

Resilient Vertical Torch Means Less Cleaning, Less Downtime, and Fewer Replacements—Even for Tough Samples

Agilent 5800 and 5900 ICP-OES



Introduction

One of the main considerations when running samples on an ICP-OES is the percentage of total dissolved solids (TDS) in the sample. Many common sample types can contain high levels of TDS. Examples include soil, sludge and brine samples, which are typically analyzed in environmental labs, and various acid digests, and fusions that are routinely analyzed in minerals, mining, and soil labs.

The level of TDS in a sample will often dictate which type of ICP-OES instrument is used for the analysis. As a guide, samples containing up to 3% TDS are analyzed using an ICP-OES instrument with a horizontal torch. Samples with higher levels of TDS are typically run on a radial instrument with a vertical torch. Other key considerations when running high TDS samples include a robust radio frequency (RF) generator system, and a torch that can run challenging samples.

The benefits of a vertical torch

Radial instruments with a vertical torch can handle higher levels of TDS. However, the radially viewed plasma (when the plasma is viewed from the side of the torch) is not capable of reaching the detection limits that an axially viewed plasma (viewed from the end of the torch, down the central channel of the plasma) can achieve. When lower detection limits are required, instruments with a horizontal torch can be equipped with a specially designed high-solids torch that can handle higher levels of TDS. But the precision and long-term stability of such systems is reduced compared to a vertical torch, and the torch must be cleaned or replaced at more regular intervals.

The Agilent 5900 and 5800 ICP-OES instruments include a resilient vertical torch in each available configuration, see Table 1. The vertical torch allows the analyst to measure the most challenging samples, from high matrix to volatile organic solvents. The vertical orientation ensures uncompromised, robust measurements on tough samples with less cleaning and less downtime. As vertical torches typically have a longer lifetime, fewer replacement torches are needed.

Table 1. The Agilent 5900 SVDV ICP-OES, 5800 VDV ICP-OES, and 5800 RV ICP-OES feature a vertical torch. Available viewing modes for each instrument are summarized.

Instrument	Radial Mode	Axial Mode	VDV Mode	SVDV Mode
5900 SVDV ICP-OES	✓	✓	✓	✓
5800 VDV ICP-OES	✓	✓	✓	Upgrade option
5800 RV ICP-OES	✓	X	X	X

The 5900 Synchronous Vertical Dual View (SVDV) ICP-OES uses a unique Dichroic Spectral Combiner (DSC) technology that enables fast sample measurement with the lowest argon gas consumption per sample (Figure 1). The SVDV configuration can be run in axial, radial, vertical dual view, and synchronous vertical dual view modes.

The 5800 Vertical Dual View (VDV) ICP-OES offers high sample throughput capabilities and is fully upgradable onsite to the SVDV configuration if sample throughput demands increase. The 5800 RV ICP-OES is ideal for labs needing a fast, high-performance radial ICP-OES.

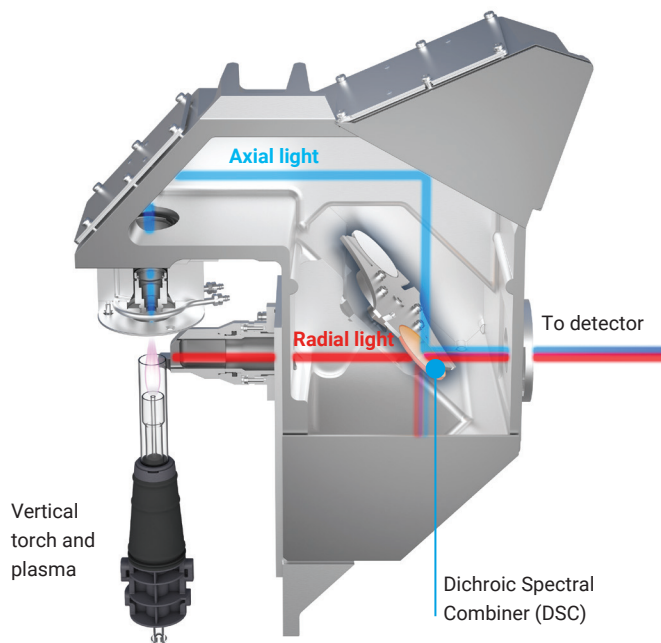


Figure 1. Schematic showing the emission from axial and radial plasma views synchronously converging onto the DSC. The combined emissions are then transmitted into the polychromator optics and to the detector.

Easy-fit torch

The 5900 and 5800 ICP-OES feature an Easy-fit torch, and a simple torch loader mechanism that automatically aligns the torch and connects gases for fast start-up and reproducible performance (Figure 2). Once loaded, there is no need for further adjustments of the torch, or optical alignment of the axial viewing position. This automatic alignment is invaluable for labs where reproducible performance is required from operator to operator, and greatly reduces instrument to instrument variability. For ultimate stability, mass flow controllers (MFC) control all plasma gas flows into the torch.



Figure 2. Sequence of three-easy steps to load the torch into the instrument for fast start-up and reproducible performance.

Solid-state RF system

The 5900 and 5800 ICP-OES include a solid-state RF (SSRF) system that operates at 27 MHz and delivers a reliable, robust, and maintenance-free plasma. To run challenging samples, the RF system must be able to rapidly adjust to changes in the plasma conditions. The free running SSRF in the 5900 and 5800 ICP-OES meets these challenges. It can handle a wide range of samples, from volatile organics such as methanol, to brine samples with 30% NaCl. The RF system can operate with a power output ranging from 750 to 1500 W, unlike other dual view systems where the RF power must be limited to 1350 W to avoid damaging the horizontal dual view torch.

Proof of performance

To demonstrate the long term stability performance of the 5900 SVDV ICP-OES for the analysis of high TDS samples, a solution of 25% NaCl was spiked with 0.20 mg/L of a multi-element solution. The spike solution included Al, As, Ba, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Se, Sr, and Zn. The NaCl solution was analyzed using a 5900 ICP-OES in SVDV mode. The 5900 was fitted with a high-solids dual view torch (2.4 mm id injector) and the Agilent Argon Humidifier Accessory. The solution was run as a sample for 9.4 hours, with a rinse step included between each sample. The spike recovery results are shown in Figure 3. The %RSD for all elements was found to be less than 1.6% over the 9.4 hour period, as shown in Table 2.

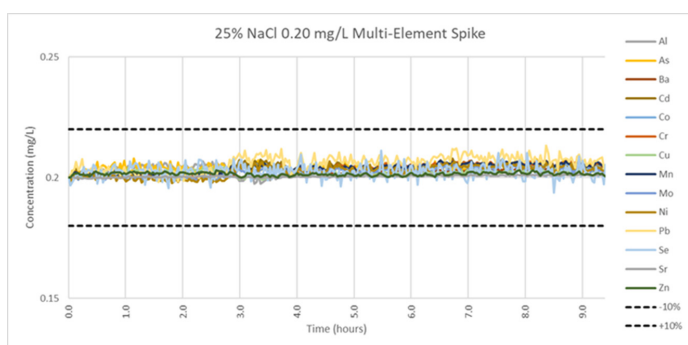


Figure 3. Stability test over 9.4 hours for a 0.20 mg/L multi-element spike in 25% NaCl.

Table 2. Relative standard deviation (%) for 14 elements in 25% NaCl multi-element spike solution.

Element and Wavelength (nm)	%RSD
Al 396.152	0.9
As 188.980	0.8
Ba 455.403	0.5
Cd 214.439	1.1
Co 238.892	1.0
Cr 267.716	1.1
Cu 327.395	0.5
Mn 257.610	0.9
Mo 202.032	0.9
Ni 231.604	1.2
Pb 220.353	1.6
Se 196.026	1.4
Sr 421.552	0.2
Zn 213.857	0.3

Conclusion

The resilient vertical torch used in the Agilent 5900 and 5800 ICP-OES instruments provides the best configuration for handling tough samples, while delivering the precision expected of an axially viewed plasma.

The SSRF system produces a reliable, robust, and maintenance-free plasma suitable for even the toughest samples, providing excellent long-term stability.

The Easy-fit torch with MFC control of all plasma gases eliminates the torch alignment process that is often required when analyzing challenging samples, ensuring consistent and reproducible results.

www.agilent.com/chem

This information is subject to change without notice.

© Agilent Technologies, Inc. 2019
Printed in the USA, November 15, 2019
5994-1514EN

 **Agilent**
Trusted Answers