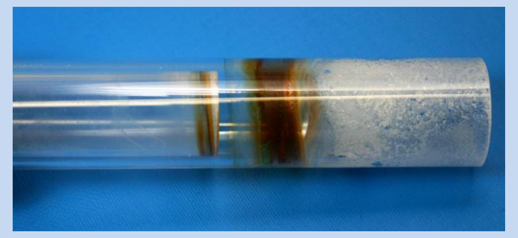
The D-Torch is a revolutionary new demountable torch design. It provides the benefits of a fully demountable torch at a significantly lower cost. The D-Torch is available for a range of ICP models, including those from PerkinElmer, Spectro, Thermo and Agilent (Varian). Our newest D-Torch release is for the Agilent 7500 and 7700 ICP-MS, and we will soon be releasing a D-Torch for other ICP models.

Options Suited To Your Application Needs

D-Torch products shown below are for the Thermo iCAP 6000 series Radial ICP.

Product options from left to right; D-Torch Base with Ceramic Inner tube, Ceramic Outer Tube, Quartz Outer Tube, Quartz Injector, Alumina Injector and Sapphire Injector.

The ICP torch is a relatively high cost consumable item that requires regular maintenance and replacement when performing more demanding applications, e.g. hydrofluoric acid (HF), organic solvents and high dissolved solids. The D-Torch has an interchangeable outer tube so that you can replace the outer tube when it fails rather than replacing the entire torch. Outer tubes made of quartz or ceramic are available (ceramic not available for all models). The ceramic outer tube is of particular benefit for the analysis of wear metals in engine oils, where quartz outer tubes often suffer from short lifetime. It is also beneficial for Si determinations, where quartz outer tubes can produce significant background signals. In general, the ceramic outer tube has a much longer lifetime, greatly reducing interruptions and downtime due to torch failure. The D-Torch also features an alumina intermediate tube and an interchangeable injector. This allows the analyst to have a specific injector for each application whether aqueous, organics, high dissolved solids or HF. Injectors made from high quality quartz, alumina and sapphire are available in a variety of internal diameters to suit your application needs.



The outer tube of the ceramic D-Torch is made from sialon, which is a ceramic material derived from silicon nitride. A combination of high temperature and salt deposit causes a quartz torch to devitrify. Higher concentrations of salt in the samples lead to more rapid devitrification. The quartz torch in the photo (above right), was run for only 6 hours with samples containing 10% NaCl and is already badly degraded. By contrast, the ceramic outer tube of the D-Torch does not devitrify and is not affected by salt deposits. The ceramic D-Torch in the photo (above left) was run for the same period and with the same samples as the quartz torch but shows no degradation at all.

Improved Plasma Robustness with a Ceramic Torch

Typical ICP operating conditions require Argon flow rates of 15.0 L/min; this high flow is necessary to shield the quartz material of the torch assembly. However, the high flow rate also cools the plasma. Running at a reduced flow can result in a more robust plasma, but there is a danger of damaging the quartz torch. A ceramic torch has a heat resistance above 2000°C compared to quartz, which can begin to strain at 1200°C. With a ceramic D-Torch in place of the standard quartz torch, Argon flow rates can be reduced down to 10 L/min or lower. The ICP figures of merit obtained on a Perkin Elmer Optima 2100 DV are compared at a plasma gas flow rate of 15.0 L/min and 10.0 L/min. Using a ceramic D-Torch, plasma robustness, atomization/ionization, excitation and stability were examined.

ICP Operating Conditions

ICP Parameter	PE Optima 2100 DV
RF Power (W)	1350
Auxiliary gas flow (L/min)	0.20
Nebulizer gas flow (L/min)	0.65
Plasma gas flow (L/min)	10 & 15
Injector ID (mm)	2.0
Solution flow rate (mL/min)	0.55

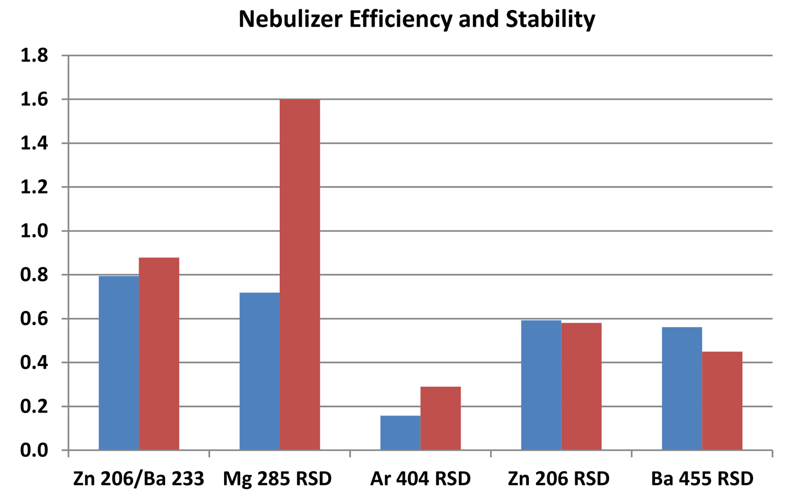
ICP Figures of Merit*

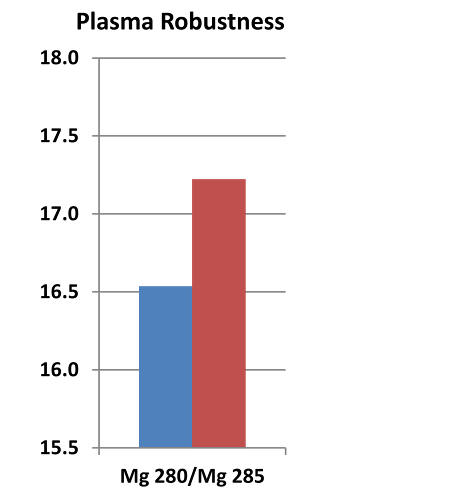
Test	Diagnostic
Mg 280(II)/Mg 285 (I)	Robustness
Zn 206 (II)/Ba 455(II)	Atomization/Ionization
Mg 285 (I) RSD	Nebulizer Efficiency
Ar 404 (I) RSD	Stability
Zn 206 (II) RSD	Stability
Ba 455 (II) RSD	Stability

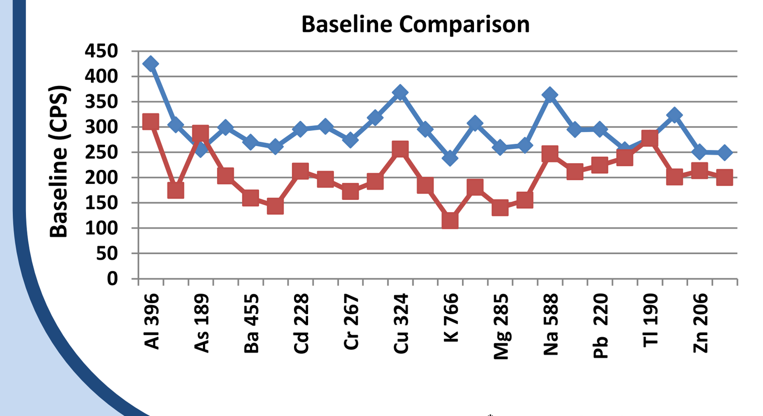
ICP Conditions

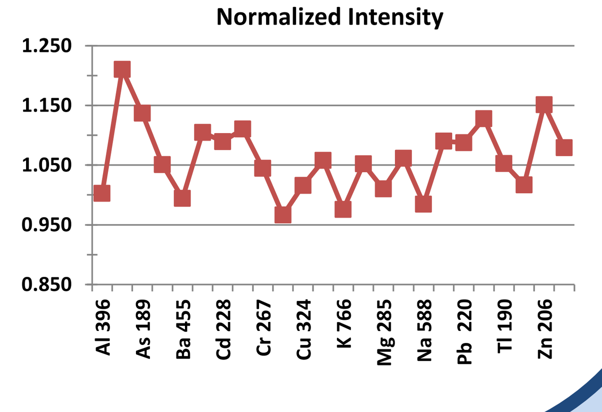
Optima 1350 W – 15.0 L/min

Optima 1350 W – 10.0 L/min









*E. Poussel and J. M. Mermet, Spectrochimica Acta, 1993

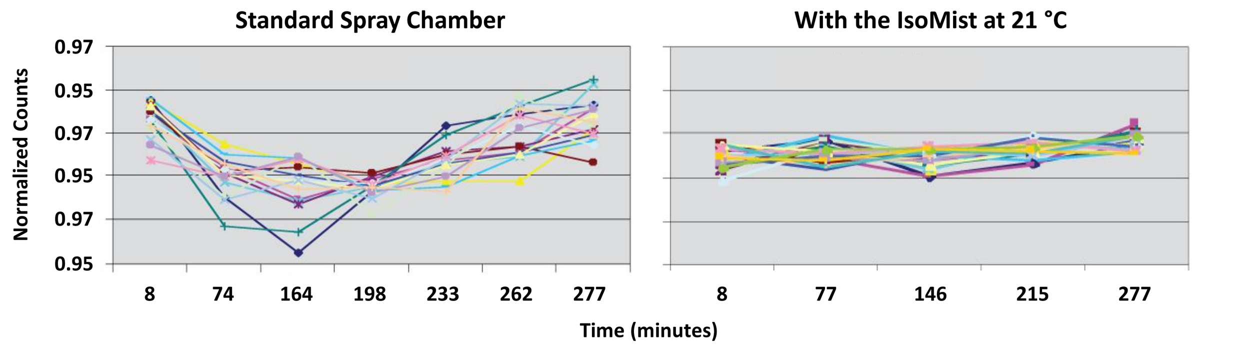
At a plasma gas flow rate of 10.0 L/min a 4% increase in plasma robustness was observed, resulting in a slight increase in sensitivity and a lower baseline for most wavelengths. The nebulizer efficiency and plasma stability results are nearly identical at both plasma gas flow rates. This proves that there is no loss in ICP performance at a lower plasma gas flow. In summary, the ceramic D-Torch provides the analyst with reduced Argon consumption and a more robust plasma, where a quartz torch would fail. The expected life time of the ceramic D-Torch is at least 5 times that of a quartz torch when dealing with difficult matrices, making the ceramic D-Torch a cost effective solution to reduce some of the traditional consumable costs associated with ICP.

Maintaining QC in the ICP Laboratory

The stability of results for ICP spectrometry depends upon a number of parameters, two important factors that we will address are the importance of maintaining constant spray chamber temperature and nebulizer sample uptake rate.

IsoMist Programmable Temperature Spray Chamber

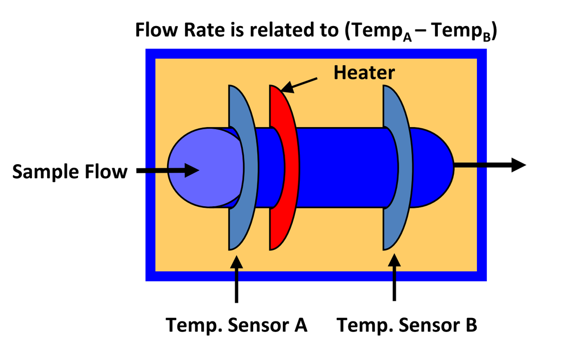
The IsoMist Programmable Temperature Spray Chamber, provides the benefits of a temperature-controlled ICP sample introduction system in a compact, convenient package. The IsoMist can be programmed anywhere from -10 to 60°C in increments of 1°C, with the temperature maintained to within 0.1°C. The built-in Peltier effect heat transfer module is intimately in contact with the spray chamber so that the desired temperature can be achieved quickly and accurately. The IsoMist incorporates the Twister baffled cyclonic spray chamber, proven to combine excellent sensitivity and precision with exceptionally fast washout.

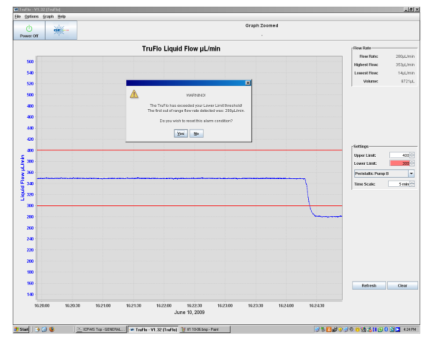


The data shown above was taken on a Perkin Elmer Optima 2100DV ICP-OES at a sample uptake rate of 1 mL/min. Without temperature control, the intensity drifts as much as 3% high and 5% low during four hours of running. With the IsoMist controlling and maintaining temperature at 21°C, intensities are held to within ± 1%. This kind of stability is necessary to achieve maximum accuracy and reproducibility. Also, if temperature drift is more severe, it will result in out of spec controls necessitating re-running of standards and samples. The stability of the IsoMist translates to reducing QC failures, decreasing the number of standardizations, and higher accuracy.

The applications of a temperature controlled spray chamber are quite diverse. In addition to signal stability, the IsoMist can be heated to increase transport efficiency and chilled to reduce solvent loading with volatile solvents and reduce oxide ratios for ICP-MS applications. Please visit www.geicp.com for more details.

TruFlo Sample Uptake Monitor





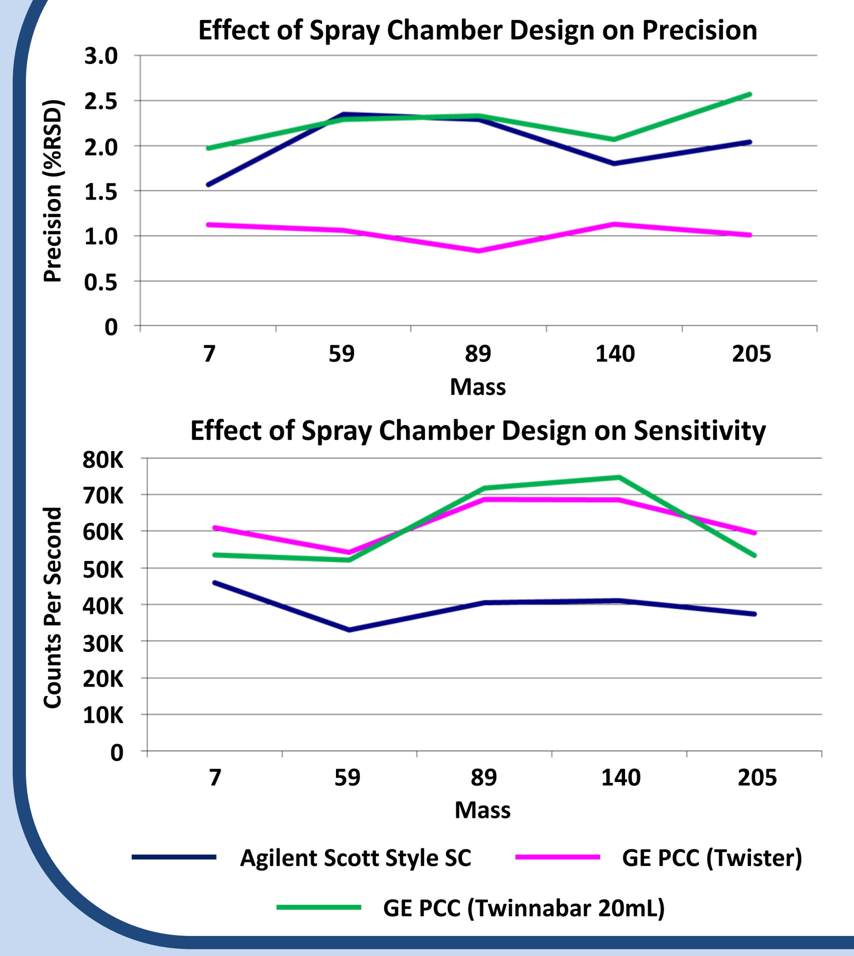
In order to achieve the best analytical performance, sample delivery must be consistent over both the short and long term. Failure to consistently deliver sample shows up in terms of poor precision and inaccuracy, but may not become evident until a QC sample is measured. Potential causes of this failure are; worn pump tubing, incorrect pressure on peristaltic pump tubing clamp, worn pump rollers, or a clogged nebulizer. With the TruFlo sample monitor the ICP analyst will instantly know when the sample uptake rate deviates from the desired level. The allowable range can be programmed so that an alarm is triggered when the sample uptake falls outside the range (shown above right). The TruFlo uses a thermoelectric sensor to cover the range of 0.05 to 4.0 mL/min, the sample uptake is displayed in real time both digitally and graphically.

The results discussed above show the sample flow rate and temperature of the spray chamber in an ICP spectrometer have a direct influence on the sample transport and the signal stability. The IsoMist programmable temperature spray chamber provides the analyst with the stability of a constant temperature to minimize drift. The TruFlo sample monitor assures the analyst of acceptable performance while monitoring the sample flow rate over the length of an analysis. By fitting your ICP with the IsoMist and TruFlo you can be assured that you have a consistent and reproducible sample introduction system for maintaining QC in the ICP laboratory.

Peltier Cooled Cyclonic Spray Chamber Agilent ICP-MS

- Interchangeable glass, quartz, and PFA cyclonic spray chambers
- Low-volume Twinnabar spray chamber also available
- Supplied with convenient mounting bracket
- Temperature controlled by Agilent ICP-MS software and electronics
- Peltier cooling system
- Utilizes standard water cooling from Agilent ICP-MS, quick-connect water lines

Analytical Performance of the GE PCC



The standard Agilent MicroMist nebulizer was used at an uptake rate of 0.4 mL/min (0.2 mL/min for the Twinnabar) in order to compare the performance of the GE PCC to the standard Agilent chilled Scott style double pass spray chamber. All spray chamber setups were kept at a temperature of 2°C. In the top chart the average %RSD shows that the GE PCC fitted with the Twister spray chamber (40 mL volume) offers the best precision with an average RSD of 1%. In addition to an improvement in precision the GE PCC fitted with either the Twister or Twinnabar spray chamber provided large improvements in sensitivity, approximately 1.5 times higher than the standard Agilent Scott Style. The cyclonic design has also proven to provide faster washout times when compared to the Scott style double pass spray chamber.

If your application requires a flow rate below 400 µL/min, we recommend fitting the PCC with the Twinnabar (20 mL volume) spray chamber. At these low flow rates the Twinnabar will offer faster washout times without sacrificing ICP-MS performance.

When the best temperature flexibility or temperature stability is required, we recommend the IsoMist Programmable Temperature Spray Chamber. However, for many ICP-MS applications, a fixed temperature of around 2°C is used and no flexibility is needed. For these applications, we recommend the Peltier Cooled Cyclonic (PCC) Spray Chambers for the Agilent 7700 and 7500 ICP-MS models. These accessories are based on the spray chamber and Peltier system of the Isomist but are coupled to the electronics and water cooling of the ICP-MS. Agilent 7700 and 7500 users can therefore reap the benefits of a cyclonic spray chamber under control of the instrument software. Compared to the Scott style spray chamber, the GE PCC spray chamber provides faster washout, increased sample throughput, and improved precision and sensitivity. The GE PCC also provides the analyst with a selection of different spray chamber designs to best suit their application needs.