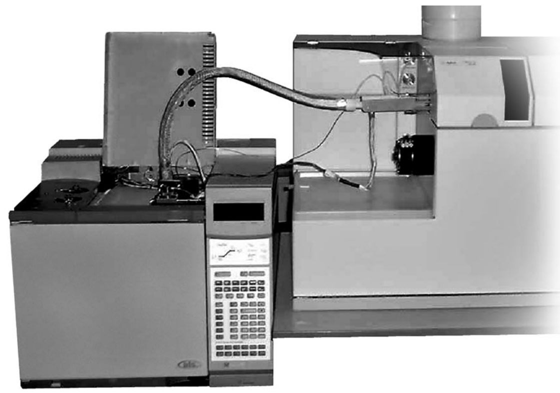
Agilent GC-ICP-MS Interface
Technology



- **Combining Agilent's expertise in GC and ICP-MS.**
- **Easy connection and removal of the interface.**
- **Transfer line is flexible so torch position optimization is available.**
- **Temperature control from GC - no external heating required.**
- **Temperature range up to 300 °C enables the measurement of high boiling point compounds.**
- **Novel transfer line heated all the way to the injector tip - no cold spots for sample condensation.**
- **Fully compatible with Agilent's Plasma Chromatographic software for real time data analysis.**

Agilent Technologies have combined their expertise in gas chromatography (GC) and inductively coupled plasma mass spectrometry (ICP-MS) to introduce the first fully integrated solution for the coupling of these two techniques. The separation capabilities of gas chromatography and the high sensitivity and selectivity of the Agilent 7500 Series ICP-MS provide analysts with the capability to separate and quantitate ultra-trace levels of organometallic compounds.

Why Speciation?

Often analysts must measure not only the total metal concentration in a sample but must also separate and quantitate the different organometallic species present. Speciation is becoming increasingly important as the chemical form of an element will often determine its activity, toxicity and mobility in biological and environmental systems. Knowledge of elemental species in environmental samples, for example, assists in identifying the source of the contamination, determining the ultimate fate of the species and designing the optimal method for treatment and removal.

Why GC-ICP-MS?

The measurement capability of currently available GC detectors such as FPD, FID and ECD are good, but the need for determining organometallic compounds at increasingly lower concentrations has fueled the investigation of alternative detection systems. This measurement challenge led to the development of the Agilent GC-ICP-MS interface. ICP-MS provides ultra-trace detection limits and high selectivity for most elements. Samples are introduced to a high temperature argon plasma where they are decomposed, atomized and ionized. Ions are then detected using mass spectrometry. Although ICP-MS alone provides information regarding the total metal concentrations in a sample, ICP-MS is being used more frequently in combination with a front-end separation technique such as GC, as a specific and highly selective detector for a variety of speciation applications. GC-ICP-MS allows for the simultaneous separation and measurement of multiple organometallic compounds in a single analytical run.

The GC-ICP-MS Interface

The GC interface is designed for use with the Agilent 6890 GC. The interface hardware consists of a torch adaptor and demountable GC torch with heated injector, and a novel heated transfer line to interface the GC to any of the Agilent 7500 Series ICP mass spectrometers.

The fully programmable Agilent 6890 GC can be used for research or routine analysis that require multiple capillary columns, valves, or specialty inlets, over a broad temperature range.

Since GC separations typically give much narrower signal peaks than LC separations, it is essential that the ICP-MS is able to acquire data quickly. The fast simultaneous dual mode detector of the Agilent 7500 is perfectly suited to GC signals since, unlike older detector designs, the acquisition speed is equally fast (100 µsec minimum dwell time) regardless of whether the detector is acquiring in pulse count or in analog mode.

Coupling and uncoupling the GC and ICP-MS has been made quick and easy to maintain flexibility in the laboratory. The general principle of combining GC and ICP-MS is simple, as seen in the schematic of the interface shown in Figure 1. The GC column extends through the flexible transfer line and terminates within the ICP torch injector tube, just upstream of the plasma, so that separated species are carried directly into the plasma by a heated argon flow. The flexibility of the GC transfer line permits easy alignment and adjustment of the torch for system optimization, so the GC interface does not hinder the automatic torch positioning routine of the Agilent 7500 software. The torch has been specially designed for ease of installation and reliability.

The transfer line can be uniformly heated to 300 °C, enabling even high boiling compounds to be separated and measured. The design of the interface eliminates cold spots in the transfer line, preventing the loss of analytes by condensation. In order to optimize the ICP-MS operating conditions, Xenon is added to the argon flow. The resultant Xe-Ar gas mixture is then preheated by passing it through a stainless steel coil mounted in the GC oven. In fact, the whole GC interface temperature is precisely controlled by the Agilent 6890 GC thus overcoming one of the limitations previously encountered with GC-ICP-MS.

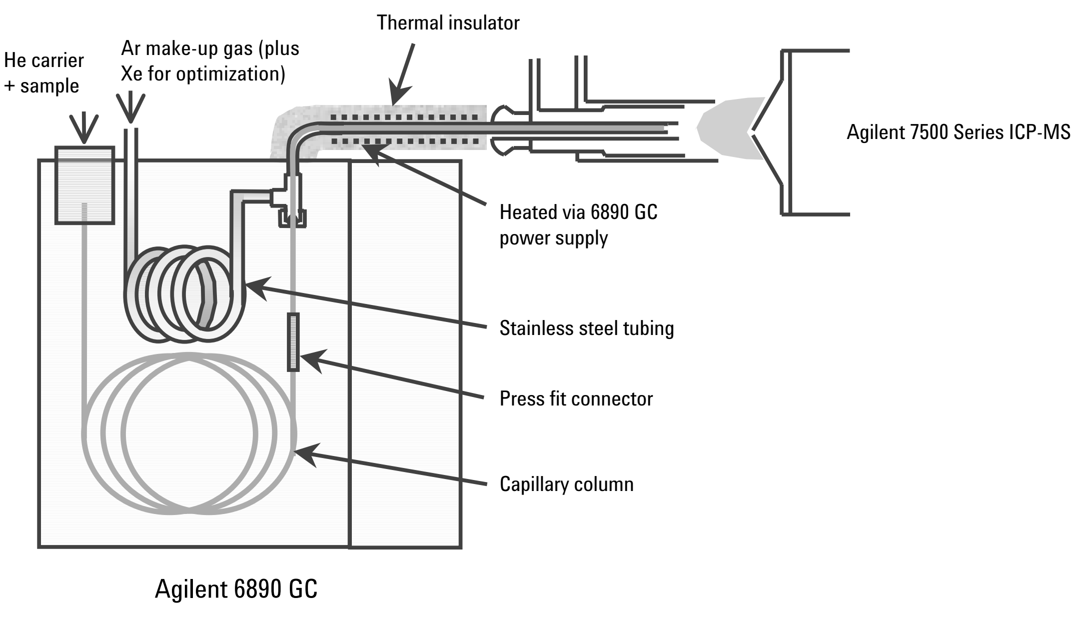


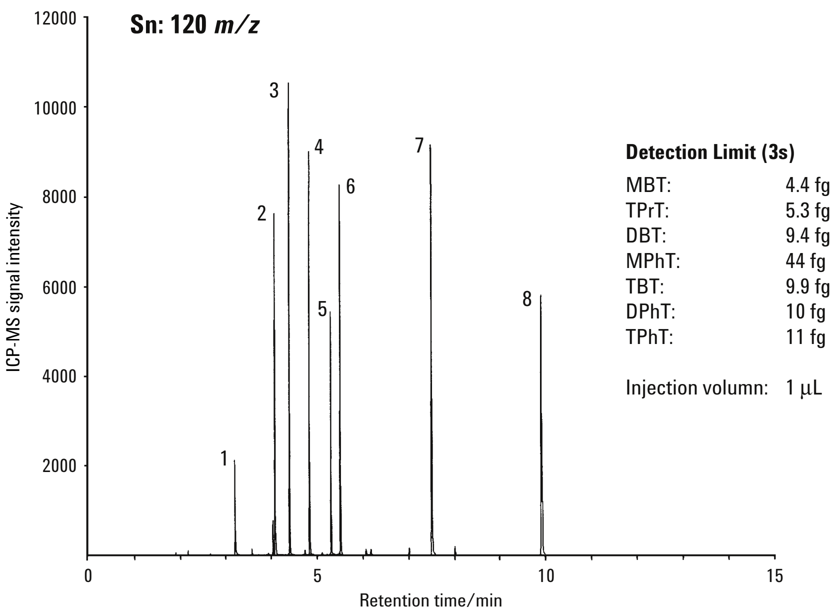
Figure 1: Schematic of GC-ICP-MS interface.

Fully Integrated Operation of the GC-ICP-MS

As expected with a fully integrated system, the interface between the GC and the ICP-MS is seamless. Once the Agilent 6890 GC has been programmed to perform the analysis, the GC triggers ICP-MS data acquisition, and results are reported in real time. The GC analytical parameters and system control demands are stored electronically making subsequent setup fast and reliable.

Chromatographic data analysis is conducted via the Agilent 7500 Plasma Chromatographic Software (Plasma Chrom) component of the ChemStation software suite. The software permits the analysis of real time chromatographic data for the first time. Based on Agilent's renowned GC/MS software, Plasma Chrom incorporates all of the features that chromatographers expect - such as real time QC, advanced peak integration routines and confirmation of target analyte. Moreover, operation of this fully integrated Agilent GC-ICP-MS system is easy making it suitable for both an R&D setting and for routine use.

Using the Agilent 7500 Series ICP-MS as a detector for GC gives fast multi-isotope or multi-element analysis and extremely low detection limits for most elements. The sensitivity of the technique is highlighted in Figure 2, which shows the chromatogram and detection limits for a mixture of organotin standards used in the analysis of oyster extracts. More information on this particular application can be obtained from Agilent Application Note "Speciation of Organic Compounds Using a Newly Developed, Experimental GC-ICP-MS Interface" (reference publication number 5980-0336E).



1: Sn (inorganic)
2: Monobutyltin (MBT)
3: Tripropyltin (TPrT) (ISTD)
4: Dibutyltin (DBT)
5: Monophenyltin (MPhT)
6: Tributyltin (TBT)
7: Diphenyltin (DPhT)
8: Triphenyltin (TPhT) concentration: 5 µg/L (5 pg) as metal

Figure 2 Chromatogram of a 1 µL injection of a 5 ppb organotin mixed standard.

Ordering Information for the Agilent GC-ICP-MS Interface

Description	Model
GC-ICP-MS Interface	G3158A #ABA
Kit includes:	
Demountable GC torch	
Torch adaptor	
Heated injector	
Flexible heated transfer line	
Gas heating coil	
APG remote cable (4 m)	

Suggested GC Configuration for Automated Analysis[1]:

Description	Model
Agilent 6890N GC	G1530N
Capillary S/SI inlet with EPC	#112
Flame ionization detector (FID)	#210
Autoinjector	G2613A
100 position sample tray	G2614A
Deactivated column	160-2325-5
Column connector (5/PK)	5181-3396

Minimum ICP-MS requirement:

Description	Model
Agilent 7500 ChemStation	G3150A #ABA
Plasma Chromatographic Software	G1824C
And one of the following Agilent ICP-MS configurations:	
Agilent 7500a ICP-MS	G3151A #ABA
Optional gas line	G3145A
or	
Agilent 7500i ICP-MS	G3152A #ABA
Optional gas line	G3145A
or	
Agilent 7500c ICP-MS	G3155A #ABA
Optional gas line	G3145A
or	
Agilent 7500s ICP-MS	G3153A #ABA

Additional utility requirement:

Description
Mixed gas: Xe 100 ppm in Ar (Typical flow: 0.1 L/min)

[1]Consult your local Agilent Technologies sales representative for alternative configurations.

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