

# Thermo Scientific iCAP 7000 Series ICP-OES Accessories Guide

The new Thermo Scientific™ iCAP™ 7000 Series ICP-OES provides the lowest cost multi-element analysis for measuring trace elements in a diverse sample range, combining advanced performance with high productivity and ease of use. The instrument provides your environmental, pharmaceutical, industrial or food safety facility with the lowest cost of analysis per sample, producing consistently reliable data, whilst ensuring compliance to global regulations and standards.



The iCAP 7000 Series ICP-OES comprises three models to cover all user needs and budgets, from high thru-put routine to the most demanding analytical environments.

## Thermo Scientific iCAP 7200 ICP-OES

A powerful, easy to use instrument for users who are new to the ICP-OES technique, suited to low thru-put analysis requirements. Offers simplicity, with no compromise on performance.

## Thermo Scientific iCAP 7400 ICP-OES

Provides the advanced performance required for a range of analysis and regulatory compliance parameters, through broad capacity, high sensitivity and low detection limits



## Thermo Scientific iCAP 7600 ICP-OES

Designed for the most demanding analysis challenges, with highest thru-put, sensitivity and detection limits; the iCAP 7600 ICP-OES incorporates an integrated sample loop, delivering the sample to the plasma in the most efficient method to drive increased productivity. Maximized scalability and advanced accessory connectivity to support expanding requirements.

The innovative hardware of the iCAP 7000 series ICP-OES, driven by intuitive Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ platform software, simplifies and minimises the user interface with the instrument, enhancing efficiency and assuring correct operation, even for new comers to the ICP-OES technique.

A comprehensive range of compatible accessories are available to maximize laboratory productivity.



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## Autosamplers

The iCAP 7000 Series ICP-OES is fully compatible with a wide range of autosampling devices that enhance efficiency.

Whether the number of samples to be run is 50 or 500, operator time is used relatively inefficiently if samples are presented manually to the instrument. With intelligent automation, staff may concentrate on other important operations, such as sample preparation.

A range of fully compatible autosamplers from CETAC provide alternatives for laboratories with various sample loads. The ASX-260 autosampler offers a 180 sample capacity for low-moderate sample throughput; the ASX-520 autosampler accommodates up to 360 samples for moderate-high sample through-put; and the XLR-8 autosampler enables the unattended analysis of up to 720 samples, for laboratories looking to push the boundaries of unattended analysis. All CETAC autosamplers offer a range of rack configurations, including 8 mL, 14 mL, 20 mL, 30 mL and 50 mL capacity tubes and have a calibration standards/quality control solution column, allowing the use of up to 10 additional 50 mL tubes.

For samples which may contain small suspended particulates such as 'wear metals' applications the ASX-1400 autosampler incorporates automated liquid stirring to ensure sample homogeneity.

The compatible autosamplers have a number of common features designed to make them the most convenient tool for your lab:

- Corrosion resistant sampling mechanism and autosampler construction ensure reliable operation over the long-term. Samples only contact inert PTFE and PEEK materials.
- Peristaltic pump wash station minimizes cross-contamination.
- A dedicated built-in rack taking up to 10 standards utilizes the full sample rack capacity.
- A range of sample racks and sample cup sizes cater for the widest spread of requirements. Larger volume tubes permit more elements to be measured without user intervention.

- An alternative bore uptake probe is available. The standard 0.5 mm bore probe may be replaced by a 0.8 mm probe to reduce blockage risk when sampling solutions that contain particulate matter.
- Intelligent software control of autosampler sequencing speeds up analysis times and guarantees simplicity of use and the highest productivity.

Description	Part number
CETAC ASX-520	9423 470 04001
CETAC ASX-260	9423 470 04002
CETAC XLR-8	8423 470 04003
CETAC ASX1400 Stirring Autosampler - for Oils and Soils Digests	8423 470 04004
CETAC APS1650 Automated Prep Station - Oils Dilutor	8423 470 04005
CETAC Autosamplers Spares and Consumables	
CETAC 0.5 mm ID Carbon Fiber Probe	9423 155 00161
CETAC 0.8 mm ID for Carbon Fiber Probe	9423 155 00171
21 Position Rack (50 mL Tubes)	9423 470 03901
24 Position Rack (30 mL Tubes)	9423 470 03911
40 Position Rack (20 mL Tubes)	9423 470 03921
60 Position Rack (14 mL Tubes)	9423 470 03931
90 Position Rack (8 mL Tubes)	9423 470 03941
50 mL Polypropylene Tubes (Pack of 500) (also used for standards)	9423 470 04151
30 mL Polypropylene Tubes (Pack of 500)	9423 470 04111
20 mL Polypropylene Tubes (Pack of 500)	9423 470 04161
14 mL Polypropylene Tubes (Pack of 1000)	9423 470 04131
8 mL Polypropylene Tubes (Pack of 1000)	9423 470 04141
Sample Probe (0.8 mm)	9423 470 04182
Sample Probe (0.5 mm)	9423 470 03991
Drain Pump Tubing and Connector Kit	9423 470 03971
Stirrer for ASX-1400	8423 470 04043
Stirring Motor for ASX-1400	8423 470 04044
Stirring Kit for Drip Cup Assembly ASX-1400	8423 470 04045

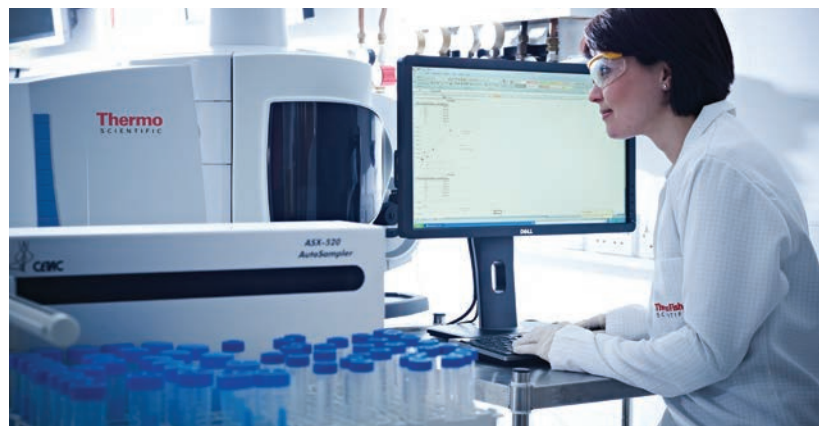


Figure 2. Autosampler

## Sample Introduction Kits

ICP-OES instrumentation relies on the sample introduction system for precise, accurate sample delivery. The iCAP 7000 Series ICP-OES sample introduction kits offer a wide choice of pre-configured kits optimized for a range of sample matrices, to ensure optimum performance.

All sample-introduction kits are 'plug and play', self-aligning systems, ensuring maximum convenience for routine maintenance. The semi-demountable torch module simply clips into place, while automatically making gas-tight connections and fully interlocking with the system. It is possible to remove the center tube whilst the torch is still in situ which dramatically reduces down time during maintenance and cleaning.

The aqueous sample introduction kit is supplied as standard with all iCAP 7000 Series ICP-OES instruments. Optional kits for organics, volatile organics, HF-based and high solids solutions are available to fit radial and duo view systems.

**Aqueous (Standard)** – For aqueous sample solutions containing relatively low acid content (except for hydrofluoric acid (HF)) or up to 3% m/v dissolved solids. The concentric glass nebulizer (within this kit) is not suitable for solutions containing large suspended particles due to the risk of blockage. This kit is shipped as standard with all instruments.

**High Solids** – For the purposes of ICP-OES analysis, high solids is defined as up to 20% m/v solutions, especially samples such as sea waters, brines and ground waters, geochemical samples and fusion mixtures. Used in conjunction with the argon humidifier, the kit allows extended analysis times without the drift and blockage problems often associated with such high concentration solutions.

**Organic** – The organics sample handling kit is recommended for sample solutions containing relatively non-volatile organic solvents, such as xylene, toluene, white spirit and kerosene. These solvents are most likely to be used for lubricating oils analysis, including additive compounds in virgin oil and wear metals in used oil.

**Volatile Organic** – The volatile organics sample handling kit is the recommended option for more volatile organic solvents, such as ketones, alcohols and aldehydes. The use of a cooled spray chamber allows for the successful introduction and analysis of these sample types. These are often found in petrochemical analysis, both for by-products

such as plastics and for petrol itself. The IsoMist temperature programmable spray chamber option provides the optimum configuration for volatile organic solvent analysis by reducing the plasma solvent load.

**HF** – The HF resistant sample handling kit is for sample solutions containing un-complexed hydrofluoric acid. These

are typically obtained during the analysis of geological samples, soils, sediments, ceramics, bricks and cement, together with some types of high temperature alloys. Components in contact with the solutions (the spray chamber and the torch center tube) are made from resistant fluoro-polymer and alumina ceramic materials, respectively.

Note: Peristaltic pump tubing must be ordered in addition to the sample introduction kits

Description	Part number
<b>Radial System</b>	
EMT Radial Organic Kit	8423 120 52311
EMT Radial Volatile Organic Kit	8423 120 52301
EMT Radial High Solids Kit	8423 120 52281
EMT Radial Aqueous Kit	8423 120 52271
EMT Radial HF Kit	8423 120 52291
<b>Duo System</b>	
EMT Duo Organic Kit	8423 120 52261
EMT Duo Volatile Organic Kit	8423 120 52251
EMT Duo High Solids Kit	8423 120 52231
EMT Duo Aqueous Kit	8423 120 52221
EMT Duo HF Kit	8423 120 52241
<b>Sample Introduction Spares and Consumables</b>	
EMT Radial Torch	8423 120 51741
EMT Duo Torch	8423 120 51841
EMT 1.0 mm Center Tube	8423 120 51941
EMT 1.5 mm Center Tube	8423 120 51951
EMT 2.0 mm Centre Tube	8423 120 51971
EMT 2.0 mm Ceramic Center Tube	8423 120 51961
EMT Torch Holder Assembly Spares	8423 155 50171
EMT Center Tube Holder Assembly Spares	8423 155 50181
Radial Spray Chamber Adaptor	8423 120 51151
Duo Spray Chamber Adaptor	8423 120 51251
Cyclonic Spray Chamber	8423 120 51411
Organic (baffled) Spray Chamber	8423 120 51311
Radial Spray Chamber HF	8423 120 51451
Duo Spray Chamber HF	8423 120 51461
Ball Join Clip	8423 120 51421
Concentric Nebulizer	8423 120 51431
Aerosalt Nebulizer	8423 120 51331
V Groove Nebulizer	8423 120 51321
Mira Mist Nebulizer	8423 120 51471
Nebulizer/Spray Chamber Connector Kit	8423 120 51402
Sample Introduction Spares Kit	8423 120 51751
Pump Sample Tube Aqueous (Pack of 6, for iCAP 7200 ICP-OES)	8423 120 51511
Pump Drain Tube Aqueous (Pack of 6, for iCAP 7200 ICP-OES)	8423 120 51521
Pump Sample Tube Organics (Solvent Flex) (Pack of 6, for iCAP 7200 ICP-OES)	8423 120 51621
Pump Drain Tube Organics (Solvent Flex) (Pack of 6, for iCAP 7200 ICP-OES)	8423 120 51631
Mini Pump Sample Tubing – Aqueous (for iCAP 7400/7600 ICP-OES)	8423 120 52401
Mini Pump Drain Tubing – Aqueous (for iCAP 7400/7600 ICP-OES)	8423 120 52411
Mini Pump Sample Tubing – Organics (for iCAP 7400/7600 ICP-OES)	8423 120 52421
Mini Pump Drain Tubing – Organics (for iCAP 7400/7600 ICP-OES)	8423 120 52431

## Ceramic D-Torch

The majority of ICP-OES torches are made from quartz. When quartz ICP-OES torches are heated (by the plasma) they can undergo a process known as devitrification (i.e. become less glass like). This is commonly observed in torches when the region of the torch that contains the plasma becomes translucent and then opaque; flaking of the internal surface of the torch can also occur. This process occurs when the transition temperature of the quartz (573 °C) is reached and the covalent bonds of the quartz are broken and reformed incorporating impurities. These impurities are introduced to the quartz from the plasma and are typically elements with a valency of less than 4 such as sodium, potassium, calcium and lithium. The process of devitrification can decrease the expected lifespan of the ICP torch and is commonly seen when samples analyzed contain the above mentioned elements at high concentrations (greater than 1000 mg/L). Typical sample types may include those prepared as lithium metabolate fusions, sea waters and brines.

To overcome the issue of devitrification a ceramic torch can be used in place of a quartz torch. The Ceramic D-Torch is such a torch that can be used with the iCAP 7000 Series ICP-OES

The geometry of the radial and duo Ceramic D-Torch is identical to that of the radial/duo Enhanced Matrix Tolerance (EMT) torch, consisting of three concentric parallel tubes; the outer tube, the intermediate or auxiliary tube and the centre or injector tube. The key differences between the EMT torch and the Ceramic D-Torch are the materials used for the outer tube and the intermediate tube and that the Ceramic D-Torch is fully demountable whereas the EMT torch is semi-demountable (the outer and the intermediate tube are fused).

The outer tube of the Ceramic D-Torch is made from a ceramic material derived from silicon nitride. This material is durable and resistant to chemical attack. These properties are maintained at high temperatures.

The intermediate tube is made from alumina which again has excellent properties for chemical and temperature resistance and has been proven as a material for ICP torches as it is commonly used for centre tubes.

The ceramic D-torch provides equivalent analytical performance to the standard EMT torch but has the added advantage of resistance to devitrification and premature failures with specific sample matrices, including organics and high dissolved solids samples such as fusions. The expected life time of the ceramic D-Torch is greater than that of a quartz EMT torch. With the matrices mentioned, the ceramic D-torch is a cost effective solution to reduce some of the traditional consumable costs associated with ICP-OES.

Note: the standard range of EMT centre tubes for the iCAP 7000 Series ICP-OES can also be used with the D-Torch.

Description	Part number
Radial Ceramic D Torch Kit	842312052201
Duo Ceramic D Torch Kit	842312052202
Base and Inner Tube for Radial and Duo D Torch	842312052204
Ceramic Outer Tube for Duo D Torch	842312052205
Ceramic Outer Tube for Radial D Torch	842312052206
Quartz Outer Tube for Duo D Torch	842312052207
Quartz Outer Tube for Radial D Torch	842312052208
Optic Fiber for Duo D Torch	842312052209



Figure 3. Ceramic Torch

## IsoMist

The temperature of the sample introduction system, and more specifically the spray chamber, can have dramatic effects on sensitivity, plasma and analytical stability. A sample introduction system at a constant temperature will enhance the analytical stability of an ICP-OES as the spray chamber is isolated from any temperature fluctuations within the laboratory, whilst temperature extremes (cooling or heating) can be used to optimize specific analyses.

Cooled spray chambers are commonly used for the analysis of volatile solvents. By cooling a solvent the vapor pressure is lowered, thereby reducing the amount of solvent reaching the plasma and enabling greater plasma stability. This also has the advantage of decreasing the background signal produced by matrix-based emissions. Conversely, high temperature spray chambers are used for the analysis of low volume samples, where low uptake rates are typically used. Low sample uptake rate can reduce sensitivity; by heating the spray chamber, more sample aerosol is transported to the plasma thereby increasing sensitivity.

The IsoMist is a solid state Peltier temperature-controlled spray chamber which integrates seamlessly with the Thermo Scientific iCAP 7000 Series ICP-OES with dedicated models for both radial and duo instruments. The IsoMist control is managed by a standalone, one screen, user-friendly software package. When coupled to the iCAP 7000 Series ICP-OES, the IsoMist fits within the introduction area of the instrument and does not use valuable lab space.

Description	Part number
IsoMist Radial Kit	842312051651
IsoMist Duo Kit	842312051641
Twister Spray Chamber for IsoMist Radial Kit	842312051661
Twister Spray Chamber for IsoMist Duo Kit	842312051671
Unifit Right Angle Connector for IsoMist Radial and Duo Kits (Pack of 3)	842312051681



Figure 4. IsoMist



### Ultrasonic Nebulizer

The use of an Ultrasonic Nebulizer (USN) in conjunction with an ICP-OES has long been accepted as a simple and cost effective way to increase sensitivity and decrease detection limits. Conventional pneumatic nebulizers are generally only 2 to 3% efficient under normal operating conditions. The CETAC U5000AT+ Ultrasonic Nebulizer converts more of the liquid sample into a usable aerosol, with an efficiency of 10 to 15%.

The CETAC USN couples to the iCAP 7000 Series ICP-OES using the nebulizer push fit connectors for the USN gas flow and coupling the sample flow directly to the torch. This allows for changeover from the standard sample introduction kit to the USN, in seconds.

The use of the CETAC U5000AT+ USN is a simple and efficient way to gain an average 12 fold improvement in sensitivity over a full range of elements.

Description	Part number
CETAC U-5000AT Ultrasonic Nebulizer (220/240V)	842318051001
CETAC U-5000AT Ultrasonic Nebulizer (110/120V)	842318051002
CETAC U-5000AT Ultrasonic Nebulizer (220/240V) Australia Only	842318051003



Figure 5. Nebulizer



## Hydride Generation Accessory

The analysis of Arsenic, Bismuth, Antimony, Selenium and Mercury in environmental, biological and food samples is common place, and is driven by regulations which require lower limits of detection year upon year to ensure that contamination by toxic substances is kept to a minimum. The analytical performance required for these elements is often difficult to achieve using a standard sample introduction setup. The analytical performance of these elements can be enhanced by the use of a hydride generation sample introduction system.

The iCAP 7600 ICP-OES spectrometer has a dedicated continuous flow hydride generation accessory which is a combined reaction chamber and GLS. The continuous flow of samples and reagents has a self-cleaning effect upon the system, improving sample throughput. The efficient design of the GLS provides greatly improved sensitivity for the hydride-forming elements.

The accessory utilizes the four channel peristaltic pump with separate channels introducing acid, reducing agent and sample and the fourth to remove waste from the system. The samples and reagents are mixed and a carrier gas (in this case argon) is introduced into the GLS. The solution then passes in to a chamber packed with glass beads to provide a large surface area for the separation to take place. The excess liquid is pumped to waste and the gaseous hydride is transported to the plasma via a transfer line.

With the simple addition of the hydride generation accessory, the lower working range of the iCAP 7000 series can be extended to sub-ppb levels for the hydride-forming elements.

Description	Part number
Internal Standards/Basic Hydride Generator Kit	842312051551
Integrated Hydride Generation System	842318050101
Replacement Tubing Kit Integrated Hydride Generation System	842312052611
Consumable Parts For Integrated Hydride Generation Kit	842318050151



Figure 6. Hydride Generation Accessory



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